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Independent Duty Corpsemen: Should the Indian Navy have Them?

Surg Capt AA Pawar

The Independent Duty Corpseman (IDCs) stands for a medical senior sailor who is trained to comprehensively manage and treat medical emergencies in the absence of the medical officer. Majority of the ships in the US Navy are manned by independent duty corpsmen. The IDCs are responsible for staffing sick call, emergency response teams, and resuscitation/stabilization teams [1]. They are trained in advanced patient care and in medical administrative and logistical duties. During peacetime, their function often focuses on primary care to the decrement of skills necessary to perform in medical emergencies. Their usefulness has been proved in various operations and in fact when terrorists off Yemen attacked the USS Cole, the initial casualty management was by the IDCs. They usually hold the rank of senior sailors and receive 52 weeks training in medical, logistic and administrative duties before being assigned to ships and submarines. They are given instruction in advanced principles and techniques required to perform duties relating to a medical department, ashore, and at sea, including patient care, first aid and emergency procedures, preventive medicine, industrial safety, and administrative duties, with emphasis on duty independent of a medical officer. The training program includes medical history taking and physical examination techniques and procedures, advanced medical and surgical procedures, environmental sanitation and preventive medicine, pharmaceutical mathematics, clerical procedures, fiscal management, and supply management. They are also being trained to independently give blood as part of trauma care in the submarine [2]. Subject Matter Experts (SMEs) in the Armed Forces have developed IDC-level treatment profiles for 336 Patient Conditions (PCs) known to occur aboard ship. These profiles, consisting of individual tasks, describe the step-by-step process of providing clinical care for each of the PCs in each IDC treatment location, including sick call, laboratory, bottle dressing station, portable medicine locker, emergency and junior emergency response kits, first-aid kit, and antidote locker. Once the profiles were prepared, SMEs assigned the required material to the kits. Comprehensive manuals have been prepared for the use of the IDCs, who often have to function alone without help of any other medical personnel. Certain universities in the USA have recognised this course as Bachelor of Health Sciences subject to qualifying certain exams. IDCs doing well are also offered a chance to be selected for graduation in medicine and qualifying as a naval doctor.

Our medical branch senior sailors are often expected to do only administration with the exception of personnel working in the OT, lab or radiology. Their professional skills are thus underutilized. Probably by introducing such a course at the level of the CPO qualifying course, the Navy can use them to man small ships, provide medical cover during helo landing or sport events. As the confidence in their utilisation increases they can be assigned even in bigger ships. In the hospital they can be utilised to augment medical care in acute medical and surgical wards.

REFERENCES


'Senior Adviser (Psychiatry), INHS Asvini, Colaba, Mumbai.'
EXERCISE AND DCS RISK : THE CURRENT PERSPECTIVE - A
PHYSIOLOGICAL VIEWPOINT

Lt Col SP Singh

ABSTRACT
Decompression sickness occurs after diving, explosive decompression in aircraft and consequent to extra-vehicular activity in space. The cause is believed to be the formation of gas bubbles in blood and tissues supersaturated with inert gas. The foremost prevention strategy is aimed at relieving tissue gas supersaturations, hence bubble formation by staged decompression. Exercise during and after decompression was suggested as an important method of reducing gas load. However it fell into disrepute due to contradictory data, and failure to differentiate between the effects of various modes of exercise. Today we have a better understanding of exercise- especially aerobic exercise, as an anti-inflammatory intervention which induces IL-6, IL-10, sTNFα-R and IL1ra. Also its role in modulating endothelial function by induction of nitric oxide (NO), and modulation of stress response by HSP induction has been studied. Thus interest in exercise at various times of the dive profile as a venous bubble load (VBL) hence DCS-risk reducing intervention has been renewed. Various studies supporting the role of exercise and nitric oxide donors as DCS-risk reducing interventions have been reviewed here. The likely role of HSP’s in conferring such an advantage has also been considered.

Key Words: Exercise, Venous bubble load, DCS-risk

Decompression sickness (DCS) refers to an assortment of signs and symptoms arising from affectation of any of the body’s systems with the common historical factor of recent decompression from pressure. The manifestations of DCS by history and examination are indistinguishable from those of arterial gas embolism consequent to pulmonary barotrauma or middle ear disorder after barotrauma. Hence it has been suggested that the disorders resulting from decompression be referred to as Decompression Illness (DCI) for the purpose of clinical description. The manifestations of DCI and their prevalence in 3495 cases reported to the divers Alert Network between 1992-1998 are listed in Table 1 [1]. For the purpose of this review however the term DCS shall refer only to disease due to inert gas bubble generation in the body.

The primary cause of DCS is believed to be the formation of inert gas bubbles in tissue or blood in response to supersaturation of tissues with inert gas in comparison to existing ambient pressure. While inert gas bubbles, it is believed, are essential to the occurrence of DCS their mere presence does not imply DCS. “Silent” bubbling in the body is a well-known phenomenon and occurs even after innocuous dives and HBOT, with no external manifestations [2]. Echocardiography and Doppler studies have demonstrated this phenomenon amply.

Pathophysiology of DCS
A gas-supersaturated solution is in an inherently unstable state and seeks stability by evolution of gas. Physical laws dictate that such a solution must develop a gas phase to relieve gas tensions and achieve stability [3]. A bubble is such a gas phase.

Supersaturation is achieved in human tissues during decompression either after a dive to depth, or gain of altitude or during extra-vehicular activity in space. Supersaturation is the result of perfusion limitations to tissues and diffusion limitations within tissues. At the rates of perfusion and diffusion known to occur in human tissues it is believed that perfusion is the limiting factor leading to supersaturation of tissue after a dive [3].
TABLE 1

<table>
<thead>
<tr>
<th>Manifestations</th>
<th>Prevalence</th>
<th>Manifestations</th>
<th>Prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Neurologic</strong></td>
<td></td>
<td><strong>Audiovestibular</strong></td>
<td></td>
</tr>
<tr>
<td>Numbness/Tingling/Paresthesias</td>
<td>40.4</td>
<td>Dizziness/Vertigo</td>
<td>12.6</td>
</tr>
<tr>
<td>Muscular weakness/Paralysis</td>
<td>23.0</td>
<td>Nausea/Vomit</td>
<td>7.2</td>
</tr>
<tr>
<td>Difficulty Walking</td>
<td>8.1</td>
<td>Tinnitus</td>
<td>4.7</td>
</tr>
<tr>
<td>Reduced Level of Consciousness</td>
<td>2.3</td>
<td>Reduced Hearing</td>
<td>0.5</td>
</tr>
<tr>
<td>Visual Disturbance</td>
<td>1.9</td>
<td>Nystagmus</td>
<td>0.2</td>
</tr>
<tr>
<td>Altered Higher Function</td>
<td>1.4</td>
<td></td>
<td>0.1</td>
</tr>
<tr>
<td>Altered Speech</td>
<td>0.7</td>
<td><strong>Cutaneous</strong></td>
<td></td>
</tr>
<tr>
<td>Bladder dysfunction</td>
<td>0.5</td>
<td>Itching/rash</td>
<td>3.5</td>
</tr>
<tr>
<td>Altered Reflexes</td>
<td>0.3</td>
<td>Marbling</td>
<td>&lt;0.1</td>
</tr>
<tr>
<td>Bowel Disturbance</td>
<td>0.3</td>
<td><strong>Cardiopulmonary</strong></td>
<td></td>
</tr>
<tr>
<td>Convulsions</td>
<td>0.1</td>
<td>Difficulty Breathing</td>
<td>2.0</td>
</tr>
<tr>
<td>Reduced co-ordination</td>
<td>0.1</td>
<td>Haemoptysis</td>
<td>1.6</td>
</tr>
<tr>
<td><strong>Pain</strong></td>
<td>22.2</td>
<td>Palpitations</td>
<td>0.2</td>
</tr>
<tr>
<td>Headache</td>
<td>14.7</td>
<td>Dyspnocia</td>
<td>0.1</td>
</tr>
<tr>
<td>Fatigue</td>
<td>6.9</td>
<td>Cough</td>
<td>0.1</td>
</tr>
<tr>
<td>General Weakness</td>
<td>6.8</td>
<td>Tachypnoea</td>
<td>&lt;0.1</td>
</tr>
<tr>
<td>Light/Heavy head</td>
<td>0.2</td>
<td><strong>Lymphatic</strong></td>
<td>0.3</td>
</tr>
<tr>
<td>Chills</td>
<td>0.1</td>
<td>Other</td>
<td>4.3</td>
</tr>
</tbody>
</table>

Total Cases 3495

Total Manifestations 1471

**Bubble Generation and stabilization**

The de-novo generation of nitrogen bubbles in water occurs at gas supersaturation of 200 atmospheres [4]. A condition, which with the diving depths achieved to date, is known to never occur. Bubble formation in heterogeneous fluids too, at liquid-hydrophobic crystal interface requires supersaturation of about 10 atmospheres while DCS is known to occur with much shallower dives [3].

Thus the current belief is that the bubbles responsible for DCS are the result of growth of pre-existing micronuclei (micro-bubbles) on supersaturation of tissues. Since pre-existing bubble nuclei eliminate the need for the tremendous amount of free energy of new bubble generation such a hypothesis appears feasible [3].

The likely source of micronuclei has been hypothesized to be development of hundreds of atmosphere negative pressure pockets in tissues consequent to their relative motion in the course of normal daily activity. This phenomenon is the resultant of and directly proportional to liquid viscosity and separation velocity and indirectly proportional to the cube of the distance between surfaces. Such large negative pressures result in local tissue "supersaturation" and gas bubble formation - a phenomenon named Tribonucleation by Hayward. Evidence is present that bubble formation in marine animals occurs at much smaller supersaturations when they are allowed to/made to move whereas 25 times greater supersaturation is tolerated without bubble formation when they are immobilized. Also, X-ray and CT have often demonstrated Vacuum Phenomenon, believed to be due to tribonucleation, in and around joints in humans [5]. An everyday example of vacuum phenomenon is the cracking of knuckles where negative tension causes formation of bubbles, which collapse with audible sound when the negative phase passes.

High power sound energy and cosmic radiation to which we are exposed daily too can cause gas
micro cavities to form. It has also been suggested that arterial micro-bubbles nucleated in circulatory turbulence at the tips of the cusps of the pulmonary valve are the primary cause of the common forms of DCS [3].

Bubbles once formed are stabilized by adsorption of a layer of amphiphilic (surface acting) molecules such as proteins, platelets and surfactant to the surface of the bubble or by the geometry of molecular crevices where they are formed. Examples of such molecular crevices are intercellular hydrophobic crevices on the vascular endothelium [3].

**Biological Reaction**

It has been realized that bubbles do not only have mechanical effects such as blocking blood flow and stretching tissues but also produce an inflammatory response in the body. Various findings attributable to inert gas bubble-body interaction are summarized in Table 2.

It is however important to point out that although these changes have been demonstrated in vitro and in severe, in vivo models of DCS, their relevance to milder human cases is uncertain. For example the activation of coagulation, complement and neutrophils was not found to be significant following bubble forming decompression with or without mild DCS in humans [6].

**Prevention and Treatment Strategies**

Prevention strategies are centered on the prevention of formation of inert gas bubbles. The most important strategy is staged decompression to allow gas to evolve steadily and prevent large tissue gas supersaturations. However the durations of decompression stops required to allow complete equilibration are often too long to be practically followed. Hence invariably decompression tables are the result of a compromise between actual decompression time required and stop times considered practically feasible.

Other strategies employed are switching slower gases for faster gases eg nitrogen for helium, during decompression and oxygen pre-breathing before the dive to reduce inert gas tensions. Better aerobic fitness, decreased physical activity before and after a dive, absence of overweight and obesity and younger age have been reported to decrease the risk of DCS [7].

The treatment of DCS as of today consists of recompression with oxygen causing the gas bubbles to dissolve followed by staged decompression of longer duration. However not every case of DCS responds to this therapy and the onset of a vigorous systemic inflammatory response before therapeutic decompression, is believed to be partly responsible [6].

**Exercise and DCS risk**

The traditional view on exercise before, during and after dives has been that it increases the risk of DCS. The proponents of this view believed that exercise during descent and at the bottom by increasing perfusion would increase gas uptake thereby increasing tissue supersaturations during decompression and increased DCS risk, and evidence has been provided in support [8,9].

On the other hand it was argued that by the same mechanism i.e. increased perfusion, exercise during and after ascent (decompression) could hasten inert gas removal from slow tissues and decrease risk of DCS. At the beginning of the twentieth century, recognition of this possibility had lead to the Royal Navy and US Navy divers being advised to exercise during decompression. However this practice was stopped when the results of dive during and after decompression were confused and various studies showed that exercise before, during and after decompression increased the incidence of DCS. Experimental evidence from some studies did, however, indicate that exercise during

---

TABLE 2

<table>
<thead>
<tr>
<th>Tissue response to bubbles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Damage to</td>
</tr>
<tr>
<td>- Phospholipid surfactant layer of blood vessels</td>
</tr>
<tr>
<td>- Vascular endothelium</td>
</tr>
<tr>
<td>- Platelet aggregation and activation</td>
</tr>
<tr>
<td>- Lymphocyte activation and aggregation</td>
</tr>
<tr>
<td>- Activation of complement</td>
</tr>
<tr>
<td>- Activation of clotting</td>
</tr>
<tr>
<td>- Increased cytokine secretion</td>
</tr>
<tr>
<td>- Increased capillary leakiness</td>
</tr>
<tr>
<td>- Haemoconcentration</td>
</tr>
</tbody>
</table>

*Jour Marine Medical Society, 2007, Vol. 9, No. 1*
decompression might be beneficial with regard to DCS risk. However it was also shown that inert gas elimination from tissues during exercise was faster only as long as bubble formation did not occur. Since it was felt that diving invariably would produce bubbles, the consensus of opinion tilted to a sedentary decompression profile [5]. Regarding exercise after decompression a significantly increased incidence of DCS was reported after exercise. Weight training before diving also appeared to increase bubble formation and exercise risk.

It was also believed that intense exercise before diving may produce microscopic muscular injuries, which may promote bubble formation [5]. However recent evidence has failed to show detectable inflammation in muscles after concentric and eccentric exercise (running uphill and downhill) [10]. Thus, today the general belief is that exercise is best avoided before, during and after a dive. Exercise however is not a homogenous entity. Aerobic vs anaerobic, concentric vs eccentric and exercise involving small muscle mass vs large muscle mass are all known to elicit different sets of physiological responses. In addition the duration and intensity of exercise are two very important factors determining the bodily response to exercise. In one study Vann has brought out that aerobic exercise before decompression to altitude appeared to protect from DCS while anaerobic exercise seemed to predispose to DCS [5]. Their subjects were however college students who exercised regularly, hence they attributed this protective effect to long term effects of aerobic exercise. In Van Der Aue’s report describing the effect of exercise post-dive on increased incidence of DCS, the exercise performed was lifting of 25 pound weights for two hours, an eccentric, anaerobic exercise.

New information on the molecular correlates of exercise, its function as an immune modulator and its role in inflammation has been generated in the last decade at a phenomenal rate. The role of exercise training and acute exercise in untrained subjects in disease processes such as CAD, Hypertension, Diabetes Mellitus, acute and chronic infection have yielded much information as has research in the field of sports medicine. In the light of such information and a renewed interest in the possible salutary role of exercise and other interventions on DCS risk, it is pertinent to review and reconsider our stand on exercise and diving.

**Exercise and the Immune Response**

Since in cases of severe DCS a systemic inflammatory response has been found to occur it is informative to overview the immune and inflammatory response modification with exercise [1]. Table 3 summarizes some of the known immunomodulatory effects of long duration high intensity exercise [11].

**Exercise and Cytokines**

Exercise induces increased production of pro-inflammatory cytokines TNFα and IL-1β. It has also

<table>
<thead>
<tr>
<th>TABLE 3</th>
<th>During</th>
<th>Exercise</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neutrophil Count</td>
<td>↑</td>
<td></td>
<td>↑↑</td>
</tr>
<tr>
<td>Monocyte Count</td>
<td></td>
<td>↓</td>
<td></td>
</tr>
<tr>
<td>Lymphocyte Count</td>
<td>↑</td>
<td>↓</td>
<td></td>
</tr>
<tr>
<td>CD4+ Count</td>
<td>↑</td>
<td>↓</td>
<td></td>
</tr>
<tr>
<td>CD8+ Count</td>
<td>↑</td>
<td>↓</td>
<td></td>
</tr>
<tr>
<td>CD4+/CD8+ Ratio</td>
<td>↓</td>
<td>↓</td>
<td></td>
</tr>
<tr>
<td>CD 19+ B Cell Count</td>
<td>↑</td>
<td>↓</td>
<td></td>
</tr>
<tr>
<td>CD 16+56+ NK Cell Count</td>
<td>↑</td>
<td>↓</td>
<td></td>
</tr>
<tr>
<td>Lymphocyte Apoptosis</td>
<td>↑</td>
<td>↓</td>
<td></td>
</tr>
<tr>
<td>Proliferative Response to Mitogens</td>
<td>↓</td>
<td>↓</td>
<td></td>
</tr>
<tr>
<td>Antibody Response in Vitro</td>
<td>↓</td>
<td>↓</td>
<td></td>
</tr>
<tr>
<td>Saliva IgA</td>
<td>↓</td>
<td>↓</td>
<td></td>
</tr>
<tr>
<td>Delayed Type Hypersensitivity</td>
<td>↓</td>
<td>↓</td>
<td></td>
</tr>
<tr>
<td>NK Cell Activity</td>
<td>↑</td>
<td>↓</td>
<td></td>
</tr>
<tr>
<td>Lymphokine Activated Killer Cell Activity</td>
<td>↑</td>
<td>↓</td>
<td></td>
</tr>
<tr>
<td>C-Reactive Protein</td>
<td>↑</td>
<td>↓</td>
<td></td>
</tr>
<tr>
<td>Neopterin</td>
<td>↑</td>
<td>↓</td>
<td></td>
</tr>
<tr>
<td>Plasma Conc TNF-α</td>
<td>↑</td>
<td>↑</td>
<td></td>
</tr>
<tr>
<td>Plasma Conc IL-1</td>
<td>↑</td>
<td>↑</td>
<td></td>
</tr>
<tr>
<td>Plasma Conc IL-6</td>
<td>↑</td>
<td>↑</td>
<td></td>
</tr>
<tr>
<td>Plasma Conc IL-1ra</td>
<td>↑</td>
<td>↑</td>
<td></td>
</tr>
<tr>
<td>Plasma Conc IL-10</td>
<td>↑</td>
<td>↑</td>
<td></td>
</tr>
<tr>
<td>Plasma Conc TNF-R</td>
<td>↑</td>
<td>↑</td>
<td></td>
</tr>
<tr>
<td>Plasma Conc IL-8</td>
<td>↑</td>
<td>↑</td>
<td></td>
</tr>
</tbody>
</table>

CD- Cluster of differentiation, NK - Natural Killer, TNF - Tumor Necrosis Factor, IL - Interleukin
been shown to induce increases in levels of IL-10, soluble TNFα receptors (sTNF-R) and IL-1β receptor antagonist, which are anti-inflammatory cytokines [12]. IL-10 is capable of inhibiting the Lipopolysaccharide stimulated production of several pro-inflammatory cytokines including TNFα, IL-10, IL-1β the chemokine IL-8 and macrophage inflammatory protein (MIP-1α) [13]. It has been shown to increase 27-fold immediately post strenuous exercise and elevated levels have been demonstrated 12 hours post-exercise [14,15].

The most marked increase however is that of the inflammation responsive cytokine IL-6. This cytokine has been recently named the first “Myokine” – a substance synthesized and secreted by muscle, which has effects on other tissues of the body. The level of IL-6 is sensitive to the intensity, mode and most importantly duration of exercise. The maximum increase is seen with running and at least 1 hour of exercise is required before significant increases occur; with levels 10-100 times basal levels. The effects of IL-6 during and after exercise are summarized in Table 4 [12].

CRP is known as a marker of inflammation and is induced by IL-6. The increase in plasma CRP is expected after a stressful event such as strenuous exercise and CRP contributes to elevated IL-1ra in plasma during late recovery from exercise and has been shown to decrease pro-inflammatory cytokine release from macrophages [13].

Other Effects

Exercise is known to increase the plasma levels of Epinephrine, Nor-Epinephrine, Growth hormone, Cortisol, β-Endorphins and Testosterone. Interestingly the catecholamines other than their cardiovascular and metabolic role also appear to contribute to the recruitment of Natural Killer cells during exercise and stress and have been shown to blunt TNFα secretion in response to endotoxin [13]. Growth hormone along with epinephrine is probably involved in recruitment of neutrophils to the blood. Cortisol levels increase significantly only with exercise of long duration and have a role in maintaining the neutrophilia and lymphopenia after exercise. In animal models exposure to dihydrotestosterone is associated with reduction in IL-4, IL-5, and INF-γ production. Conflicting reports on levels of circulating immune complexes after exercise are present and some reports suggest that immune complex-induced complement activation does not occur during concentric exercise. However complement activation may contribute to post-exercise neutrocytosis in eccentric exercise [10,11].

Thus, the current view is that moderate to high intensity exercise of more than 60 min duration, by increasing IL-6 levels and other mechanisms appears to facilitate a broad anti-inflammatory response.

**Exercise and Coagulation**

The effects of exercise on the coagulation cascade have been studied but not extensively characterized. Evidence for a mild increase of coagulation indices accompanied by enhanced fibrinolysis is present [16]. Exercise trained subjects have been shown to have decreased activation of stimulated platelets when compared to sedentary subjects. A significant reduction in platelet

**TABLE 4**

**Metabolic & Hormonal effects of exercise induced IL-6**

<table>
<thead>
<tr>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased O2 Consumption/CO2 production</td>
</tr>
<tr>
<td>Increases rate of appearance of glucose (interferes with Insulin signaling in Hepatocytes)</td>
</tr>
<tr>
<td>Increases rate of glucose uptake by tissues</td>
</tr>
<tr>
<td>Increases lipolysis and FA oxidation</td>
</tr>
<tr>
<td>Increase in serum Cortisol</td>
</tr>
<tr>
<td>Increase in Glucagon (~200pg/ml)</td>
</tr>
<tr>
<td>Increase in Growth Hormone</td>
</tr>
<tr>
<td>Increased Adrenaline/Nor-adrenaline (~300 pg/ml)</td>
</tr>
</tbody>
</table>

**Immunoregulatory effects of exercise induced IL-6 infusion**

<table>
<thead>
<tr>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increases plasma Cortisol</td>
</tr>
<tr>
<td>Increases plasma IL-1ra</td>
</tr>
<tr>
<td>Increases plasma sTNF-R</td>
</tr>
<tr>
<td>Increases plasma CRP</td>
</tr>
<tr>
<td>Decreases TNFα secretion in LPS stimulated monocytes</td>
</tr>
</tbody>
</table>

The normal level of IL-6 in a healthy individual is ~1 pg/ml, IL-1ra-IL-1 receptor antagonist, sTNF-R-soluble Tumor Necrosis Factor Receptor, CRP = C Reactive Protein, TNFα - Tumor Necrosis Factor α, LPS-Lipo-poly-saccharide rhIL-6 - recombinant human IL-6
activation and enhanced sensitivity towards prostacyclin (PGI2) and nitric oxide in response to physical exercise has been reported in patients with CAD and advanced atherosclerosis. The occurrence of similar changes in response to exercise in healthy subjects remains to be studied. Conversely heavy resistance exercise induces in vivo activation of platelets [17, 18].

Exercise and Inflammation

The conventional view of acute severe exercise has been that it causes muscular injury resulting in inflammation and muscle adaptation. This view has however been challenged in recent years with evidence that high intensity muscular exertion whether eccentric or concentric does not result in damage and inflammation of muscles [10]. However a characterization of the anti-inflammatory/inflammatory response after different types of exercise is required.

Exercise and Nitric Oxide

Nitric Oxide has become the subject of intense study in the past two decades consequent to realization of the fact that it functions as an intercellular messenger in multiple processes in many tissues. It is also a part of the oxidant system in the body and is a potent oxidant. Of particular interest is its role in arterial endothelium where it is induced by shear stress and helps cause vasodilatation. Its role in immune regulation and immune function has also been studied and it is known to reduce leucocyte and platelet adherence to the endothelium. Exercise has been shown to induce prolonged increase in endothelial NO release [19,20].

Exercise and DCS: Recent Studies

The results of various studies in the last decade on exercise and DCS risk are summarized in Table 5.

Jankowski and colleagues studied the effect of moderate intermittent exercise during decompression in a dive during which the divers were inactive during compression and bottom time. They found a reduced venous bubble load (VBL) in the exercised versus the sedentary subjects. The incidence of DCS was not significantly different between the subjects in either group [21]. Similar data has been reported by Dujic et al [22]. This phenomenon can be understood in haemodynamic terms as exercise during decompression by increasing flow to muscle and cutaneous tissues would hasten nitrogen elimination. Also the mild to moderate intensity of exercise used in these studies might not induce sufficient muscular exertion/tissue motion to enhance tribonucleation as it has been shown that exercise in water to leads to lower workloads as compared to that when exercising in air at the same VO2 [23]. In the study of Dujic the divers also exercised at the bottom. This could increase the gas uptake but the water temperatures were 15-17°C and peripheral vasoconstriction in this scenario would be significant in spite of the exercise and could lead to attenuated inert gas uptake. Indeed, the most favourable scenario for minimizing inert gas uptake and hastening its elimination is believed to be a relatively inactive, cold bottom time with an active, warm ascent [5]. Based on their study and earlier work on increased N2 elimination rates with exercise during decompression Dujic et al have made the important observation that the nitrogen pool for bubble formation after short dives would appear to come from the "faster" tissues. Thus it is important to consider the role of fatty (slow) tissues in DCS in terms of the duration of the dive.

The effect of exercise after a dive on VBL and DCS risk is still controversial. Animal experiments have shown that post-dive exercise after a simulated dive to 80 msw for 2 hours in the rat is significantly associated with more DCS. However in another study it was shown that humans diving to 30 msw for 30 mins followed by 10 mins exercise at 85% VO2 max, 30-40 minutes after the dive, had an eightfold lower VBL after exercise and did not develop DCS [24]. The authors suggest bubble stability modification by nitric oxide (NO) and heat shock proteins (HSP's) as the likely mediators. While NO induction has been shown to occur within minutes of the onset of exercise and may occur faster, HSP induction as characterized so far requires longer durations of exercise [25]. Whatever the cause of the decreased VBL, the very fact that VBL decreased after exercise is an important finding. The sample size in the study is very small, only seven divers and the decompression stress small - 30 msw for 30 minutes. Thus all we may safely conclude at this time is that the issue of exercise after decompression should be...
TABLE 5

<table>
<thead>
<tr>
<th>Author</th>
<th>Subject</th>
<th>Dive type/profile</th>
<th>Sample size</th>
<th>Timing of exercise</th>
<th>Exercise intensity and duration</th>
<th>Result VBL/DCS incidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wisloff (Ref 27)</td>
<td>Rats Sprague-Dawley</td>
<td>Chamber 700kPa</td>
<td>26 C</td>
<td>8min 85-90%</td>
<td>VO₂max</td>
<td>DCS</td>
</tr>
<tr>
<td>Berge (Ref 29)</td>
<td>Rats Sprague-Dawley</td>
<td>Chamber 20 Hrs before</td>
<td>60 C</td>
<td>2min 50-60%</td>
<td>VO₂max for 1.5 Hrs</td>
<td>DCS S = C</td>
</tr>
<tr>
<td>Dujic (Ref 26)</td>
<td>Human</td>
<td>Chamber 280 kPa</td>
<td>30min</td>
<td>24 Hrs before</td>
<td>VO₂max</td>
<td>VBLNo DCS</td>
</tr>
<tr>
<td>Blatteau (Ref 28)</td>
<td>Human</td>
<td>Chamber 30msw</td>
<td>30min</td>
<td>2 Hrs before</td>
<td>VO₂max</td>
<td>VBLNo DCS</td>
</tr>
<tr>
<td>Dujic (Ref 22)</td>
<td>Human</td>
<td>Open-sea 30msw</td>
<td>30min</td>
<td>Bottom time &amp; 3 min</td>
<td>VO₂max</td>
<td>VBLNo DCS</td>
</tr>
<tr>
<td>Jankowski (Ref 21)</td>
<td>Human</td>
<td>Open-sea 45msw</td>
<td>30min</td>
<td>During Arm &amp; Leg</td>
<td>VO₂max</td>
<td>VBLDCS risk difference NS</td>
</tr>
<tr>
<td>Dujic (Ref 24)</td>
<td>Human</td>
<td>Open-sea 30msw</td>
<td>30min</td>
<td>500 m swim at bottom</td>
<td>VO₂max</td>
<td>VBLNo DCS</td>
</tr>
</tbody>
</table>

VBL - Venous Bubble Load (seen by Echocardiography in the Right Ventricular Outflow Tract), DCS - Decompression Sickness, VO₂max - maximal oxygen consumption

considered in the context of the type of exercise (aerobic vs anaerobic, concentric vs eccentric), its timing in relation to surfacing, its intensity and duration and most importantly the dive profile - depth, duration and gas mixture used. The role of NO and HSP in this setting deserves further study.

The importance of the study of post-dive exercise on DCS risk is relevant especially in the military setting. Ours divers are likely to be in operational scenarios where exertion after a dive might be a necessity. The importance of knowledge of what activity they might safely undertake and indeed if such activity might decrease their DCS risk in such a scenario need hardly be emphasized.

What is more relevant however is, the effect of

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exercise or other interventions before a dive on subsequent DCS risk because it may be practically possible to derive the benefit of such interventions.

The effect of exercise training has been studied and shown to reduce the venous bubble load and risk of DCS after diving in recreational divers. Other studies in military and recreational divers have however not shown such effects [7,24,26]. The topic is thus controversial and studies are on to better define the relationship between aerobic capacity and DCS risk, if any, and the causative factors. In the course of such a study Wisloff and colleagues studied rats aerobically trained for two and six weeks as also sedentary rats who had a single bout of interval exercise lasting 1.5 hrs, 20 hrs before the dive. The rats trained for 2 weeks fared better than those trained for six weeks. The rats, which underwent a single bout of exercise 20 hrs before the dive, however had the lowest bubble grades after dive. This effect was reduced if the dive was delayed to 48 hrs after the exercise. They thus concluded that rather than increasing nitrogen elimination by a sustained haemodynamic effect, pre-dive exercise may alter the population of nuclei from which bubbles form [27]. They hypothesized that NO formation in response to exercise may alter the hydrophobicity of the endothelium thus reducing the number of nuclei adhering to the surface. This would reduce gas nucleus stability leading to dissolution of such nuclei. Strenuous aerobic work 24 hours before a dive has also been shown to decrease VBL in 12 experienced, healthy, male divers when they dived after exercise as opposed to a dive not preceded by exercise [26].

Subsequent work has shown that exercise ending up to 2 hours before a dive in humans and 30 minutes before a dive in rats decreased and had no effect respectively on the post dive bubble count and hence DCS risk [27,28]. In the human study the exercise was of high intensity, lasted 45 minutes and resulted in significantly lower bubble grades. The authors have suggested that the decreased stroke volume (cardiac output was maintained) post-exercise coupled with moderate dehydration might lead to decreased gas loading of tissues during the dive and hence decreased bubble count post dive. While this may be so, such exercise as their subjects undertook would lead to induction of both NO and HSP. NO might disturb bubble stability as earlier proposed. HSP expression is known to have a protective effect on stressed cells. In addition it is conceivable that HSP’s in blood might affect the inflammatory response to bubbles as also bubble stability.

Arterial endothelial dysfunction has been demonstrated in asymptomatic divers with silent bubbling after a single open sea dive [30]. It has also been shown that administration of Nω-nitro-l-arginine methyl ester, a non-specific nitric oxide synthase (NOS) inhibitor increases bubble formation in sedentary rats while a single bout of exercise 20 hours prior to the dive protected NOS-inhibited rats from severe DCS and death [31]. Subsequently it has also been shown that Isosorbide dinitrate - a NO donor-administered to rats for 5 days before a dive (65 mg/kg once daily) significantly reduced bubble formation compared to rats given placebo and the same effect was observed with drug administration as a single dose 30 mins before the dive [32]. Exercise 20 hrs before the dive had a similar protective effect. In a subsequent human study administration of 0.4 mg nitroglycerine by oral spray 30 mins before a dive reduced post-dive venous bubble load in wet and dry dives compared to control dives by the same divers without nitroglycerine [33]. Thus the beneficial role of nitric oxide in decompression sickness risk appears to be undeniable in human dives up to 30 msw for 30 mins breathing air. Further work to elicit its role in deeper dives with different gas mixtures is needed in large trials before it can be used as a pre-dive DCS risk-moderating drug. The mechanism of its action once elicited will help enhance our understanding of DCS.

Exercise and Heat Shock Proteins

Heat Shock Proteins are expressed both intra and extracellularly. Their expression is increased in stresses like heat, exercise, sepsis etc and is believed to protect cells from injury and apoptosis. In the plasma, HSP-72 has been shown to be elevated in response to moderate non-damaging exercise as early as 30 mins into treadmill running with peak levels at 48 hours [25]. Heat preconditioning leading to increased HSP 70 expression in pulmonary epithelial cells, has been shown to hasten recovery.

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from pulmonary edema as a result of both, the pulmonary form of DCS and air injection induce pulmonary air embolization and infarction [34]. The studies on DCS risk and exercise mentioned here have considered the role of NO on DCS risk, but none has studied HSP expression as a result of exercise. It is possible that part of the protective effect of exercise on DCS was attributable to HSP expression. It is conceivable that they may alter the properties of amphiphilic proteins in plasma, which adsorb to and stabilize bubbles. In addition they have been shown to modulate immune function by binding to cell surface receptors, toll like receptor (TLR) on immune cells – TLR2, and TLR4 [35]. Expression of HSP’s on the endothelial (HSP60 in response to stress) and other cell membranes has also been shown and increased expression of HSP17 on cell membranes has been shown to stabilize cell membranes and antagonize stress-induced damage to the cell membrane [36]. A similar role for HSP in DCS is plausible.

To summarize, recent work has demonstrated that high intensity aerobic exercise after a dive, during decompression and especially before a dive far from being a risk factor for DCS, may have a protective role. While conflicting data is present on the timing of pre-dive exercise that confers a protective effect its promise in decreasing venous bubble load and DCS risk appears irrefutable. The effect of administration of NO donors before a dive merits a special mention. Not only does it support the role of NO induced by exercise as the factor decreasing venous bubble load but it could per se become an important intervention to reduce DCS risk. The role of heat shock protein in the beneficial effect of exercise has not been studied in detail yet, however the evidence from unrelated studies does not preclude such a role. None of the studies reviewed here have considered the role of alterations in cytokine profiles and inflammatory state with exercise and its effect on DCS risk. Ample characterization of the exercise induced cytokine expression and role of IL-6 has been done and it is likely that exercise of sufficient duration and intensity (> 60 minutes, moderate to high intensity) to induce its expression and subsequent anti-inflammatory effect may have a beneficial effect on DCS risk and severity of DCS. Studies on the effect of exercise on coagulation profile in healthy individuals, its time course and interaction with diving stress may provide useful clues on the impact of pre-dive exercise on DCS risk and the mechanisms of DCS.

**Study Directions in Our Scenario**

We have no literature on the incidence of DCS during different dive profiles. While reported cases of DCS are few and far in between, informal interactions with divers has brought out the fact that they are not sensitized to the milder forms of DCS and recognize it only as a disease that "incapacitates".

Normative data on aerobic capacity in Indians is lacking (a pub med search for "aerobic capacity in Asian Indians" and "VO2 max in Asian Indians" returned no data, while data could be retrieved for American whites/blacks and Caucasians) as is data on the effect of aerobic capacity on post-dive venous bubble load and DCS risk. Literature on the effect of body composition on venous bubble load is similarly lacking, and workers abroad who have studied this aspect have generated conflicting data. As brought out above the contribution of "obesity" (fatty tissues) to risk would vary with the dive profile. All these have to be studied in our population, as data from studies in Caucasians cannot be transposed to our population without modifications. There is ample evidence that Asian Indians have a significantly different body composition and metabolic profile compared to other races. How this alters their aerobic capacity, systemic physiological response and especially inflammatory molecular response to exercise and stressors like diving needs to be studied in detail.

The salutary effects of pre-dive exercise, NO donors and exercise during and after decompression are still a "hot" area and studies on these would help us bring the advantages of exercise, if any, to our divers early. Studies on the role of NO, HSP’s, inflammatory response (cytokine profile) and coagulation profile modifications with exercise, on DCS risk need to be conducted to better understand the disease process and suggest practical preventive and possibly also therapeutic measures.

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25. Morton JP, MacLaren DPM, Cable NT et al. Time


 MEDICAL DEPARTMENT ABOARD AN USN AMPHIBIOUS VESSEL: USS DUBUQUE

Surg Cdr Kaushik Chatterjee

Key Words : Medical set up, Medical cover, Amphibious vessel

INTRODUCTION

USS Dubuque (LPD 8) is an Austin-class amphibious transport dock ship with a length of 173 mtrs and displacement of 16,500 tonnes. It is of the same class as USS Trenton, which is being acquired as the Jalashva. The ship has a staff of around 350 and is capable of carrying an additional 900 marines (who embark with their own medical complement). The primary purpose of the ship is to transport marines with their vehicles, stores and equipment. The ship carries a single amphibious landing vessel (LCU/LCAC) in its well deck which is launched from the dock in the aft, to land marines on the beach. It also has a flight deck capable of supporting 02 large or 04 small helicopters. The home port is San Diego, California and the ship is typically deployed overseas for 06 - 09 months at a time during which the crew is not permitted leave except in an emergency. Crew members typically serve on board for 02-04 years.

The Dubuque visited Visakhapatnam from 19 to 22 Mar 07. The following personnel from INHS Kalyani were part of the ENC team which visited the ship on 19 Mar and sailed onboard on 21 Mar 07 -

a. Surg Cdr K Chatterjee (75465K)
b. Lt (SDM) DK Singh
c. KRajan POMA (163965Z)
d. MM Khadse LMA (115672T)

The Medical department onboard USS Dubuque is a well-staffed and provisioned, run professionally and is located in spacious and well laid-out compartments. The staff was friendly and cooperative. They readily answered our queries and shared hard and soft copies of information requested.

STAFFING

Medical Manpower

The department is headed by a General Medical Officer who is GP qualified (GDMO). The current incumbent is Lt. (Dr.) Dean Balagtas who has completed his internship 1 1/2 years ago. The department has 08 Corpsmen (Medical Assistants) which includes two Chief Petty Officers. The CPOs carry out administrative, instructional, departmental regulatory and operational functions. The 04 Specialist Corpsmen are Independent Duty Corpsman (AN), Laboratory technician, X-ray technician and Preventive Medicine technician. The rest are Basic Hospital Corpsmen.

Dental Manpower

The department has one Dental Officer (Lt Alan Noordmans). There are 04 dental technicians which includes 02 specialists (one each of preventive and operative dentistry).

Deployment

Though the two departments have separate professional roles, they run synergistically particularly in operational requirements. The staff is combined to man the 04 Battle Dressing Stations (First Aid Posts) during General Quarters (Action Stations). Administratively, the Medical Officer carries out duties of HOD.

Responsibilities

General Health and Welfare of Crew

The Sick Call (Sick Parade) is registered from...
0830 - 0930 hrs on all working days. Annual health assessment with the necessary investigations is carried as per schedule. In case illnesses are detected which require intervention beyond capabilities available on board, the necessary specialist referrals are made. Health documentation is maintained. Medical records are indexed by the persons unique Social Security Number.

Standby for Medical Emergencies
The Corpsmen (Medical Assistants) are available round-the-clock at the Sickbay on rotation watches to attend to medical emergencies, trauma and mass casualty situations. They are trained and certified in BLS (Basic Life Support) and ACLS (Advanced Cardiac Life Support) procedures. The Medical Officer is available on call. The aim is to stabilise and transfer to higher echelon care.

Preventive Medicine
The following preventive health measures are carried out by the medical department –

a. Immunisations
b. Periodic water testing
c. Onboard pest surveillance
d. Infectious disease surveillance
e. Health promotion education to the crew

Pharmacy Services
Sufficient supplies of all relevant medications are maintained onboard. Further specific medications prescribed for crew with chronic illnesses is carried for the duration of deployments.

First-aid training
The entire ship’s crew are imparted first-aid training in batches, during initial indoctrination soon after being posted on board, so that they are capable of providing buddy-care. The training includes CPR (Cardio-pulmonary resuscitation) and treatment of 08 basic battle wounds. This is followed-up with refresher courses during the ship’s training cycle.

Ship-wide emergencies
The medical department responds to the following ship-wide emergencies –

a. General Quarters (Action Stations)

FACILITIES
Routine Health Facilities
The routine patient care facilities are located on the 2nd deck (beneath the flight deck), close to the sailors’ messes, clustered along the port-side. They are:

a. Sickbay – where the sick call is examined by the Independent Duty Corpsman and the Medical officer. ECG machine, portable X-ray, defibrillator, suction etc. are available.
b. Ward – 10 bed capacity for admission/stabilisation with attached toilet/bathroom. Includes 04 bed isolation cubicle.
c. Laboratory – Automated Cell Counter & Auto-analysers. Capable of CBC, Blood chemistry, LFT, Urinalysis, Lipid profile etc.
d. X-ray Room – For developing Basic films taken by portable X-ray machine located in sickbay
e. Dental Clinic – 02 dental chairs. One for cleaning, periodontal and bleaching etc. and another for basic dental procedures including fillings, restoration, RCT etc. Adjacent separate compartment for operating compressor, vacuum etc.

Battle Dressing Stations (BDS)
The 04 BDSs (FAP) serve to receive and stabilise casualties and are manned during General Quarters (Action Stations). Each is manned by 02 medical
personnel. The senior member attends to the casualty while the junior member communicates with DC 1 (Damage Control HQ) wearing headphones connected to sound-powered telephones which can function in the event of a total power failure. The casualties are carried by non-medical stretcher bearers to the BDSs. The main BDS is located next to the Sickbay and is used by the marines as their medical facility when embarked. Each BDS has an OT table (fixed or stowed), overhead OT lights, alternate battle lights, water point and tank, stowage space for medical equipment, dressings and medications. The 04 BDSs are Main, Forward, Mid & Aft.

Medical Supply Storage
The main storage location is on the 4th deck where medication and dressings are stowed. A computer located there tracks storage, expiry and re-order. Bulk supplies required for humanitarian aid like infant formula, diapers etc. are stored in a compartment on the 7th deck.

Medical Communications
Telephones and computers (connected by onboard LAN with internet facility) are available in all medical workspaces.

a. Medical Database. Central Medical Records Database called SAMS located in USA is accessed through secure navy-net to obtain personnel health records, immunisation status etc.
b. Telemedicine. Informal telemedicine consults are obtained over telephone / internet from Naval Hospital, San Diego. ECG, X-rays are scanned and necessary digital images are taken for transfer.
and resources implies that the following cannot be carried out on board –

a. Surgery involving General Anaesthesia
b. Mental health evaluation by psychologist/psychiatrist
c. Formal physiotherapy
d. Audiometry
e. Optometry
f. HIV testing

OTHER RELEVANT INFORMATION

Expansion of Medical facilities

If deemed necessary, available medical infrastructure might be expanded/augmented by setting up an Operation Theatre in the Aft Dressing Station. This location has sufficient space and is located in the Marine berthing area which can serve as High Dependency Unit/Wards. However, this would require suitable modifications and positioning of necessary equipment.

USN Medical Manpower deployment

Medical Officers are posted only aboard ships with crew of 350 and above. Ships with lesser crew (Destroyers, Frigates etc.) are served by Independent Duty Corpsmen (Advanced Nursing), who consult with medical officers on large ships in company or hospitals ashore if required. This is apparently necessitated by requirement for effective utilisation of available medical manpower and an efficient chain of casualty evacuation.

USN Medical Manpower recruitment and retention

Doctors and dentists are recruited by USN while they are undergoing training at medical/dental schools by providing them with generous stipendiary benefits. During internship they receive 02 wks Combat Medicine training at Texas. On completion they receive basic training at Officers’ school for 01 month before joining the USN. They have an obligation to serve for duration equivalent to period for which stipend was provided. On completion of this duration, they can apply for residency (specialisation) which entails a further obligation for 03 years. Corpsmen join after high-school and after basic training at Chicago are posted to hospitals for on-job-training before being posted aboard ships. They are eligible to apply for specialisation training after 02 yrs. Certain specialists like surgeons and anaesthesiologists have greater demand/lesser retention. The USN provides large bonuses to retain them.

Conclusion

The well staffed and equipped Medical Department of USS Dubuque is capable of providing effective and professional medical care in the support of operational role of the vessel. It might be worthwhile to consider augmentation of the medical facilities aboard the Jalashva if planned for deployment in disaster management or hospital ship roles.
DOES THE NAVY NEED TO SPRINT OR BE SMART?

Surg Capt AA Pawar*, Surg Cdr A Tripathi*

Key Words: Sprint, Smart, Stress management, Special psychiatric teams

INTRODUCTION

October 12, 2000 - The 8300-ton, 293 crew US warship USS Cole was anchored off the coast of Yemen when suddenly terrorists in a Gemini with explosives carried out a suicide attack on the ship, blowing a 20 feet by 40 feet hole on the side. 17 sailors died in the attack. The attack disrupted communication between the fore and aft part of the ship. The power and drainage system became non-operational. Only two toilets were functional. The temperature in the ship rose to 35°C. The first aid boxes were locked and the keys were unavailable and people were unable to access these immediately. The attack frightened people on board as they were not sure whether another attack would occur or not. Also, as usual the media (in this case CNN) reported the matter on TV even before the US Navy had a chance to disclose the information. This upset the families of the people on board and they rushed to the naval base at Norfolk where the ship was based. The Navy was kind enough to give them free food and accommodation. When the attack occurred the nearest ship was only a submarine and there was a difficulty in evacuating casualties till other ships arrived on the scene. Within 48 hrs SPRINT arrived.

SPRINT*

SPRINT stands for Special Psychiatric Rapid Intervention Team. Such teams have been in existence with the US Navy for almost two decades now. The teams comprise of a psychiatrist, a psychologist, social worker, a chaplain and psychiatric nursing assistants. After the USS Cole incident, the team was sent and interacted with the commanding officer, the executive officer and the command master chief. They informally intermingled with the personnel on board and conducted onboard debriefings emphasizing stress reduction, mission focus and command cohesion. One to one meetings were held with a large number of staff. 42 cases of insomnia were treated. The psychiatrist treated 12 cases of acute stress reaction returning all except one to active duty.

September 11, 2001 - The SPRINT team again proved their worth in the aftermath of the terrorist attack on the World Trade Centre. The SPRINT team was deployed in the Pentagon as well as on USS Comfort i.e. the hospital ship anchored off New York harbour. Their role was appreciated by all. It may be noted that the US Army also has similar team called as SMART-SM i.e. Special Medical Augmentation Recovery team - Stress Management. In the aftermath of the WTC attack, these teams were also deployed. They provided useful psycho-educational information related to expected normal responses to abnormal experiences. This was offered to individuals as well as organizational leaders. They provided mental health hygiene recommendations, reminding everyone to take good care of themselves by maintaining appropriate sleep, eating, and physical fitness schedules, as well as limiting exposure to media coverage of the event. Team members provided mental health surveillance, as well as monitored and maintained contact with high-risk individuals and groups to support wellness. Risk was determined based upon individual and organizational exposure, as well as individual communication after initial contacts. Clinicians also provided clinical services when appropriate and ensured that all individuals had ready access to services, should they desire them in the future. The teams focussed on two aspects i.e. one was treating

*Senior Advisor Psychiatry, *Classified Specialist Psychiatry, INHS Asvini

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survivors of the WTC attack as well as the relief and recovery workers who worked long hours for days extracting dead bodies and clearing the rubble. For this the US Army had deployed all available mental health resources on the site and cover was provided throughout the day or night on all days.

Do these teams have any useful role. In the follow up report on the USS Cole attack, a debriefing session was carried out under the orders of the Commander Surface Forces Atlantic. One of the recommendations was that there was an initial delay in deployment of these teams following the attack on USS Cole due to passport and delay in getting sanctions. It was recommended that this procedure be streamlined so that clearance could be obtained faster. All SPRINT teams should be trained in crisis intervention, command consultation, and combat stress control. They should be taught debriefing-based methods such as critical incident stress management (CISM) and follow-on interventions. Other recommendations included, that the Cincs and Fleet Commanders should be more familiar with counselling and mental health resources, including at least brief training on combat stress and its management.

Critical Incident Stress Management (CISM)

A consensus meeting held in 2005 of five organizations in the USA comprising of the NVOAD Emotional and Spiritual Care Committee, the American Red Cross, International Critical Incident Stress Foundation, National Organization for Victim Assistance and the Salvation Army emphasized the value of early psychological intervention in addition to services for physical disaster. The consensus emphasized the role of training in this modality before personnel can successfully employ these services. The primary focus in the field of CISM is to support staff members of organizations or members of communities who have experienced a traumatic event. What CISM does not share with the field of crisis intervention is the range of the populations served. For example, CISM does not focus on primary victims such as auto accident victims, dog bite victims, women suffering post-partum depression, women who have lost a child in a miscarriage, child abuse victims, substance abusers, victims of elder abuse or sexual assault victims, all of whom are typically served through various other crisis intervention programs. Should primary victims with those concerns come into contact with CISM trained personnel, the best course of action is a referral to appropriate crisis intervention or psychotherapy resources.

The question is does this sort of intervention work. In a study published in the British Journal of Medical Psychology, 106 British soldiers involved in a United Nations peacekeeping operation in Bosnia received an Operational Stress Training Package. Random selection was made into groups receiving Critical Incident Stress Debriefing (CISD) or no CISD. At 6-month follow-up, CISD group had significantly lower prevalence of alcohol abuse than no-CISD group. CISD group members had lower scores on psychometrically assessed anxiety and psychometrically assessed depression than no-CISD group. Also, CISD group members had lower scores on psychometrically assessed PTSD symptoms. Some meta-analytic studies have also been carried out on the use of these critical incident stress debriefings [2], which also indicate a positive effect. The role of these debriefings is to reduce the incidence of PTSD i.e. Post Traumatic Stress Disorder. Ten percent of casualties are affected by PTSD and it is hoped that with the provision of such teams prevention of PTSD can occur. The US Navy has four SPRINT teams, three of which are based in the USA and one is based in Europe. As stated earlier, such teams have been in existence for last fifteen to twenty years. The teams are based at the hospital, moving out only when required. The existence of these teams for such a long period indicates their usefulness. The primary role of such teams is to protect the naval personnel from psychological ill health thus ensuring better operational performance. Other than in the Pentagon incident they are not usually involved in treating non uniformed personnel.

CONCLUSION

Psychological effects of operations cause silent morbidity among naval personnel and unless looked for, can lead to significant impairment in functioning of the individual. Recent morbidity data show that mental health is one of the largest causes of morbidity in the Armed Forces. With the progress of
the Indian Navy from a fleet of small ships to a blue water navy, it is time for us to consider the need for such a team in our service.

REFERENCES


ON BIOMEDICAL WASTE MANAGEMENT IN AFLOAT UNITS

Surg Cdr Sundeep Bhandari*, Surg Lt Cdr P Anand**

Key Words: Biomedical waste, Waste management, Afloat units

INTRODUCTION

The biomedical waste regulations enforcement was included in the 1981 [1]. The law deals with the health concerns relating to the potential effects of improper disposal of biomedical waste. "Biomedical waste" means a waste that may contain human pathogens of sufficient virulence and in sufficient concentrations that exposure to it could result in disease. The study was done to understand the international procedures on Biomedical waste management [2] and to implement them in the Indian Naval Ships.

AIM

a) The procedures and methods of Biomedical waste management onboard.

b) Recommendations and preparation of relevant Navy Order.

OBSERVATIONS

a) The study was conducted onboard two French and a Royal Navy ships during 16-19 Apr 04 along with team of Officers from other branches.

b) The observations are listed in the Tables 1 & 2.

RECOMMENDATIONS

a) Biomedical Waste Management Committee onboard ships for implementing BMW rules, dissemination information, reports & returns and accident report

b) Colour code classification [3].

i) Green waste: Food, fruits, galley waste, stationary waste, card board cartons, newspaper, bottles, metal cans, soiled/unsoiled cotton, gauze dressings, patient linen, expired drugs

ii) Red waste: Gauze, cotton, bandage/dressing soiled with blood, pus and other discharges, all types of plastic and rubber waste from sickbay.

iii) Yellow waste: Human body parts and tissues, etc.

c) Waste segregation and minimization onboard ships by separating infection and non-infectious waste materials at the point of origin.

d) Mode of BMWM onboard ships

a) Red waste – In situ treatment (microwave)

b) Sharps – Needle and syringe destroyer

c) Dirty soiled linen – 2.5 % Cresol

e) Disposal of sickbay waste generated (in harbour)

a) No green waste will be thrown overboard and should be deposited in authorized garbage dumps in the Naval Dockyard

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**TABLE 1**

<table>
<thead>
<tr>
<th>SL No</th>
<th>Ship</th>
<th>Type/Class</th>
<th>AMA</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>HMS Gloucester</td>
<td>(Destroyer)</td>
<td>MO</td>
<td>03 Yrs experience</td>
</tr>
<tr>
<td>02</td>
<td>FNS Montcalm</td>
<td>Frigate</td>
<td>NA</td>
<td>Supply Officer manages BWM</td>
</tr>
<tr>
<td>03</td>
<td>FNS Meuse</td>
<td>Tanker</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Staff Officer Health, HQWNC; **INHS Asvini

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<table>
<thead>
<tr>
<th>Sl. Parameter</th>
<th>French Ships</th>
<th>British Ship</th>
<th>Indian Ships</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2. Yellow Clinical waste</td>
<td>2. Yellow Clinical waste</td>
<td>2. Red Bags - Clinical waste</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Brown/Red Biodegradable galley waste</td>
<td>3. Brown bags - Biodegradable galley waste</td>
<td>(Yellow kept only for anatomical waste and</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>cytotoxic drugs as per</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>gazette Notification</td>
<td></td>
</tr>
<tr>
<td>2. <strong>Bins</strong></td>
<td>Foot operated with lids</td>
<td>Sharps in puncture proof containers (Yellow colour):</td>
<td>Foot operated with lids</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>When ¾ full the cover is put and kept aside</td>
<td>Sharps in puncture proof containers (Yellow colour):</td>
<td></td>
</tr>
<tr>
<td>3. <strong>Sharps</strong></td>
<td></td>
<td></td>
<td>When ¾ full the cover is put and kept aside</td>
<td></td>
</tr>
<tr>
<td>4. <strong>Needle Melters</strong></td>
<td>NIL</td>
<td>NIL</td>
<td>NIL</td>
<td></td>
</tr>
<tr>
<td>5. <strong>1% Hypochlorite Solution</strong></td>
<td>NIL</td>
<td>Nil</td>
<td>NIL</td>
<td></td>
</tr>
<tr>
<td>6. <strong>Microwave</strong></td>
<td>NIL</td>
<td>Nil</td>
<td>NIL</td>
<td></td>
</tr>
<tr>
<td>7. <strong>Rest of sick</strong></td>
<td>Yellow bags with Biohazard symbol</td>
<td>Yellow bags with Biohazard symbol</td>
<td>Yellow bags with Biohazard symbol</td>
<td></td>
</tr>
<tr>
<td>8. <strong>Disposal of Sick Bay waste</strong></td>
<td>Yellow bags are packed when ¾ full in yellow bags</td>
<td>Yellow bags are packed when ¾ full in yellow</td>
<td>Red bags are to be landed ashore for disposal at</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Except sharps) yellow containers</td>
<td>containers</td>
<td>FMC/dockyard dispensary</td>
<td></td>
</tr>
<tr>
<td>9. <strong>Final disposal of sharps</strong></td>
<td>Carried back to the country and handed over to the</td>
<td>Carried back to the country and handed over to</td>
<td>Sharps container and red bags to be handed over to</td>
<td></td>
</tr>
<tr>
<td>and other sick bay containers</td>
<td>hospital/health authorities through proper</td>
<td>hospital/health authorities through proper</td>
<td>common facility at FMC/</td>
<td></td>
</tr>
<tr>
<td>10. <strong>Galley waste</strong></td>
<td>Pulper used when over 03 nautical miles off land</td>
<td>Pulper used when over 03 nautical miles off</td>
<td>Pulper or shredder not available. Bags are handed</td>
<td></td>
</tr>
<tr>
<td>(Biodegradable)</td>
<td>1. In harbour bags disposed off ashore (Jetty)</td>
<td>land</td>
<td>ashore in (Separately for biodegradable waste)</td>
<td></td>
</tr>
<tr>
<td>11. <strong>Galley waste</strong></td>
<td>1. Shredder used for plastic, glass and aluminium</td>
<td>1. Shredder used for plastic, glass and</td>
<td>Shredder not available.</td>
<td></td>
</tr>
<tr>
<td>(Non biodegradable)</td>
<td>items</td>
<td>aluminium items</td>
<td>To be kept in containers</td>
<td></td>
</tr>
<tr>
<td>for Medical personnel</td>
<td>2. TT injection</td>
<td>2. TT injection</td>
<td>2. TT injection</td>
<td></td>
</tr>
</tbody>
</table>

*Foot. Marine Medical Society, 2007, Vol. 9, No. 1*
b) Red waste - in situ treatment
f) Shipboard non infectious medical waste disposal (at sea)
a) Plastics – Store for shore disposal
b) Non plastics – Shredder or pulper is to be used and then discharged overboard
c) Expired medicines – Store for shore disposal
g) Shore support for afloat units
a) Incinerator
b) Shredder
c) Compactor
d) Sterilisation unit [4]
e) Vendor receiving facility
f) Maintenance of records and returns
g) Training of personnel

REFERENCES
HOSPITAL WASTE MANAGEMENT AND THE HEALTH WORKERS: A KNOWLEDGE, ATTITUDE AND PRACTICE STUDY AT A DEFENCE STATION

Surg Cdr Sougat Ray

ABSTRACT

Background: As per the Hospital Waste Management Act, 1998, India, every institution generating waste including hospital, nursing homes, blood bank, laboratories etc. are liable to follow the recommended guidelines of segregation, disinfection and safe disposal of hospital waste. The aim of the study was to assess the level of knowledge about hospital waste disposal amongst health workers and to find out the difficulties they face regarding practice of the law.

Method: A cross-sectional study was carried out amongst the health workers posted at a defence service station. There are a total of approx 50 doctors, 25 female nurses, 200 male nurses and 100 safaiwalas. A specially designed, pilot pretested proforma was sent by mail to all the health workers and completed proforma was received from 20 doctors, 15 nurses, 124 medical assistants and 64 safaiwalas.

Result: Almost all the health workers know that there is a law regarding Biomedical Waste Management. 96.77% of medical assistants and 64.66% of the safaiwalas know about the categories but most of them did not know the number of categories. Most of them know about four colour coding, but don’t know category segregation procedures correctly. 90% of the doctors, 80% of the nurses, 84.68% of the medical assistants and 68.75% of the safaiwalas knew about some form of disposal of biomedical waste. It was also found that 100% of the Lab Technicians and the OT assistants amongst the medical assistants know about segregation, disinfection, universal precaution and disposal correctly.

Key Words: Biomedical waste, Health workers, Knowledge

INTRODUCTION

Biomedical waste is the waste generated during diagnosis, treatment or immunization of human beings or animals or in research activities pertaining thereto or in the production or testing of biological including categories mentioned in schedule – 1 of the Gazette of India: Extraordinary, Ministry of Environment and Forest, Notification, New Delhi, published on 20 Jul 98 [1].

Till July 1998, there was no system for proper waste disposal. Most of the hospitals were disposing their waste along with general waste. For prevention of these improper practices, the Govt. of India had launched a law known as Biomedical Waste (Management and Handling) Law 1998. Under this law, the Govt. has given specific guidelines for management of biomedical waste [2].

The reports and figures available from developed countries indicate a range from 1-5 Kg/bed/day of biomedical waste is generated, with substantial international and interspeciality differences. The meager data available from developing countries indicate that the range is essentially similar, but the figures are lower (1-2 Kg/day/patient). In India, it is estimated to be 2 Kg/bed/day [3] and annually about 0.33 million tones of waste is generated [4]. According to WHO fact sheet, from the total waste generated by health care activities, 20% is hazardous [5].

Health care workers need to understand the difference between biomedical waste and other waste connected with the hospital [3].

AIM

The aim of the study was to assess the
knowledge, attitude and practice of Biomedical Waste (Management & Handling) Rules amongst health workers of a defence service community.

OBJECTIVES
The chief objectives of the study were:
- To assess the level of knowledge of health workers about biomedical waste
- To find out the practices followed by the health workers in their clinical set up for waste management
- To find out the deficiencies in the practice of hospital waste management in a clinical set up.
- To train all health workers in waste management practices
- To improve the overall set up of hospital waste management in the community.

MATERIAL AND METHODS
A cross-sectional study was carried out amongst the health workers posted at a defence service station. The station has one 300 bedded hospital with 25 doctors, 100 male nurses (medical assistants), 20 female nurses and 15 safaiwalas. It also has 30 smaller clinical settings, also called Medical Inspection Rooms (MI Rooms) each with 01 to 03 doctors, no female nurses, 05 to 10 medical assistants and 01 to 02 safaiwalas depending upon the size. Total of 25 doctors, 100 male nurses and 60 safaiwalas in these MI Rooms were included in the study. A specially designed pilot pretested proforma was sent by mail to all the health workers.

RESULT
Completed proforma was received from 20 doctors, 15 nurses, 124 medical assistants and 64 sweepers.

Table 1 depicts the awareness of the health workers in regards to hospital waste management.

Hospital Waste Management Law
All the doctors, 86.67% of the nurses, 90% of the medical assistants and 87.5% of the safaiwalas know that there is law regarding Biomedical waste management for any clinical setting.

Categories of Biomedical Waste
It is also observed that all the doctors and nurses know that there are 10 categories of biomedical waste. 96.77% of medical assistants and 64.06% of safaiwalas know about the categories but most of them did not know how many categories are there.

Colour Coding
90% of the doctors, 73.33% of the nurses, 77.42% of the medical assistants and 37.50% of the safaiwala know about the colour coding correctly. Though most of them know the four colour coding, they don't know which colour bins to be used for what category. It was also found that 100% of the Lab Technicians and the OT assistants amongst the

<table>
<thead>
<tr>
<th>Awareness</th>
<th>Doctors N=20</th>
<th>Nurses N=15</th>
<th>Medical Assistants N=124</th>
<th>Safaiwalas N=64</th>
</tr>
</thead>
<tbody>
<tr>
<td>Presence of law</td>
<td>Yes: 20(100) No: 0(0)</td>
<td>Yes: 13(86.67) No: 2(13.33)</td>
<td>Yes: 121(97.58) No: 0(2.42)</td>
<td>Yes: 56(87.50) No: 08(12.5)</td>
</tr>
<tr>
<td>Category</td>
<td>Yes: 20(100) No: 0(0)</td>
<td>Yes: 15(100) No: 0(0)</td>
<td>Yes: 120(96.77) No: 04(3.23)</td>
<td>Yes: 41(64.06) No: 23(35.94)</td>
</tr>
<tr>
<td>Colour coding</td>
<td>Yes: 18(90) No: 02(10)</td>
<td>Yes: 11(73.33) No: 04(26.67)</td>
<td>Yes: 96(77.42) No: 28(22.58)</td>
<td>Yes: 24(37.50) No: 40(62.50)</td>
</tr>
<tr>
<td>Disposal</td>
<td>Yes: 18(90) No: 02(10)</td>
<td>Yes: 12(80) No: 3(20)</td>
<td>Yes: 105(84.68) No: 19(15.32)</td>
<td>Yes: 44(68.75) No: 20(31.25)</td>
</tr>
<tr>
<td>Universal precaution</td>
<td>Yes: 20(100) No: 0(0)</td>
<td>Yes: 15(100) No: 0(0)</td>
<td>Yes: 112(90.32) No: 12(9.67)</td>
<td>Yes: 42(65.62) No: 22(34.38)</td>
</tr>
<tr>
<td>Treatment of sharps</td>
<td>Yes: 20(100) No: 0(0)</td>
<td>Yes: 15(100) No: 0(0)</td>
<td>Yes: 114(91.93) No: 10(8.06)</td>
<td>Yes: 11(17.18) No: 538(2.82)</td>
</tr>
</tbody>
</table>
medical assistants know about colour coding correctly.

Disposal

90% of the doctors, 80% of the nurses, 84.68% of the medical assistants and 68.75% of the safaiwalas knew about some form of disposal of biomedical waste. Most of them were found to know about incinerator or open burning of the waste. Only 50% of the doctors, 33% of the nurses and 40% of the medical assistants knew about landfilling, hydroclave, autoclave and microwave as methods of waste disposal. Waste disposal at sea is still a grey area and proper methods are not being followed in 90% of the afloat units.

Universal Precaution

Knowledge and practice of Universal Precaution seem to be good amongst the health workers. 100% of the doctors and nurses, 90.32% of the medical assistants and 65.62% of the safaiwalas knew about universal precaution and its importance. Hardly anyone seem to practice it specially in the small clinical setting. In the hospital however, the health workers are practicing universal precaution.

Treatment of sharps

Treatment of sharps mainly include disinfection, segregation and safe disposal. 100% of the doctors and nurses are aware of it and practicing it in the clinical setting. However, 91.93% of the medical assistants are actually practicing it and only 17.18% of the safaiwala know the correct procedure of treatment of sharps.

From Table 2, it could be seen that all the doctors and health workers are aware about the risks associated with hospital waste. 100% of all visited doctors, nurses, medical assistants and safaiwalas said that HIV can be transmitted through this kind of waste. 100% of all visited doctors and nurses, 96.77% of medical assistants and 45.31% of safaiwalas said that Hepatitis B can also be transmitted. 80% of the doctors, 60% of nurses, 68.55% medical assistants and 37.50% of safaiwalas are aware that healthworkers may have injuries from sharps or airborne transmission of diseases like Tuberculosis.

DISCUSSION

Hospital waste is considered dangerous because it may possess pathogenic agents and can cause undesirable effects on human health and the environment [6]. Hospital waste may contain infectious agents, genotoxic material, chemical toxins, radioactive material and sharp objects. Major portion of this is contained in syringes, intravenous needles, blood, body fluids, human tissues, dressings, drainage bags and frequently used disposable items [7].

The standard waste management plan include categories of the waste, a standard colour coding system, separation of waste at the source of generation, storage in properly labelled color coded bags, scientific handling and safe disposal, all conducted with adoption of safety measures for workers. For pathological waste, double colour bags should be used and sharps, collected in separate sharp cutter boxes. These are later transported in specialized dumping vehicles to the disposal sites avoiding leakage and spillage. Final disposal is

<table>
<thead>
<tr>
<th>Diseases</th>
<th>Doctors N=20</th>
<th>Nurses N=15</th>
<th>Medical Assistants N=124</th>
<th>Safaiwalas N=64</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIV</td>
<td>Yes 20 (100)</td>
<td>No 0 (0)</td>
<td>Yes 124 (100)</td>
<td>Yes 64 (100)</td>
</tr>
<tr>
<td>Hepatitis B</td>
<td>Yes 20 (100)</td>
<td>No 0 (0)</td>
<td>Yes 120 (96.77)</td>
<td>Yes 29 (45.31)</td>
</tr>
<tr>
<td>Others (Injuries,</td>
<td>Yes 16 (80)</td>
<td>No 4 (20)</td>
<td>Yes 85 (68.55)</td>
<td>Yes 24 (37.50)</td>
</tr>
<tr>
<td>Air Borne)</td>
<td></td>
<td></td>
<td>06 (40)</td>
<td></td>
</tr>
</tbody>
</table>

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usually into the sanitary landfills or incineration according to the nature of waste. Autoclaving, microwave technology and hydroclaving are recent techniques for final disposal of hospital waste [8].

In this study, it was seen that most of the doctors, nurses, medical assistants and safaiwalas know about the categories, colour coding, segregation and treatment of sharps but they don't know them correctly and are not using them properly. Proper colour coding was followed by the Govt. service hospital and in 80% of the small clinical treatment rooms. It was observed that process of segregation of waste at generation level into various colour coded bags and plastic drums, internal transportation of waste to kerb site, storage at kerb site in various colour coded metallic drums was found to be completely in place. Safaiwalas were using complete protective equipment like gloves, masks, shoes etc while handling waste and also sodium hypochlorite was available in each and every sharp generating site in wards as well as departments. The procedures are same as being followed at other service hospitals [9].

Non availability of colour coding bins was cited as the reason for not procuring the bins in some smaller clinical settings. Only 60% of the small treatment centres followed the segregation procedures and treatment of sharps. Same has been found in other studies where only 26.6% of the hospitals [2] were practicing segregation methods. All the clinical settings were using needle shredders which is encouraging compared to 11 out of 15 hospitals in other studies [2].

CONCLUSION

The study revealed that there is a lack of knowledge about hospital waste management among the paramedical staff and the safaiwalas, who actually handle this waste and is at a higher risk and needs to be educated.

In developing countries like India, where rules and regulations are not implemented in their true spirit, hospitals and clinical settings should evolve a self-check system to arrest the problem of hospital waste management. Rather than waiting for the regulatory mechanism to come into full force, a more proactive role may be taken by addressing this problem on sound footing. Specific skills and training of health workers is also required to face the challenge. The rapidly emerging image of hospitals as “polluters” should be taken very seriously. Empirical research is required to quantify the problem and ascertain the extent of the spread of diseases like HIV/AIDS and hepatitis B and C, as a result of exposure to hazardous waste.

REFERENCES

HEAT STRAIN RESPONSES IN FIGHTER AIRCREW IN SIMULATED HOT DRY ENVIRONMENT

Surg Lt Cdr B Vikas*, Gp Capt PK Jain*

ABSTRACT

One of the major stresses in aviation still remains heat stress, which interferes with efficient flying. Heat stress is a common problem aboard high performance aircraft particularly during high-speed low-level flights in tropical climates. The temperature inside the cockpit sometimes exceeds 50°C during high-speed low-level flying. The strain thus induced in low-level high speed flying during summer months could exceed the physical tolerance limits of the aircrew. Fighter aircrew is expected to use various additional clothing to combat with other aviation stresses of flying. Clothing profoundly affects heat transfer processes by adding thermal insulation, impeding air movements, and trapping water vapour at the skin. Fourteen male subjects, were exposed to simulated hot dry environment of T_a 50°C, T_v 50°C and T_w 33°C for a WBGT index -38.1°C for 1 hr in the hot cockpit, both viz. (1) without fighter flying clothing acting as the control group (CON group) (2) with fighter flying clothing acting as the experimental group (EXP group). It was seen that the physiological strain imposed by the simulated heat stress of WBGT -38.1°C, in the subjects using fighter flying clothing, was within the human tolerance limit and also within the safe limits for flying. Increased heat strain responses in EXP group are attributed to aircrew clothing.

Key Words: Heat Stress, Heat Strain, Low Level Flying

INTRODUCTION

Heat stress remains the major problem in the fighter aircrafts of eastern origin flying in the tropical climates [1,2,3]. These aircrafts form the bulk of fighters in Indian air force. Studies have shown that the cabin conditioning system in these aircrafts are not effective, especially during low-level flying. Cockpit temperature in these aircraft has been found to exceed temperature dry bulb (Tdb) of 50°C during low level flying even when the ambient temperature was Tdb of <38°C [4,5,6,7]. Heat stress during flying occurs mainly due to aerodynamic heating, radiant heating, and limited air conditioning of the cockpit [8]. Heat stress can influence human cognitive activity, which might be critical in the flying situation requiring efficient and error-free performance [9]. The strain thus induced in low-level high speed flying during summer months could exceed the physical tolerance limits of the aircrew and may result in deterioration of performance leading to failure of the mission and also compromise flight safety. The performance changes that occur include increased error rate, narrowed attention with neglect of secondary task, decreased tolerance to acceleration, increased fatigue, potentiation of effects of hypoxia and susceptibility to motion sickness [12].

Additional flying clothing worn by these aircrew to combat with other aviation stresses of flying could further increase the heat strain in these aircrew. Clothing profoundly affects heat transfer processes by adding thermal insulation, impeding air movements, and trapping water vapour at the skin [11]. It will be interesting to know the heat strain responses in the person wearing the aircrew clothing used by the fighter aircrew in a simulated thermally stressful environment having a low humidity content, in the representative group for the aircrew and also compare with the subject when they are not using additional flying clothing.

The study was undertaken with the following aims:-

To assess heat strain responses, on 60 min of simulated heat stress exposure at T_a 50°C, T_v 50°C and T_w 33°C for a wet bulb globe temperature (WBGT) index -38.1°C, in healthy adult males using

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fighter flying clothing and compare these responses in the same subjects without flying clothing.

METHODS

Subjects:
A total of fourteen healthy adult males took part in the study. The subjects were randomly selected from the normal population and represented the age group of the aircrew flying fighter aircraft.

Controls:
The subjects acted as their own controls by undergoing the heat stress exposure once without flying ensemble (CON group) and next time with flying ensemble (EXP group). The heat stress runs were given on different days so as to enable the subject to recover completely from the effects of heat accumulation.

Equipments Used:

1) HOT COCKPIT:
The desired hot environment was simulated in the hot cockpit at the Department of Environmental Physiology of IAM.

2) Intelligent Satellite Unit Model – CS-7562-D (ISU):
Body temperature data from various places of body viz skin temperature from chest, upper arm, thigh and leg; and oral temperature were obtained through Resistance Temperature Detector (RTD, PT – 100 Sensors) sensors connected to Intelligent Satellite Unit Model – CS-7562-D (ISU) obtained from Century Systems, Bangalore.

3) PHYSIOLOGICAL MONITOR (L & T, 7133-A Minimon):
The Electro Cardio Gram (ECG) recording was made by utilizing 7133-A Minimon Physiological Monitor, for the measurement of HR. ECG, blood pressure and temperature from two places of body can be recorded by 7133-A Minimon Monitor.

4) WEITEK Model WTE 100:
WEITEK Model WTE 100 weighing scale was used to record body weight to obtain sweat production.

5) Heat stress monitor (HSM):
HSM was utilized to record the room Tdb, Twb, Tbg and WBGT prior to commencement of heat exposure.

DATA-ACQUISITION (DA) System:
DA System combines the data obtained from Hot Cockpit, ISU, ECG machine, Weitek weighing scale, Multiplexer, computer with specially Written DA software.

Clothing:
The CON group subjects used following clothing.
1) Cotton brief
2) Cotton vest
3) Flying overall MK-II (ABEU)
4) Nylon socks
5) Flying boots

EXP group used the following clothing, as used by the aircrew flying MiG 21, in addition to the above-mentioned clothing used by the CON group.
1) ZSH-3 Helmet with inner leather helmet
2) KM-32 O2 Mask
3) MK-II Anti-G Suit (Indigenous)
4) Leather Gloves

Sweat Production (SP):
Sweat production was calculated by subtracting the post exposure nude body from pre exposure nude body weight [8,19,20]. It was ensured that the subject dries himself absolutely with cotton towel before weighing himself.

HEAT EXPOSURE PROTOCOL
All the subjects were given heat exposure twice at an interval of minimum of 24 hrs [12]. The first exposure was without flying ensemble (CON group) while the second exposure was with flying ensemble (EXP group). All exposures were done in the morning to avoid any variation in the results due to circadian rhythm. Both the groups were exposed to the simulated heat stress in the hot cockpit for 60 minutes at 50°C Tdb, 50°C Twb and 33°C Tbg, representing 30% relative humidity (RH) and WBGT index of 38.1°C. Such an environment of 50°C Tdb, 50°C Twb and 33°C
Temand was selected in the present study, as such an environment represented WBGT index of 38.1°C which is considered thermally stressful. It was decided that the exposure would be terminated if the following occurred: Rise in Tmand of more than 39.2°C, heart rate more than 180 beats/minute, dehydration of greater than 1% body weight or signs of imminent collapse viz. thready pulse, decrease in blood pressure, inattention, tingling and numbness of extremities, dyspnoea, confusion and restlessness and subjective discomfort to the extent that the subject could no longer continue with the experiment [22].

Following Formulae were used:

a) Sweat production (Kg) = Pre exposure Nude body weight (Kg) – Post exposure Nude body weight (Kg)

b) Physiological Strain Index (PSI): PSI = 5 (Tm – Tm) × (39.5 - Tm) + 5 (HR – HR) × (180 - HR)

c) Heat Accumulation Index (HAI):
Heat accumulation =
D MBT°C X body weight in kg
X specific heat of body
body surface area

TABLE I
Physical characteristics of the subjects participating in the study “Effect of aircrew clothing on evaporative heat loss”

<table>
<thead>
<tr>
<th>Subject Number</th>
<th>Age (Years)</th>
<th>Weight (Kg)</th>
<th>Height (cm)</th>
<th>Body Surface Area (m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>26</td>
<td>63</td>
<td>169</td>
<td>1.72</td>
</tr>
<tr>
<td>2</td>
<td>23</td>
<td>73.5</td>
<td>166</td>
<td>1.81</td>
</tr>
<tr>
<td>3</td>
<td>27</td>
<td>56</td>
<td>170</td>
<td>1.64</td>
</tr>
<tr>
<td>4</td>
<td>24</td>
<td>72.03</td>
<td>172</td>
<td>1.85</td>
</tr>
<tr>
<td>5</td>
<td>30</td>
<td>65.58</td>
<td>160</td>
<td>1.68</td>
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<tr>
<td>7</td>
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</tr>
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<td>63.9</td>
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<td>1.69</td>
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<td>1.64</td>
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<td>12</td>
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<td>13</td>
<td>24</td>
<td>63.2</td>
<td>169</td>
<td>1.72</td>
</tr>
<tr>
<td>14</td>
<td>25</td>
<td>72.98</td>
<td>171</td>
<td>1.85</td>
</tr>
<tr>
<td>MEAN</td>
<td>26.64</td>
<td>65.19</td>
<td>169.64</td>
<td>1.75</td>
</tr>
</tbody>
</table>

STATISTICAL ANALYSIS
Student’s paired ‘t’ test was applied to compare the pre exposure and post exposure parameters in the CON group as well as the EXP group to find out the effects of heat stress. The level of significance for the p value was kept at 0.05.

RESULTS
Fourteen male subjects, with a mean age 26.64 ± 3.85 yrs, height 169.64 ± 4.84 cm, body weight 65.19 ± 6.00 kg and body surface area 1.75 ± 0.08 m² (Table 1), took part in the study. Each subject was given two heat stress runs in the hot cockpit. Heat stress parameters during 1 hour of EXP study were Tmand 50.06 ± 1.51°C, Tm 48.52 ± 1.78°C, Tma 33.53 ± 0.88°C and WBGT 38.26 ± 1.10°C (Table 2). The effects of heat stress on the heat strain responses are presented here.

1. Heart Rate:
The HR in CON group increased from a pre exposure value of 79.71 ± 5.9 beats/min to 101.71 ± 4.61 beats/min at 60 min of the heat stress exposure. An increase of 22 ± 4.3 beats/min in HR at 60 min in CON group was found highly significant (Table 3). The HR in EXP group also increased from a pre exposure value of 84.07 ± 4.84 beats/min to 112.93 ± 4.41 beats/min at 60 min of the heat stress exposure. An increase of 28.86 ± 5.35 beats/min in HR at 60 min in EXP group was also found highly significant (Table 4). Increase in HR in EXP group was found significantly higher than the increase in HR in CON group (Table 5).

2. Temperature Oral:
The Tmand in CON group increased from a pre exposure value of 37.26 ± 1.10°C to 39.12 ± 1.05°C at 60 min of the heat stress exposure. An increase of 1.86 ± 0.34°C in Tmand at 60 min in CON group was found highly significant (Table 3). The Tmand in EXP group also increased from a pre exposure value of 37.16 ± 1.12°C to 39.47 ± 1.08°C at 60 min of the heat stress exposure. An increase of 2.31 ± 0.24°C in Tmand at 60 min in EXP group was also found highly significant (Table 4). Increase in Tmand in EXP group was found significantly higher than the increase in Tmand in CON group (Table 5).

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exposure value of $36.56 \pm 0.28 \degree C$ to $37.49 \pm 0.14 \degree C$ at 60 min of the heat stress exposure. An increase of $0.92 \pm 0.24 \degree C$ in $T_{\text{real}}$ at 60 min in CON group was found highly significant (Table 3). The $T_{\text{real}}$ in EXP group also increased from a pre exposure value of $36.75 \pm 0.2 \degree C$ to $37.84 \pm 0.3 \degree C$ at 60 min of the heat stress exposure. An increase of $1.09 \pm 0.43 \degree C$ in $T_{\text{real}}$ at 60 min in EXP group was also found highly significant.

### TABLE 2
Heat Stress Profile For Control and Experiment Group, $n = 14$

<table>
<thead>
<tr>
<th>Subject</th>
<th>Control Group</th>
<th>Experiment Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$T_{\text{db}}$</td>
<td>$T_{\text{bg}}$</td>
</tr>
<tr>
<td>1</td>
<td>48.10</td>
<td>49.16</td>
</tr>
<tr>
<td>2</td>
<td>48.82</td>
<td>47.07</td>
</tr>
<tr>
<td>3</td>
<td>49.48</td>
<td>47.36</td>
</tr>
<tr>
<td>4</td>
<td>48.46</td>
<td>47.26</td>
</tr>
<tr>
<td>5</td>
<td>49.49</td>
<td>47.74</td>
</tr>
<tr>
<td>6</td>
<td>49.57</td>
<td>47.68</td>
</tr>
<tr>
<td>7</td>
<td>53.6</td>
<td>52.433</td>
</tr>
<tr>
<td>8</td>
<td>49.59</td>
<td>47.89</td>
</tr>
<tr>
<td>9</td>
<td>49.64</td>
<td>48.32</td>
</tr>
<tr>
<td>10</td>
<td>49.55</td>
<td>47.54</td>
</tr>
<tr>
<td>11</td>
<td>49.12</td>
<td>49.87</td>
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<tr>
<td>12</td>
<td>50</td>
<td>48.2</td>
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<tr>
<td>13</td>
<td>49.62</td>
<td>48.38</td>
</tr>
<tr>
<td>14</td>
<td>48.82</td>
<td>47.07</td>
</tr>
<tr>
<td>MEAN</td>
<td>49.56</td>
<td>48.28</td>
</tr>
<tr>
<td>SD</td>
<td>1.28</td>
<td>1.43</td>
</tr>
</tbody>
</table>

Control = Without flying ensemble; Experimental = With flying ensemble; $T_{\text{db}}$ = Temperature dry bulb in $\degree C$; $T_{\text{bg}}$ = Temperature black globe in $\degree C$; $T_{\text{wb}}$ = Temperature wet bulb in $\degree C$; WBGT = Wet Bulb Globe Temperature Index in $\degree C$

### TABLE 3
Effects of 60 min of Heat Stress exposure to $T_a$ 50$^\circ$C and $T_{\text{bl}}$ 33$^\circ$C on Heat Strain parameters in subjects without flying ensemble

<table>
<thead>
<tr>
<th>PARAMETERS</th>
<th>Pre Exposure</th>
<th>Post Exposure</th>
<th>Mean Difference (Post-Pre Exposure)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HR (beats/min)</td>
<td>79.71±5.90</td>
<td>101.7±4.61</td>
<td>+22.0±4.30***</td>
</tr>
<tr>
<td>Toral ($^\circ$C)</td>
<td>36.56±0.28</td>
<td>37.49±0.14</td>
<td>+0.92±0.24**</td>
</tr>
<tr>
<td>MST ($^\circ$C)</td>
<td>34.60±0.62</td>
<td>37.65±0.26</td>
<td>+3.05±0.60**</td>
</tr>
<tr>
<td>MBT ($^\circ$C)</td>
<td>35.91±0.30</td>
<td>37.54±0.13</td>
<td>+1.63±0.25**</td>
</tr>
<tr>
<td>Nude body weight (kg)</td>
<td>65.87±5.34</td>
<td>65.32±5.32</td>
<td>-0.55±1.0**</td>
</tr>
<tr>
<td>Instrumented body weight (kg)</td>
<td>67.72±5.29</td>
<td>67.37±5.27</td>
<td>-0.35±1.0**</td>
</tr>
<tr>
<td>HAI (Cal/m$^2$)</td>
<td>NA</td>
<td>50.45±9.11</td>
<td>+50.45±9.11</td>
</tr>
<tr>
<td>PSI</td>
<td>NA</td>
<td>2.51±0.39</td>
<td>+2.51±0.39</td>
</tr>
</tbody>
</table>

Values are mean±SD; n=14; *** Significant at P<0.001; Toral = Oral Temperature; HR = Heart Rate; MST = Mean Skin Temperature; MBT= Mean Body Temperature; HAI = Heat Accumulation Index; PSI = Physiological Strain Index.

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significant (Table 4). Increase in $T_{\text{as}}$ in EXP group was not significantly different than the increase in $T_{\text{as}}$ in CON group (Table 5).

3. Mean Skin Temperature:

The MST in CON group increased from a pre exposure value of 34.6 ± 0.26 °C to 37.65 ± 0.26 °C at 60 min of the heat stress exposure. An increase of 3.05 ± 0.6 °C in MST at 60 min in CON group was found highly significant (Table 3). The MST in the EXP group also increased from a pre exposure value of 34.77 ± 0.49 °C to 37.9 ± 0.33 °C at 60 min of the heat stress exposure. An increase of 3.13 ± 0.43 °C in MST at 60 min in EXP group was also found highly significant (Table 4). Increase in MST in EXP group was not significantly different than the increase in MST in CON group (Table 5).

4. Mean Body Temperature (MBT):

The MBT in CON group increased from a pre exposure value of 35.91 ± 0.30 °C to 37.54 ± 0.13 °C at 60 min of the heat stress exposure. An increase of 1.63 ± 0.25 °C in MBT at 60 min in CON group was found highly significant (Table 3). The MBT in the EXP group also increased from a pre exposure value of 36.09 ± 0.25 °C to 37.86 ± 0.26 °C at 60 min of the

<table>
<thead>
<tr>
<th>Parameters</th>
<th>CON</th>
<th>EXP</th>
<th>Mean Difference (EXP - CON)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HR (beats/min)</td>
<td>84.07±4.84</td>
<td>112.93±4.41</td>
<td>+28.86±5.35***</td>
</tr>
<tr>
<td>Toral (°C)</td>
<td>36.75±0.20</td>
<td>37.84±0.30</td>
<td>+1.09±0.43***</td>
</tr>
<tr>
<td>MST (°C)</td>
<td>34.77±0.49</td>
<td>37.9±0.33</td>
<td>+3.13±0.43***</td>
</tr>
<tr>
<td>MBT (°C)</td>
<td>36.09±0.25</td>
<td>37.86±0.26</td>
<td>+1.77±0.38***</td>
</tr>
<tr>
<td>Nude body weight (kg)</td>
<td>65.89±5.33</td>
<td>65.21±5.33</td>
<td>-0.68±0.15 ***</td>
</tr>
<tr>
<td>Instrumented body weight (kg)</td>
<td>71.37±5.60</td>
<td>71.08±5.59</td>
<td>-0.29±0.07***</td>
</tr>
<tr>
<td>HAI (Cal/m²)</td>
<td>NA</td>
<td>54.55±12.12</td>
<td>-54.55±12.12</td>
</tr>
<tr>
<td>PSI</td>
<td>NA</td>
<td>3.5±0.53</td>
<td>+3.5±0.53</td>
</tr>
</tbody>
</table>

Values are means ±SD; n=14; *** Significant at P<0.001; Toral = Oral Temperature; HR = Heart Rate; MST = Mean Skin Temperature; MBT = Mean Body Temperature; HAI = Heat Accumulation Index; PSI = Physiological Strain Index.

**Table 4** Effects of 60 min of Heat Stress exposure to $T_{\text{in}}$ 50°C and $T_{\text{in}}$ 33°C on Heat Strain parameters in subjects with flying ensemble.

**Table 5** Effects of 60 min of Heat Stress exposure to $T_{\text{in}}$ 50°C and $T_{\text{in}}$ 33°C on Heat Strain parameters in subjects without flying ensemble (CON) and with flying ensemble (EXP)

<table>
<thead>
<tr>
<th>Parameters</th>
<th>CON</th>
<th>EXP</th>
<th>Mean Difference (EXP - CON)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toral (°C)</td>
<td>0.92±0.24</td>
<td>1.09±0.43</td>
<td>+0.16±0.18**</td>
</tr>
<tr>
<td>HR (beats/min)</td>
<td>22.00±4.3</td>
<td>28.86±5.35</td>
<td>+6.86±1.05***</td>
</tr>
<tr>
<td>MST (°C)</td>
<td>3.05±0.6</td>
<td>3.13±0.43</td>
<td>+0.08±0.17***</td>
</tr>
<tr>
<td>MBT (°C)</td>
<td>1.63±0.25</td>
<td>1.77±0.38</td>
<td>+0.14±0.13***</td>
</tr>
<tr>
<td>SP (kg)</td>
<td>0.55±0.10</td>
<td>0.68±0.15</td>
<td>+0.13±0.09***</td>
</tr>
<tr>
<td>HAI (Cal/m²)</td>
<td>50.45±9.11</td>
<td>54.55±12.12</td>
<td>+4.09±15.29 NS</td>
</tr>
<tr>
<td>PSI</td>
<td>2.51±0.39</td>
<td>3.5±0.53</td>
<td>+0.99±0.71***</td>
</tr>
</tbody>
</table>

Values are means ± SD; n=14; * = Significant at P<0.05; ** Significant at P<0.01; NS = Not significant (P >0.05); $T_{\text{in}}$ = Oral Temperature; HR = Heart Rate; MST = Mean Skin Temperature; MBT = Mean Body Temperature; SP = Sweat Production; HAI = Heat Accumulation Index; PSI = Physiological Strain Index.
heat stress exposure. An increase of $1.77 \pm 0.38^\circ C$ in MBT at 60 min in EXP group was also found highly significant (Table 4). Increase in MBT in EXP group was not significantly different than the increase in MBT in CON group (Table 5).

5. Sweat Production:
The Nude body weight in the CON group showed decrease from a pre exposure value of $65.87 \pm 5.34$ kg to $65.32 \pm 5.32$ kg at 60 min of the heat stress exposure. A decrease of $0.55 \pm 0.10$ kg in nude body weight at 60 min of heat stress exposure, reflecting sweat production, in CON group was found highly significant (Table 3). The Nude body weight in the EXP group also showed decrease from a pre exposure value of $65.89 \pm 5.33$ kg to $65.21 \pm 5.33$ kg at 60 min of the heat stress exposure. A decrease of $0.68 \pm 0.15$ kg in Nude body weight at 60 min of heat stress exposure, reflecting sweat production, in EXP group was also found highly significant (Table 4). Increase in SP in EXP group was found significantly higher than the increase in SP in CON group (Table 5).

6. Heat Accumulation Index:
The HAI in CON group at 60 min of heat stress exposure was $50.45 \pm 9.11$ Cal/m$^2$. The HAI in EXP group at 60 min of heat stress exposure was $54.55 \pm 12.12$ Cal/m$^2$. HAI in EXP group was not found significantly different than the HAI in CON group (Table 5).

7. Physiological Strain Index:
The PSI in CON group at 60 min of heat stress exposure was $2.51 \pm 0.39$. The PSI in EXP group at 60 min of heat stress exposure was $3.50 \pm 0.53$. PSI in EXP group was found significantly higher than the PSI in CON group (Table 5).

DISCUSSION
Increase in HR in EXP group was significantly higher than the increase of HR in CON group. In the present study although change in $T_{\text{core}}$ in both the groups was not significant but it showed a trend of higher rise in $T_{\text{core}}$ in EXP group. MST in CON and EXP group at the 60 min of heat stress exposure was not found significantly different. MST is dependent on core temperature and the environment temperature, as the terminal core temperature and simulated environment were not significantly different in both the groups, the difference in MST was not observed in the present study. Increase in MBT in EXP group was not significantly different than the increase in MBT in CON group. This is due to the fact that increase in $T_{\text{core}}$ and MST in EXP group was not significantly different from the increase in $T_{\text{core}}$ and MST in CON group. SP in EXP group was found significantly higher than the SP in CON group. Higher SP in EXP group is an expected result due to the added barrier (due to the flying clothing) for the convective and radiative heat loss mechanisms from the body. The only efficient mechanism available to the body in this situation under heat stressful environment was through sweat production. Increased heat strain responses in EXP group are attributed to aircrew clothing. HAI in EXP group was not found significantly different than the HAI in CON group. Insignificant difference of HAI in CON and EXP group can be explained due to insignificant differences of changes in MBT in these two groups. PSI in EXP group was found significantly higher than the PSI in CON group.

Higher PSI in EXP group can be explained by the fact that HR increase in the EXP group was significantly higher than the HR in CON group, although $T_{\text{core}}$ increase in both the groups were not significantly different.

It can be seen from the above that physiological strain imposed by the simulated heat stress of WBGT $-38.1^\circ C$, in the subjects using flying clothing, was significantly higher than the control group. However the physiological strain was within human tolerance limit and also within the safe limits for flying.

CONCLUSION
Sixty minutes of heat stress exposure in CON group resulted in the increase of HR from $79.71 \pm 5.9$ beats/min to $101.71 \pm 6.1$ beats/min, $T_{\text{core}}$ from $36.56 \pm 0.28^\circ C$ to $37.49 \pm 0.14^\circ C$, MST from $34.6 \pm 0.62^\circ C$ to $37.65 \pm 0.26^\circ C$, MBT from $35.91 \pm 0.30^\circ C$ to $37.54 \pm 0.13^\circ C$, SP of $0.55 \pm 0.10$ kg, HAI of $50.45 \pm 9.11$ Cal/m$^2$, PSI of $2.51 \pm 0.39$. Sixty minutes of heat stress exposure in EXP group resulted in the increase of HR $84.07 \pm 4.84$ beats/min to $112.93 \pm 4.41$ beats/min, $T_{\text{core}}$ from $36.75 \pm 0.2^\circ C$ to $37.84 \pm 0.3^\circ C$, MST from $34.77 \pm 0.49^\circ C$ to $37.9 \pm 0.33^\circ C$, MBT from $36.09 \pm 0.25^\circ C$ to $37.86 \pm 0.26^\circ C$, SP of $0.68 \pm 0.15$ kg, HAI...
of $54.55 \pm 12.12 \text{ Cal/m}^2\text{, PSI of } 3.50 \pm 0.53$.

Increase in HR, SP and PSI in EXP group was significantly higher than the increase of HR, SP and PSI in CON group. In the present study although change in $\text{T}_{\text{core}}$, MST, MBT, HAI was not significantly different in both the groups, it showed a trend of higher rise in these parameters in EXP group. This finding are indicative of increased heat strain responses in EXP group due to aircrew clothing.

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ANALYSIS OF RADIOLOGICAL FINDINGS AND PERIOD OF INEFFECTIVENESS OF AIRCREW FOLLOWING AN EJECTION

Surg Cdr Samir Kapoor*

ABSTRACT

Ejection is the only possible means of abandoning a disabled, high performance fighter aircraft when the safety of the aircrew is jeopardized. The spinal column is the most vulnerable part of the human body during the act of ejection. There have been quantum leaps in radiological techniques for evaluation of the spine. These include CT, MRI and radionuclide bone scan which allow more accurate localization of the pathologic process. Following an ejection from an aircraft, there is a period of ineffectiveness during which aircrew are observed on ground, investigated and reflighted only if found fit, after a thorough evaluation. Also, if spinal injuries are detected, there is a resultant loss of trained manpower if aircrew have to either be permanently made unfit for flying duties or made unfit for ejection seat aircraft. The study analyses radiological findings of spine and period of ineffectiveness in 59 cases of ejection from various fighter aircraft in the IAF and Indian Navy. The study reveals that evaluation of cases of ejection from fighter aircraft needs to be viewed in a new light. There is a scope for safely reducing the period of ineffectiveness of aircrew. This reduced period of ineffectiveness will auger well for the aircrew in terms of psychological well being and on the professional front. It will also serve the larger purpose of confidence building in the rest of the aircrew in flying stations. Most important of all, it will conserve the productivity of highly trained manpower. A few recommendations for possible ways to achieve the same are also brought out.

Key Words: Aircrew, Ejection, Spine, Radiological abnormalities, Period of ineffectiveness

INTRODUCTION

Ejection is the only possible means of abandoning a disabled, high performance fighter aircraft when the safety of the aircrew is jeopardized. There have been quantum leaps in the design of ejection seats over the years in the light of new knowledge, both technical and in biodynamics of the spine. Modern-ejection seats have been instrumental in not only saving the lives of many aircrew but also preserving the structural integrity of the spine allowing for early reflighting of aircrew even into ejection seat aircraft.

The spinal column is the most vulnerable part of the human body during the act of ejection. This has been adequately documented over the years in various studies. Despite advancements in seat design, spinal injuries have continued to plague Air Forces all over the world. The Indian Air Force and Indian Navy are no exceptions and this fact can be seen from various studies, the most important and revealing being:

(a) A study conducted by Dogra et al. covering a period from 1960 to May 1980 showing a spinal injury rate of 35.2% [1].
(b) A study by Dogra et al. covering a period from June 1980 to Mar 1987 showing a spinal injury rate of 27.5% [2].
(c) A study by Gopal et al. from Apr 1987 to May 1993 showing a spinal injury rate of 26.2% [3].

There has also been a quantum leap in radiological techniques for evaluation of the spine. These include CT, MRI and radionuclide bone scan. These techniques allow more accurate localization of the pathologic process and provide additional information to characterize a lesion or form a differential diagnosis [1].

Following an ejection, there is a period of ineffectiveness during which the aircrew is observed on ground, investigated and reflighted only if found fit, after a thorough evaluation at the Institute of Aerospace Medicine (IAM). If spinal injuries are

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detected, there is a resultant loss of trained manpower if aircrew have to either be permanently made unfit for flying duties or made unfit for ejection seat aircraft.

The current policy regarding evaluation of the spine was introduced in 1999 as an amendment to IAP 4303 2nd ed. on "Post Ejection Injuries". The same has since been incorporated into the IAP 4303 3rd ed. These policies dictate the period for which the aircrew will be observed in a non-flying category. Policies regarding evaluation of ejectees depend to a large extent on the radiological findings (which in turn are a reflection of the severity of injury). Hence there appears to be a relationship between post ejection radiological findings and period of ineffectivity of aircrew.

This study attempts to throw light on the radiological abnormalities seen post ejection vis-a-vis the period of ineffectivity of aircrew.

MATERIAL AND METHODS

Aircrew (Indian Navy and IAF) who eject from an aircraft are evaluated at IAM. This evaluation is mandatory whether the aircrew sustain injury or not. Data regarding ejections was obtained from the records maintained at the Medical Evaluation Centre at IAM. Although, initially it was envisaged that the study will cover a period of 10 years, medical documents of ejectees and Human Engineering evaluation opinions were found to be available only from Jan 2001 onwards and included cases who had ejected prior to 2001 but were still in low medical category and were undergoing periodic evaluation. Data was collected from the available case sheets / opinions and analyzed.

Data collected was segregated according to:
(a) the type of aircraft from which ejections took place.
(b) whether the aircrew was symptomatic or asymptomatic post ejection.
(c) radiological findings on roentgenogram, CT/MRI of spine and in a few cases, a radionucleide bone scan.
(d) period for which the aircrew were placed in a non-flying category.

The period of ineffectivity was considered to be

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the period for which aircrew were grounded (placed in low med cat A4). Return to restricted flying duties (A3 upwards) was not considered to be included in this period. Reasons for a delay in reflighting, as well as conditions the aircrew fulfilled for early reflighting were looked for.

Data was analysed with the intent of determining the period of ineffectivity of aircrew vis-a-vis spinal radiological abnormalities.

RESULTS

A total of 59 cases (N=59) for which documents were available were studied. Among these, were cases dating back from Feb 96 to the most current in Jan 06.

For the purpose of analyzing the data collected, ejectees were divided into 5 groups based on the radiological findings. These were:
(a) Group 1: Cases in which the roentgenogram of the spine and CT/MRI revealed no abnormality.
(b) Group 2: Cases in which the roentgenogram revealed no findings but the CT/MRI revealed incidental findings which were not related to the ejection injury.
(c) Group 3: Cases in which the roentgenogram of the spine revealed no abnormality however CT/MRI revealed findings possibly related to the ejection injury.
(d) Group 4: Cases in which the roentgenogram of the spine revealed an abnormality attributable to the ejection and CT/MRI revealed similar findings. Incidental findings on CT/MRI not related to the ejection injury were/were not present.
(e) Group 5: Cases in which the roentgenogram of the spine revealed an abnormality attributable to the ejection and CT/MRI revealed additional findings possibly related to the ejection injury.

Each group was further subdivided into those who were asymptomatic and those who were symptomatic (for spine and for injury other than spine). Those who were symptomatic for spine included cases that were symptomatic after a vibration run / human centrifuge run or following reflighting. Reports of Technetium 99m labeled whole body bone scan were available in a few cases. The
reports of these bone scans were also noted.

Table 1 shows the details of cases in which no radiological abnormality was detected (Group 1). It is seen that about 28% (n=17), ejectees did not reveal any radiological abnormality. Of this group, 11 were asymptomatic. Of the remaining 06 cases, 04 were symptomatic for the spine. The others were symptomatic for injuries other than spinal. In 06 cases, a bone scan was also done, and it did not reveal any abnormality. Of these 06 cases, 04 were symptom free. It is seen that the period of ineffectivity varied from a minimum of 41 days to a maximum of 109 days in the asymptomatic group. The average period of ineffectivity of the 03 groups is as follows:

(a) Asymptomatic cases – 64 days
(b) Symptomatic (spine) cases – 227 days
(c) Symptomatic (others) cases – 241 days

Details of cases in which the roentgenogram revealed no findings but the CT/MRI revealed incidental findings which were not related to the ejection injury (Group 2) is shown in Table 2. It is seen that about 6.7% (n=04), ejectees did not reveal any findings on the X-ray spine but revealed incidental findings on CT/MRI. These were not related to recent trauma and showed chronic degenerative changes. Of this group, 03 were asymptomatic. Only 01 case had symptoms related to the spine. In 02 cases of the asymptomatic group, a bone scan was also done, and it did not reveal any abnormality. It is seen that the period of ineffectivity varied from a minimum of 62 days to a maximum of 212 days in the asymptomatic group. The average period of ineffectivity of the 02 groups is as follows:

(a) Asymptomatic cases – 181 days
(b) Symptomatic (spine) cases – 339 days
(c) Symptomatic (others) cases – 704 days

Table 3 shows the details of cases in which the roentgenogram of the spine revealed no abnormality, however CT/MRI revealed findings possibly related to the ejection injury (Group 3). This group comprised of a total of 07 cases (11.86%). Of this group, 03 were asymptomatic and 04 had symptoms related to spinal trauma. Bone scan was done in only 01 symptomatic case and revealed no abnormality. It is seen that the period of ineffectivity varied from a minimum of 81 days to a maximum of 945 days in the asymptomatic group and a minimum of 275 days to a maximum of 1263 days in the symptomatic group. The average period of ineffectivity of the 02 groups is as follows:

(a) Asymptomatic cases – 390 days
(b) Symptomatic (spine) cases – 653 days

Table 4 shows details of cases in which the roentgenogram of the spine revealed an abnormality attributable to the ejection and CT/MRI revealed similar findings. Incidental findings on CT/MRI not related to the ejection injury were/were not present (Group 4). This group comprised about 27.11% (n=16) of the total number of cases studied. Of this group, 07 cases were asymptomatic. 08 cases had symptoms related to spinal trauma and only 01 case was symptomatic for other causes. A bone scan was done in a total of 05 cases, 03 in the asymptomatic group which revealed no abnormality and 02 in the symptomatic group which revealed reactive osteoblastic activity in 01 case only. The average period of ineffectivity for the 03 groups is as follows:

(a) Asymptomatic cases – 181 days
(b) Symptomatic (spine) cases – 339 days
(c) Symptomatic (others) cases – 704 days

Table 5 shows details of cases in which the roentgenogram of the spine revealed an abnormality attributable to the ejection and CT/MRI revealed additional findings possibly related to the ejection injury (Group 5). This group comprised about 25.4% (n=15) of the total number of cases studied. Of this group, 06 cases were asymptomatic, 09 cases had symptoms related to spinal trauma and there were no cases in the group symptomatic for other causes. A bone scan was done in a total of 06 cases. In the asymptomatic group of the 05 cases who underwent a bone scan, an increased uptake was seen in 02 cases. Only one case underwent a bone scan in the symptomatic group and revealed an increase uptake. The average period of ineffectivity for the 02 groups is as follows:

(a) Asymptomatic cases – 326 days
(b) Symptomatic (spine) cases – 581 days

Distribution of cases with radiological findings and period of ineffectivity is shown in Table 6. It is seen that the average period of ineffectivity is as follows:

Jour Marine Medical Society, 2007, Vol. 9, No. 1
(a) Asymptomatic cases with no radiological abnormality – 64 days
(b) Asymptomatic cases with radiological abnormality – 289 days
(c) Symptomatic cases with no radiological abnormality – 213 days
(d) Symptomatic cases with radiological abnormality – 487 days

05 cases who were symptomatic but did not reveal any radiological abnormality averaged 213 days of ineffectivity. An interesting finding is that almost 50% of all the cases were found to be symptomatic.

DISCUSSION

Despite many years [1957-2006] of experience in dealing with ejection spinal injuries in the IAF, a logical consensus on disposal of these cases is still elusive. Although the IAP 4303 lays down guidelines for disposal of these cases in detail, every case does not neatly fit into this framework. It has been seen that there is a wide variation in the disposal and period for which the ejectee is kept off from flying duties even in similar cases. With the introduction of the current policy which includes conduct of an MRI in cases of ejection, additional findings, related both to bony as well as soft tissue injuries adds to the dilemma of evaluation and disposal of these cases. This paper discusses the post-ejection period of ineffectivity of aircrew vis-à-vis these radiological findings.

Currently, at IAM, evaluation of a case of ejection includes:

(a) a radiological evaluation
(b) clinical evaluation as deemed appropriate by the surgeon / orthopaedic surgeon / neurosurgeon / clinical psychologist / aviation medicine specialist
(c) Evaluation in the Human Centrifuge and vibration chair for asymptomatic cases

Current modalities of radiological evaluation in ejection spinal injuries as outlined in the IAP 4303 include:

(a) Plain radiography of the spine
(b) MRI

(a) Plain radiography: The plain film study is the basic examination of the patient with acute spine trauma. It provides an anatomical display of bone pathology.

(b) MRI: This examination is highly sensitive in detection of soft tissue abnormalities. It can clearly visualize the intervertebral discs, vertebral bodies, vertebral alignment, ligaments, and neural elements. Disc herniations, epidural fluid collections, subluxations, vertebral body fractures, cord swelling, and cord compression are also visualized [5]. Sagittal T2-weighted images depict most of the soft tissue abnormalities including spinal cord edema and hemorrhage, ligamentous injury, disc herniation, and epidural fluid collections. All acute fractures generally produce a reduced signal intensity on T1-weighted images and an increased signal intensity on T2-weighted images. MRI is the only imaging modality available that directly visualizes changes to the ligaments as a result of trauma. When overstretched or ruptured, a gap in the ligament may be identified and the surrounding tissues may increase in signal intensity on T2-weighted images because of an increase in free water content from extracellular fluid and/or adjacent hemorrhage [6, 7].

Bone Scintigraphy is a modality which has been utilized in a few cases as a part of a pilot study [8]. In cases of ejection, it is not being routinely resorted to, but has been done in a few cases where thought appropriate. This modality provides information about the metabolic state and perfusion of the osseous system. Bone scans demonstrate changes in osteoblast activity long before anatomic imaging modalities, thus complimenting the anatomic studies in the diagnosis and management of injuries [9]. Fractures not apparent on routine radiographs may be readily detected with radionuclide bone scanning. All recent fractures in the axial skeleton can be seen by 14 days and continue to show a hot spot in case of a bony injury for up to 09 months [10]. Images of 90% of fracture sites are totally normal after 2 years [11]. Radionuclide bone imaging has been successfully used in situations in which more objective evidence of a fracture is desired prior to treatment, and to demonstrate occult fractures. The most commonly used radiopharmaceutical is 99m Tc MDP which produces the best image. It must be emphasized that no single modality is complete in
itself and needs to be complemented by the other.

Of the 59 cases studied, it is seen that 38 (64%) of the 59 ejectees had some form of radiological abnormality (radiograph or CT/MRI) related to recent trauma commensurate with an ejection injury. This rate of spinal injury is higher than that reported previously [1-3]. This finding could be attributed to the introduction of a new policy for evaluation of ejection cases which includes a mandatory MRI as a mode of investigation within 8 weeks of the ejection [4] as opposed to the earlier policy which did not utilize this modality and only utilized a radiograph of the spine. Since very few records of ejection prior to the introduction of this policy were available, it was not possible to compare the two groups.

A total of 10 pilots of the 59 ejectees were made unfit for ejection seat aircraft. All these pilots were detected to have radiological abnormalities. 07 of these were found fit for transport aircraft/helicopters and 03 were found fit only for transport aircraft.

The guidelines laid down in the IAP 4303 have a direct bearing on the period of ineffectivity of aircrew. It is seen that the average period of ineffectivity of asymptomatic cases with no radiological abnormality is 64 days [Table 1]. As per the new policy, aircrew whether symptomatic or not, are to be immediately hospitalized and evaluated. Asymptomatic cases with no bony or soft tissue injury are then placed in medical cat A4G4 (T-6) and an MRI spine is to be done as early as possible, but within 4 weeks. The older policy did not specify the disposal of this group of cases and usually they were reflighted from the unit level itself. It is felt that this period of ineffectivity of cases that are asymptomatic can be reduced if the period of lowering the medical category is restricted till the time the MRI is done. If the same does not show any abnormality the case is to be declared A1G1 at unit level. This will have two advantages:

(a) It will reduce the period of ineffectivity of the ejectee considerably.

Table 1
Details of cases in which No radiological abnormality was detected (n=17)

<table>
<thead>
<tr>
<th>S No</th>
<th>Roentgenogram</th>
<th>CT/ MRI findings</th>
<th>Bone scan</th>
<th>Period of ineffectivity (Days)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Asympto</td>
</tr>
<tr>
<td>1</td>
<td>NAD</td>
<td>NAD</td>
<td>Not done</td>
<td>57</td>
</tr>
<tr>
<td>2</td>
<td>NAD</td>
<td>NAD</td>
<td>Not done</td>
<td>49</td>
</tr>
<tr>
<td>3</td>
<td>NAD</td>
<td>NAD</td>
<td>NAD</td>
<td>64</td>
</tr>
<tr>
<td>4</td>
<td>NAD</td>
<td>NAD</td>
<td>Not done</td>
<td>55</td>
</tr>
<tr>
<td>5</td>
<td>NAD</td>
<td>NAD</td>
<td>NAD</td>
<td>77</td>
</tr>
<tr>
<td>6</td>
<td>NAD</td>
<td>NAD</td>
<td>NAD</td>
<td>64</td>
</tr>
<tr>
<td>7</td>
<td>NAD</td>
<td>NAD</td>
<td>Not done</td>
<td>58</td>
</tr>
<tr>
<td>8</td>
<td>NAD</td>
<td>NAD</td>
<td>NAD</td>
<td>78</td>
</tr>
<tr>
<td>9</td>
<td>NAD</td>
<td>NAD</td>
<td>Not done</td>
<td>161</td>
</tr>
<tr>
<td>10</td>
<td>NAD</td>
<td>NAD</td>
<td>Not done</td>
<td>109</td>
</tr>
<tr>
<td>11</td>
<td>NAD</td>
<td>NAD</td>
<td>Not done</td>
<td>58</td>
</tr>
<tr>
<td>12</td>
<td>NAD</td>
<td>NAD</td>
<td>Not done</td>
<td>168</td>
</tr>
<tr>
<td>13</td>
<td>NAD</td>
<td>NAD</td>
<td>Not done</td>
<td>314</td>
</tr>
<tr>
<td>14</td>
<td>NAD</td>
<td>NAD</td>
<td>Not done</td>
<td>146</td>
</tr>
<tr>
<td>15</td>
<td>NAD</td>
<td>NAD</td>
<td>Not done</td>
<td>542</td>
</tr>
<tr>
<td>16</td>
<td>NAD</td>
<td>NAD</td>
<td>NAD</td>
<td>59</td>
</tr>
<tr>
<td>17</td>
<td>NAD</td>
<td>NAD</td>
<td>NAD</td>
<td></td>
</tr>
</tbody>
</table>

AVERAGE 64 227 241
Reducing this period may also prove to be a psychological boost to the ejectee who is made to feel that ejection is an intrinsic part of fighter flying and that he is a fully fit pilot with no residual disability.

It is also seen that 04 of these cases were symptomatic for spine even when no radiological abnormality, including a bone scan, was detected. The average period of ineffectivity of these cases was 227 days. It is therefore considered prudent in such cases, to perform a bone scan. These are the kind of cases that require a thorough psychological evaluation in addition. Presently, a psychometric evaluation includes an interview along with administering the following tests:

(a) 16 PF test.
(b) Work need assessment inventory.
(c) Rorschach test.

The psychometric evaluation in these cases revealed no anxiety or low motivation for flying.

In this group there were also 02 cases that had no spinal radiological abnormality but were symptomatic due to other injuries. These cases were not included in calculating the period of ineffectivity.

Table 2 shows a group of 04 cases where the CT/MRI abnormality was not commensurate with a recent trauma and the cases were seen to have early and chronic disc degenerative changes at various levels. 03 cases were asymptomatic but were kept in a non flying category for an unduly long period of time (average=142 days) due to:

(a) Human centrifuge non availability for evaluation of these cases.
(b) Reversion of the medical category commensurate with flying, recommended by IAM, to a ground category by Air HQ probably on the basis of the MRI report which did not reveal evidence of recent injury as outlined above.

The current protocol for evaluation of the spine includes a human centrifuge run and a vibration chair evaluation in asymptomatic ejectees. It is felt that in case of non-availability of the same, the pilot should be upgraded to a restricted flying category for 12 weeks (provided clinical evaluation is normal) and cleared for dual sorties. These cases are to be closely monitored by the unit medical authorities and are to be reviewed at IAM on completion of the period of observation along with an executive report. It is felt that the period of ineffectivity (average=142 days) of asymptomatic cases in this group could also have been reduced considering that the findings of CT/MRI were incidental and possibly not related to the ejection.

Cases of ejections showing no findings on radiography but revealing findings on CT/MRI possibly related to the ejection injury were found to

<table>
<thead>
<tr>
<th>S No</th>
<th>Roentgenogram</th>
<th>CT/ MRI (Findings possibly not related to ejection injury)</th>
<th>Bone scan</th>
<th>Period of ineffectivity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Asympto</td>
<td>Sympto (spine)</td>
</tr>
<tr>
<td>1</td>
<td>NAD</td>
<td>Early disc degenerative disease CV 2-3, 4-5</td>
<td>Not done</td>
<td>151</td>
</tr>
<tr>
<td>2</td>
<td>NAD</td>
<td>Disc degenerative disease D10-11, L5-S lumbar canal stenosis</td>
<td>NAD</td>
<td>212</td>
</tr>
<tr>
<td>3</td>
<td>NAD</td>
<td>Early disc degenerative disease-multiple levels</td>
<td>Not done</td>
<td>131</td>
</tr>
<tr>
<td>4</td>
<td>NAD</td>
<td>Disc degenerative disease L5-S1</td>
<td>NAD</td>
<td>62</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>AVERAGE</td>
<td>142</td>
</tr>
</tbody>
</table>

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TABLE 3
Details of cases with no findings on spinal roentgenogram but findings on CT/MRI possibly related to ejection injury (n=07)

<table>
<thead>
<tr>
<th>S No</th>
<th>Roentgenogram</th>
<th>CT/ MRI (Findings possibly not related to ejection injury)</th>
<th>Bone scan</th>
<th>Period of ineffectivity (Days)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Asympto (spine)</td>
<td>Sympto (other)</td>
</tr>
<tr>
<td>1.</td>
<td>NAD</td>
<td>Evidence of Contusion spine with annular disc bulge - L5</td>
<td>Not done</td>
<td>1263</td>
</tr>
<tr>
<td>2.</td>
<td>NAD</td>
<td>Stable compr fracture DV12, LV1, 4 &amp; 5</td>
<td>Not done</td>
<td>945</td>
</tr>
<tr>
<td>3.</td>
<td>NAD</td>
<td>Stable compr fracture D9, disc degenerative disease- C2-3-4-5</td>
<td>Not done</td>
<td>343</td>
</tr>
<tr>
<td>4.</td>
<td>NAD</td>
<td>Stable compr fracture DV-12</td>
<td>Not done</td>
<td>145</td>
</tr>
<tr>
<td>5.</td>
<td>NAD</td>
<td>Disc protrusion C5-6</td>
<td>NAD</td>
<td>730</td>
</tr>
<tr>
<td>6.</td>
<td>NAD</td>
<td>Protrusion of disc L3-4, L5-S1 Discs hydrated</td>
<td>Not done</td>
<td>275</td>
</tr>
<tr>
<td>7.</td>
<td>NAD</td>
<td>Early degenerative changes cervical &amp; lumbar spine L4-5-S1 Herniation Tr Schmorl nodes DV11, 12, L1 Ant wedging DV12</td>
<td>Not done</td>
<td>81</td>
</tr>
</tbody>
</table>

AVERAGE 390 653

be 11.8%. Cases included recent traumatic disc protrusion, contusion spine, traumatic Schmorl's nodes and compression fractures. In one case, the delay in relighting was due to unserviceability of the Human Centrifuge in addition to the radiological findings. In the others, it was because of the findings on CT/MRI. It is felt that the period of ineffectivity in asymptomatic cases in this group which averages 390 days can be reduced especially in cases of spinal contusion. This period can be reduced to an observation on ground of 12 weeks unlike the present 24 weeks followed by a re-evaluation at IAM. Soft tissue injuries of the spine like contusions, are likely to heal in this period hence re-evaluating may relight a pilot at an earlier date.

It is primarily because of the two groups discussed above (Group 2 & 3) that the percentage of detection of spinal injuries has increased from 26.2% [3] before 1999 (when the new policy regarding introduction of MRI to evaluate these cases was introduced) to almost 60% in the present study. This itself has added a burden to the period of ineffectivity of aircrew.

Table 4 shows those cases where the spinal radiograph revealed findings commensurate with a trauma to the spine and additional incidental findings on CT/MRI possibly not related to the ejection trauma. This group also showed cases of chronic degenerative disc disease in most of the cases. Two cases revealed an increased uptake on bone scan, one asymptomatic and the other symptomatic. In 03 asymptomatic cases, where the radiograph of the spine revealed an anterior wedging, the bone scan was normal. These cases of anterior wedging were probably either old injuries or were cases of congenital wedging which is a common vertebral deformity but were attributed to the ejection. However, since bone scan is not a part of the evaluation protocol, and also that it was conducted late in the disease process, it is possible that its findings were not taken cognizance of during disposal of these cases.

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TABLE 4

Details of cases with abnormal findings on spinal roentgenogram and incidental findings on CT/MRI not related to ejection injury (n=16)

<table>
<thead>
<tr>
<th>S No</th>
<th>Roentgenogram</th>
<th>Additional CT/MRI findings</th>
<th>Bone scan</th>
<th>Period of ineffectivity (Days)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Asympto</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Sympto (spine)</td>
</tr>
<tr>
<td>1</td>
<td>Stable ant compr fracture DV12</td>
<td>Incidental sacralisation L5</td>
<td>Not done</td>
<td>149</td>
</tr>
<tr>
<td>2</td>
<td>Stable compr fracture LV1</td>
<td>Conus medullaris syndrome</td>
<td>Not done</td>
<td>158</td>
</tr>
<tr>
<td>3</td>
<td>Stable compr fracture DV6</td>
<td>Nil</td>
<td>NAD</td>
<td>374</td>
</tr>
<tr>
<td>4</td>
<td>Stable ant wedging D3,4,5</td>
<td>Nil</td>
<td>Not done</td>
<td>582</td>
</tr>
<tr>
<td>5</td>
<td>Stable ant compr fracture</td>
<td>Ant osteophytes D9, 10</td>
<td>Not done</td>
<td>204</td>
</tr>
<tr>
<td></td>
<td>DV11, 12 &amp; L1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Stable ant compr fracture LV1</td>
<td>Degenerative disc</td>
<td>Reactive</td>
<td>266</td>
</tr>
<tr>
<td></td>
<td></td>
<td>disease LV5-S1</td>
<td>osteoblastic activity</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Stable compr fracture DV9, 10</td>
<td>Nil</td>
<td>Not done</td>
<td>704</td>
</tr>
<tr>
<td></td>
<td>&amp; fracture trans process DV8, 9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Stable ant compr fracture DV7,</td>
<td>Nil</td>
<td>Not done</td>
<td>795</td>
</tr>
<tr>
<td></td>
<td>Unstable fracture LV1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Stable ant wedging DV5</td>
<td>Stable ant wedging DV5</td>
<td>Not done</td>
<td>221</td>
</tr>
<tr>
<td>10</td>
<td>Schmorl’s nodes DV9 (not recent onset)</td>
<td>Reduced IVDS L4-5 with degenerative changes</td>
<td>Not done</td>
<td>79</td>
</tr>
<tr>
<td>11</td>
<td>Stable ant wedging DV12-L1</td>
<td>Mild ant compr LV1</td>
<td>NAD</td>
<td>136</td>
</tr>
<tr>
<td>12</td>
<td>Mild ant wedging DV11, 12</td>
<td>Nil</td>
<td>NAD</td>
<td>68</td>
</tr>
<tr>
<td>13</td>
<td>Stable ant compr DV12</td>
<td>Shows compr to be old injury</td>
<td>Not done</td>
<td>133</td>
</tr>
<tr>
<td>14</td>
<td>Stable ant compr D9, 12</td>
<td>Nil</td>
<td>Not done</td>
<td>421</td>
</tr>
<tr>
<td>15</td>
<td>Stable ant wedging DV12, L1</td>
<td>Nil</td>
<td>NAD</td>
<td>204</td>
</tr>
<tr>
<td>16</td>
<td>Stable ant compr DV9, 12</td>
<td>Nil</td>
<td>Increased uptake DV9,12 &amp; 5th 7th costochondral junction</td>
<td>190</td>
</tr>
</tbody>
</table>

AVERAGE: 181 339 704

of the cases which varied from 68 days to 374 days can be reduced if a bone scintigraphy is carried out at the appropriate time to differentiate between old injuries [12] and congenital deformities from changes due to a recent injury, since a cuneiform tendency is the most commonly found variation in the dorso-lumbar vertebrae [13,14].

There is no gold standard in the definition of a vertebral fracture. The concept of a wedged vertebra and its definition varies with different authors. It is necessary therefore to distinguish between the true-wedged vertebra of traumatic and congenital origin [13]. Hence a bone scan will help in a more objective and scientific disposal of these cases and early refighting of trained aircrew where bone scan shows no evidence of a recent trauma. This can be safely resorted to since it is known that even if an ejectee suffered a vertebral fracture in the first ejection, this does not predispose him to any additional injury on a subsequent ejection [15].

Table 5 shows details of cases where the spine radiograph revealed findings related to the ejection
and the CT/MRI revealed additional findings related to the ejection in the form of additional fractures, recent onset disc bulges, thecal compression, traumatic Schmorl's nodes etc. Herein lies the importance of conducting a MRI study of the spine following ejection. It is seen that the period of ineffectivity in asymptomatic and symptomatic cases increased from 181 days and 339 days in cases where no additional findings were seen on the MRI to 326 days and 581 days respectively where MRI revealed additional findings. However, it is also seen that in 03 asymptomatic cases in which compression fractures were seen, the bone scan was normal. This is an important finding since it indicates that these injuries may have been old injuries. The period of ineffectivity in such cases can be reduced if a bone scan is done at an appropriate time. Increased uptake was seen in the bone scan of 02 asymptomatic and 01 symptomatic case. This scan however did not affect the period of ineffectivity since it was not taken cognizance of.

From Table 6 it can be seen that there were 05 cases that were symptomatic but did not reveal any radiological abnormality. These are the cases that require to be psychologically evaluated thoroughly to rule out low motivation for flying due to the psychological trauma of an ejection or due to familial pressures. During the data collection it was seen that the few psychometric evaluation reports which were available, did not yield any results by which the dilemma of disposal could be resolved. A study needs to be conducted to assess the current methods of psychometric evaluation and suggest improvements if required to yield more definitive results.

Another interesting finding is that almost 50% of all the cases were found to be symptomatic. Has the incidence of symptomatic cases increased with the advent of MRI as a modality of investigation? This could well be possible due to a psychological overlay in the aircrew that have recently ejected and are psychologically vulnerable. It was felt that the detection of incidental findings of an MRI for evaluation of spinal injuries may have increased the number of symptomatic cases in ejectees. This however, could not be substantiated since data prior to 1999 was not available. A study carried out at the Department of Aviation Psychology at IAM on aircrew who suffered from musculo-skeletal disabilities found that in these physical conditions, emotional factors, emotional over-reactivity and emotional over / under-stimulation appeared to be influencing recovery of the physical illness, sometimes also resulting in anxiety or somatisation [16].

A study therefore needs to also be conducted to determine whether the introduction of an MRI has increased the number of symptomatic cases in ejectees. This study may help in reducing the period of ineffectivity in symptomatic aircrew.

CONCLUSION

The evaluation of cases of ejection from fighter aircraft needs to be viewed in a new light. There is a scope for safely reducing the period of ineffectivity of aircrew as has been brought out. This reduced period of ineffectivity will augur well for the aircrew in terms of psychological well being and on the professional front. It will also serve a larger purpose of confidence building in the rest of the aircrew in flying stations. Most important of all, it will conserve the productivity of highly trained manpower. A few recommendations for possible ways to achieve the same are as below.

RECOMMENDATIONS

1. To reduce the period of ineffectivity in the asymptomatic group with no radiological abnormalities it is recommended that on discharge post hospitalization, the aircrew be placed in Med Cat A4G4 only till the time the MRI is done and is found to reveal no abnormality. If all radiological investigations are normal, the individual is asymptomatic and clinical examination reveals no functional abnormality, the individual should be upgraded to A1G1 at the unit level itself. The individual is to be monitored regularly by the local medical authorities. All documents of the individual along with radiography of the spine and MRI are to be forwarded to IAM for perusal and data archiving.

2. Although it has been recently recommended that bone scanning be incorporated as a necessary part of the standard protocol in the evaluation of ejection spinal injury [8], it is recommended that a whole body bone scan should be done during the post-ejection hospitalization phase or on reporting

Jour. Marine Medical Society, 2007, Vol. 9, No. 1
<table>
<thead>
<tr>
<th>S No</th>
<th>Roentgenogram</th>
<th>Additional CT/ MRI findings</th>
<th>Bone scan</th>
<th>Period of ineffectivity (Days)</th>
<th>Asympto (Spine)</th>
<th>Sympto (other)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Stable ant compr fracture LV2,3,4</td>
<td>Spondyloitic changes LV2.3,4 Bilat disc bulge LV3-4, 4-5</td>
<td>Not done</td>
<td>139</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Stable compr fracture DV7&amp;12</td>
<td>Focal fatty changes DV2.3,4,5 Sclerotic end plates</td>
<td>Mild uptake DV12</td>
<td>355</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Stable compr fracture L1.2 Osteophytes C3, C7 Reduced IV disc space C3-4, 5-6</td>
<td>C5-4 C5-6 disc postero-lat protrusion with compression</td>
<td>NAD</td>
<td>471</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Stable ant compr fracture DV7,8</td>
<td>Stable ant compr fracture DV9 Paravertebral soft tissue swelling &amp; haematoma DV7</td>
<td>Not done</td>
<td>496</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Stable ant compr fracture DV10 Fracture tr process LV4</td>
<td>PIYD LV5-S1</td>
<td>Not done</td>
<td>971</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Stable compr fracture DV4 &amp; fracture spinous process C6 Loss of lumbar lordosis</td>
<td>IV disc bulge C5-6 with indentation nerve root C6</td>
<td>Not done</td>
<td>581</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Unstable compr fracture DV 11,12 Reduced disc space D 10-11,11-12 Ant osteophytes D11-12</td>
<td>Thecal compression with D12 body</td>
<td>Not done</td>
<td>730</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Stable Compr fracture DV 11, 12 &amp; L1 Fracture lamina C3, arch and base of odontoid (C2)</td>
<td>Reduced height C3-4-5 &amp; DV 10-11 Increased uptake 221</td>
<td>Increased uptake 221 DV 12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Stable ant compr fracture DV12, L1</td>
<td>Schmorl's nodes DV12</td>
<td>NAD</td>
<td>282</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Stable ant compr fracture DV 3,4</td>
<td>Fracture DV5 Disc bulge LV4-5-S1 Spinal canal stenosis LV3-4</td>
<td>NAD</td>
<td>272</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Stable ant compr DV6</td>
<td>Ant wedging LV1 Disc bulge C6-C7 Disc prolapse L5-S1</td>
<td>Not done</td>
<td>352</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Subluxation C3 over C4 Stable ant compr DV6, 7 &amp; LV1</td>
<td>Traumatic Schmorl's nodes end plate DV6, 7</td>
<td>Not done</td>
<td>633</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Multiple compr fractures DV5, 7</td>
<td>Compr fractures DV5, 7, 8 &amp; 9 Increased uptake DV 5, 7, 8 &amp; 9</td>
<td>Increased uptake DV5, 7, 8 &amp; 9</td>
<td>518</td>
<td>(presently being evaluated)</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Mild ant compr LV1 Chip fracture LV2 Schmorl's nodes-multiple dorsal levels</td>
<td>IV disc bulge DV5-6, DV6-7, L5-S1</td>
<td>Not done</td>
<td>180</td>
<td>(presently being evaluated)</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Ant compr fracture DV3, 4</td>
<td>Compr fracture DV4, 5, 6 Chip fracture DV3 Early disc degen changes-multiple levels</td>
<td>Not done</td>
<td>180</td>
<td>(presently being evaluated)</td>
<td></td>
</tr>
</tbody>
</table>

AVERAGE 326 581
TABLE 6
Average period of ineffectivity (POI) in the asymptomatic and symptomatic groups

<table>
<thead>
<tr>
<th></th>
<th>Asymptomatic</th>
<th>Symptomatic</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total No Radio Abnor Av POI (days)</td>
<td>Radio Abnor Av POI (days)</td>
</tr>
<tr>
<td>Average</td>
<td>64</td>
<td>289</td>
</tr>
<tr>
<td>Total</td>
<td>30</td>
<td>17</td>
</tr>
</tbody>
</table>

to IAM only in the cases shown below:
(a) symptomatic cases where no radiological abnormality is detected.
(b) cases where roentgenogram and MRI findings are not found to be commensurate with each other.
(c) asymptomatic cases where wedging of a vertebra is detected.
These cases should then be studied over a reasonable period of time to determine whether a whole body bone scan helps in the correct disposal of the cases enumerated above.

3. A study should be undertaken to evaluate the current psychometric evaluation of aircrew who are symptomatic and yet reveal no radiological abnormality. The study should also bring out if the current methods can be improved in any way to yield more definitive results so as to resolve the dilemma of disposal in these cases. It is also suggested that when these cases undergo a psychometric evaluation, a report from the unit Medical Officer / Squadron Commander / Commanding officer regarding the individual's social, cultural, behavioral and job profile should be forwarded to IAM to help in psychological evaluation of the individual.

4. Non-availability of the Human centrifuge and vibration chair for assessing an asymptomatic case of ejection should not be a cause for delay in evaluation of these cases. In case the same is not available, the aircrew should be upgraded to a restricted flying category for 12 weeks (provided clinical evaluation is normal) and cleared for dual sorties with gradual increase in G-loads. These cases are to be closely monitored by the unit medical authorities and are to be reviewed at IAM on completion of the period of observation along with an executive report. If they are asymptomatic following relighting, they are to be immediately downgraded to A4G4 for 24 weeks followed by the next review at IAM.

5. Cases of soft tissue injuries to the spine which are possibly of recent origin and probably related to the ejection-like spinal contusions, should be re-evaluated after a period of 12 weeks instead of 24 weeks at IAM. They should be relighted if found to be asymptomatic and clinical / radiological evaluation reveals no abnormality.

6. Important data like records of ejection etc should be maintained at IAM for a longer period of time to enable a database to be built up.

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A PRELIMINARY STUDY TO FIND OUT LIKELY AIRCREW PROBLEMS IN USE OF NVGs IN HELICOPTER AIRCREW

Surg Cdr S Patnaik*, Gp Capt G Gomez**

ABSTRACT
Thirty-six male pilots with a mean age of 32.94 ± 4.03 yrs, total flying hours 2539.33 ± 1221.44, on type 1350.30 ± 925.41 hrs and 22.66 ± 29.23 hrs of flying experience with NVGs took part in the study.

This survey shows, that night flying with NVGs has various effects and implies a series of problems and difficulties, whose solution has been only partially successful as yet. Some of the problems as brought out by the crew such as excessive head support weight, restricted FOV, inadequate eye relief, monochromatic imagery, inaccurate perception of depth, poor image quality because of bright lights as well as poor illumination, compromised resolution etc. are inherent to present generation NVGs.

Other problems faced by aircrew in this survey, such as donning & doffing of NVGs assembly, difficulty in adjustment of knobs & focusing procedure, improper sizing of helmet, eye strain etc. are mainly related to procedural errors. Any reduction in goggle or visual performance which goes undetected can have a serious implication on flight safety and operational capability. Most of the aircrew were of the opinion that NVGs operations are characterized as stressful with high task loading. Therefore a need arises to formulate SOPs on flight duty time limitations and night crew shift policies.

Even if future NVGs gives us 20/20 resolution, the image color, contrast and texture are not apt to be the same as that experienced with normal day vision. With effective training and a thorough understanding of the limitations associated with NVGs operation, aircrew will be better off with them than without.

Key Words : NVGs, Aircrew

INTRODUCTION
Throughout the ages, man’s capability to carry out continuous military operations has been in part limited by his ability to function effectively at night. The last three decades have seen a growing interest all over the world to enhance military operations round the clock. Two approaches are being pursued in an attempt to effectively extend aviation operation into the night. One approach concerns the development of techniques to train aviators to fly with the unaided eye while the other approach concerns the utilization of devices, which enhance night vision. Night Vision Goggles (NVGs) have revolutionized night flying by permitting vastly expanded night operations. Diverse mission areas and aircrafts types are being committed to night operations, with an increasing reliance on the use of NVGs [1].

Though NVGs has been considered as a great boon for night time operations, it has its own inherent problems. NVGs have been criticized in the media in the recent past, especially after the increase in aircraft mishaps seen during Operation Desert Storm. Even with minimal uncertainty concerning whether or not any aircraft mishaps were due to NVGs, research is indicated to evaluate and identify possible etiological factors.

The research conducted in rotary wing aircraft at night in aviators using NVGs revealed that, these devices restrict Field of View, provide monochromatic imagery, and add weight to the head [2]. Pronounced loss of depth perception was also observed in a few helicopter pilots after prolonged use of NVGs [3]. The vertical vibration load transmitted to the human body in Helicopter flying caused substantial reductions of vision and rapid fatigue reducing mission time [4]. NVG

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operations have also been characterized as very stressful with high task loading for the crew [5].

Although NVGs have been used in aviation since early 1970's, researchers are just now beginning to understand the man-goggle interrelationship. In an effort to increase flight safety, it is imperative to learn as much as possible about the advantages and disadvantages of flying with NVG during crucial night operations.

A need was therefore felt to study the problems being encountered by Helicopter pilots in the use of NVGs for night operations.

MATERIAL AND METHODS

The project was carried out at the Institute of Aerospace Medicine, Bangalore and an Air Force Station, during the period from Jul 2002 to Dec 2002. Following this, a field visit was made to the Air Force Station, where regular night flying is carried out and where Night Vision Goggles (NVG) familiarization courses are conducted and pilots converted onto this device.

MATERIALS

NL-93 Super Gen 2++ Type I Class A Aviators Night Vision Imaging System

The NVGs used for this study was the NL-93 Super Gen 2++ Type I Class 'A' Aviators Night Vision Imaging System. It is manufactured by New Noga Light and Night Light Technologies, a well established Israeli Company of electro-optical experts that specialize in the development, manufacturing and marketing of night vision devices and services.

CGF Gallet 250 Flight Helmet

The requirement of the helmet was to provide a stable platform for the NVG to be mounted, apart from its other normal function. The CGF Gallet 250 type flight helmet is designed for helicopter pilots and flight personnel on helicopter.

METHODS

This project titled “A Preliminary Study to find out likely aircrew problems in use of NVG in Helicopter Aircrew” was conducted at AF STN, Hindon during the period of 14 Sep 02 to 29 Sep 02.

For formulation of questionnaire, the problem areas were discussed with the pilots, with a special emphasis on the areas suggested by the senior more experienced pilots. In addition, existing literature on the subject was taken into account.

The questionnaire was then distributed to the aircrew operating from this base and aircrew of visiting squadrons who had come for NVG conversion courses. The questionnaire was given to a total of 36 aircrew of which 19 were aircrew of the local squadrons and 17 were from visiting squadrons.

An interview was conducted of the respondents at the time of submission of the questionnaire with the objective of obtaining their experience/opinion/suggestions in respect to the various problems they faced and the preventive and protective measures, which were taken.

The questionnaire consisted of questions of the following type:

a. Direct questions were designed related to the problem. The answers to these questions were in yes & no form.

b. Questions were designed to assess the frequency of a problem. The answers to these questions were in the form of multiple choices.

c. Questions designed so as to invite the comments of the aircrew, their opinion, suggestions and experience with the aim of highlighting a problem if it existed.

The questionnaire was used to assess the following Aeromedical aspects of NVG:

a. Operational aspects of NVG use
b. The effects of NVG on the task complexity and performance of aircrew
c. Ease of operation with the equipment
d. Comfort factors
e. Fatigue factors
f. Eye strain
g. Neck strain
h. Disorientation potential
i. Circadian rhythm disturbance
j. To bring forth the problems of NVG flying
RESULTS

The data collection was done from 14 Sep 2002 to 29 Sep 2002 at AF STN, where regular NVG conversion courses for helicopter aircrew are carried out. Thirty-six male pilots with a mean age of 32.94 ± 4.03 yrs, total flying hours 2539.33 ± 1221.44, on type 1350.30 ± 925.41 hrs and 22.66 ± 29.23 hrs of flying experience with NVGs took part in the study.

A. Helmet-NVG ergonomics, and Work station compatibility:
   a. Nine pilots (25%) reported it to be slightly difficult in donning and doffing of NVGs assembly
   b. Six (17%) out of thirty six pilots, reported difficulty in the location & ease of operation of adjustment knobs of the NVGs assembly.
   c. Six (17%) out of thirty six pilots suggested that the focusing procedure be standardized.
   d. Nine pilots described, it had a tendency to foul with one or the other aircraft structures due to inadequate clearance from cockpit structures/instruments.
   e. Ten pilots (28%) of the total aircrew questioned, expressed some difficulty in visualizing overhead instruments
   f. Eleven (31%) of them expressed difficulty in map reading in view of incompatibility of cockpit lighting and NVG performance during the sortie

B. Operational Aspects of NVG Usage:
   a. All the 36 pilots (100%) were unanimous in their opinion that, vision was better in moonlight conditions.
   b. In poor illumination conditions such as overcast sky and when the moon was obscured by clouds, all the thirty six pilots (100%) were of the opinion that, NVG performance deteriorates.
   c. Aircrew opinion was unanimous (100%) that, cultural lighting effects adversely on the NVG performance. However seven pilots (19%) reported, that though cultural light effects adversely, it sometimes helps to pickup target in poorly lit terrain/dark condition.

C. Vision Aspects of NVG:
   a. Most of the aircrew (97%) reported that the field of vision through the NVGs was not satisfactory.
   b. Only five pilots (14%) out of thirty six aircrew reported inadequacy of eye relief for viewing instruments through eye relief of NVGs
   c. Nine pilots (25%) experienced problems with NVGs image, in the form of bright spots & scintillations
   d. Only one (3%) of them experienced visual distortion through the device
   e. Nineteen pilots (53%) reported that the monochromatic image of NVGs reduces color discrimination and gives a homogenous picture.

D. Fatigue Aspects of NVG:
   a. Majority of the aircrew interviewed i.e. thirty five pilots (97%) complained of slight to severe tiredness after NVG flying sorties.
   b. Twenty five pilots (69%) experienced symptoms, like neck strain and back pain during or after NVG flying.
   c. Twenty six pilots (72%) out of the total thirty six interviewed, experienced symptoms like eye
strain, headache during or after NVG flying.

d. Twenty two pilots (61%) felt stressed during NVG flying.

e. Seventeen pilots (47%) of total aircrew recommended that continuous flying with NVGs should not exceed 03 hrs.

RECOMMENDATIONS

1. Aircrew should be given adequate ground training on helmet fitment, equipment familiarization, focusing procedures of NVGs.

2. Aviation medicine specialist should also gain expertise on NVGs, so as to be a help to aircrew in the field on various aeromedical aspects of the device.

3. NVG eye lanes with provision for NVGs resolution charts to be set up in all NVG operational squadrons & flights.

4. NVG eye lanes to have a standardized light source to produce one moonlight i.e. 0.1 lux illumination of the charts.

5. Various sizes of helmets with adjustable pads to ensure snug fit to be provided.

6. Periodic examination of NVGs assembly by local Aviation Medical Specialist whenever necessary especially to assess quality of image.

7. Periodic examination of NVG monoculars by BRD to ensure no degradation in output of tubes.

8. The benefits of regular neck exercise to reduce the occurrence of neck strain on prolonged NVGs use may be emphasized amongst the pilots.

9. Continuous flying operations with NVGs may be limited to 2 hrs, and only in extreme circumstances to 3 hrs.

10. A work-rest schedule for NVGs operations needs to be formulated.

11. The present study can be considered as a pilot study. On the basis of the present study, a more in depth study may be undertaken.

REFERENCES


'DENTAL ILLUSIONS' - CLOSING DIASTEMAS TO CREATE SMILES!

Surg Lt [D] CM Zameer Ahmed

Key Words : Midline diastemas

INTRODUCTION

Midline Diastemas represents a significant challenge for dental personnel who are frequently called upon to provide a positive treatment plan for closure of such spacings in the maxillary arch (in most of the cases), and at times, even the mandibular teeth. Maxillary midline diastemas are a common socio-aesthetic as well as a functional problem a patient may face, and dentists must treat. Many innovative therapies have been used, varying from Restorative Procedures to Surgery (Frenectomies), Orthodontics, and even Prosthodontics. At times, these procedures have been performed by Dental Officers without full appreciation of the factors contributing to the diastemas.

The objective of this paper is to stress the need of educating and making the parents aware that this space is a common finding in children, and is part of normal dental development until about 12 years of age. Before the practitioner can determine the optimal treatment, he or she must consider the contributing factors. These include normal growth and development, tooth-size discrepancies, excessive incisor vertical overlap of different causes, mesiodistal and labiolingual incisor angulation, generalized spacing and pathological conditions. A carefully developed differential diagnosis allows the dentist to choose the most effective orthodontic and/or restorative treatment.

The aim of this paper is to establish a Differential Diagnosis that can lead to a treatment approach that most effectively addresses the patient's problem. By treating the cause of the diastema, rather than just the space, the dentist can enhance both the patient’s dental function, and also the appearance to a greater extent. To close or not to close a midline diastema is a very significant issue. Ultimately, such decisions are subjective. The role of the dentist is to help patients understand the various fundamental geometric laws of aesthetics, when the relative balance and harmony of the distributed space is properly proportioned and conforms to the laws of nature, either scenario is acceptable.

"One Goal - Multiple Approaches", as one may call it, similar cases of a diastema can be dealt with in multiple ways. Several cases of midline diastema closures with various techniques and different treatment plans subjective to each individual have been discussed. Thus, another focus of this paper will be on the total assessment of the severity of the existing dental condition (diastema), and arrive at a conclusive treatment plan which is most suitable in that individual case, to produce consistent-successful results in not only providing the patient the best of function, form and aesthetics but creating new Smiles! To save the life of an individual is a great act, but Adding Life to a Living, just by adding a new Smile is another great attempt!

CAUSES OF MIDLINE DIASTEMA

Midline Diastema refers to the anterior midline spacing between the two maxillary central incisors. It is one of the most frequently seen malocclusions. Spaces between children’s front teeth are a concern for many parents. This dental spacing can affect facial balance, aesthetics, speech, social behavior, and proper function. There are many causes of dental spacing (diastemas). The key to correcting a diastema lies in understanding these contributing factors.

Diastemas are a normal part of dental growth and development in children. The reason is that around
the age of 8, the unerupted lateral incisors begin to push against the roots of the already-erupted central incisors - which then causes a space to appear between the central incisors. It is only later, around the age of 12, that the upper eye teeth erupt into the mouth, and help the diastemas between the incisors close naturally.

TRANSIENT MALOCCLUSION
It is very often seen as an incipient malocclusion that is self-correcting. A midline spacing can occur as a part of the generalized spacing seen in the deciduous dentition. A midline spacing can occur during the mixed dentition period associated with the eruption of the permanent canines, i.e., 'The Ugly Duckling Stage'.

ABNORMAL FRENAL ATTACHMENT
The presence of a thick and fleshy labial frenum gives rise to a midline diastema. This kind of frenal attachment prevents the two central incisors from approximating each other due to the fibrous connective tissue interposed between them. Master X was diagnosed to have a high frenal attachment using a Blanch Test, and presence of a notch in the inter-dental alveolar bone as seen on a radiograph. The same was treated with frenectomy and a removable orthodontic appliance, about 24 months post-op, the case has been reviewed to be still satisfactory, and the same is discussed.

MIDLINE PATHOLOGY
The presence of an unerupted mesiodens and midline pathologies, such as cysts, odontomes, and tumors often cause spacing between the maxillary central incisors. Master Y reported with a mesiodens and an increased spacing between the central incisors, leading to a diastema, and blocking of the lateral incisors. The case was successfully treated with surgical extraction of the mesiodens [supernumerary tooth], followed with a series of orthodontic appliances to close the diastema and correction of the cross bite in relation to the right lateral incisor.

TOOTH MATERIAL-ARCH LENGTH DISCREPANCY
A disparity in which the arch length exceeds the tooth material can result in midline diastema. This includes, partial anodontia, microdontia, macrognathia and extractions with resultant drifting of adjacent teeth.

- Mr. A with multiple spacings in anterior region and severe drifting of remaining teeth which occurred due to a combination of extractions and impacted teeth in the upper jaw, was treated with a prosthodontic approach involving a fixed porcelain bridge of upper eight teeth from right 1st premolar to left 1st premolar.

- Master Z with a midline diastema due to non-eruption of left central incisor and multiple impacted supernumerary teeth as a hard tissue obstruction, was treated with surgical extraction of two impacted supernumerary teeth and surgical exposure of the left central incisor, and allowed to erupt normally.

- Mr. B with mild macrognathia, and resultant diastema due to drifting of the left central incisor, was successfully treated with an orthodontic appliance.

All with definite success!

RACIAL PREDISPOSITION
The Negroid race shows the greatest incidence of midline diastema. Such cases will have to be taken up on an individual basis, depending on subjective condition and may be treated accordingly.

IATROGENIC
Midline diastemas can occur when certain therapeutic procedures are undertaken. The appearance of a midline spacing is an important prognostic sign during rapid maxillary expansion.

POOR ANGULATION OF THE TEETH
One example is called excessive side-to-side angulation of the teeth (excessive distal crown angulation). In this situation, the result is a small space above the point where the central incisors contact - giving the illusion of a gap. Ms. M with microdontia and rotated lateral incisors causing spacing in all the upper anteriors was treated with Light cure composite build-ups.

HARMFUL ORAL HABITS
Lower lip biting can protrude the upper teeth.
Flaccid lips (poor muscle tone) can cause protrusion of teeth. Poor tongue posture - such as holding the tongue forward between the front teeth - can affect the position of the incisors. Ms. N was successfully treated with a habit breaking appliance for tongue thrusting with a diastema.

HORMONAL IMBALANCE

An endocrine gland imbalance, such as acromegaly, causes abnormally large jaws - but the teeth remain normal in size - causing spacing.

MANAGEMENT OF MIDLINE DIASTEMA

- REMOVAL OF THE CAUSE

This phase involves removal of the etiology. Habits should be eliminated using fixed or removable habit breakers. Erupted/unerupted supernumerary teeth should be extracted, frenectomy should be performed, and any midline pathology should be treated as indicated.

- ACTIVE TREATMENT

This phase can be carried out using removable or fixed orthodontic appliances.

Removable Appliances

- Finger springs

Fixed Appliances

- Split labial bow
- Hawley’s Appliance

Fixed Appliances

- Appliances with elastics or springs
- Closed coil springs
- M shaped springs with three helices

- RETENTION

Long term retention is recommended using suitable retainers, like Hawley’s retainer, and lingual bonded retainers.

CONCLUSION

Midline diastema is often quite easy to treat, but difficult to retain. The key to its successful management is the elimination of the etiologic factors involved. The total assessment of the severity of the existing dental condition (diastema), arriving at a conclusive treatment plan which is most suitable to that individual case, producing consistent successful results and not only providing the patient the best of function, form and aesthetics but also creating new Smiles! To save the life of an individual is a great act, but adding life to a living, just by adding a new Smile is another great attempt.
KLIPPEL-FEIL SYNDROME - A CAUSE OF CONGENITAL SKELETAL DEFORMITIES: A CASE REPORT

Surg Capt J D'Souza*, Surg Cdr Shashi G Gupta*, Dr Asutosh Upadhyay#, Dr Jayanta Das**

Key Words: Klippel-Feil Syndrome, Hemivertebrae, Congenital Dislocation of Hip, Brachycephaly

INTRODUCTION

In 1912, Maurice Klippel and Andre Feil independently provided the first descriptions of Klippel-Feil syndrome [1]. They described patients who had a short, webbed neck; decreased range of motion (ROM) in the cervical spine; and a low hairline. Although loosely applied to many types of congenital vertebral fusion anomalies, at present the designation of the Klippel-Feil syndrome indicates a congenital fusion of two or more cervical vertebrae. The classical triad is not apparent in more than fifty percent of patients. The clinical manifestation of the syndrome is present at birth, but sometimes the manifestation may be delayed up to as late as second or third decade due to relatively minor nature of the involvement. We report a case of Klippel-Feil syndrome of a 13 months old child presenting with classical vertebral fusion anomalies along with congenital dislocation of hip.

CASE REPORT

A 13 months old female child presented with inability to crawl at 12 months. Antenatally the mother had pregnancy induced hypertension with intrauterine growth retardation of the fetus. The baby was born at 34 weeks. Her developmental milestones were normal except for inability to crawl. X-ray pelvis showed congenital dislocation of hip. Other radiological work up showed brachycephaly (Fig. 1) along with segmentation anomaly (hemivertebrae) of CV6 to DV6, scoliosis of the thoracic spine, fusion of left 6th and 7th posterior ribs, hypoplastic 2nd ribs and 13 pairs of ribs (Fig. 2). Left femoral head was displaced upwards and outwards with retarded ossification of left femoral epiphysis. The acetabulum was shallow and Shenton’s line was broken (Fig. 3). In view of the above mentioned features the case was diagnosed as Klippel-Feil Syndrome.

DISCUSSION

The reported frequency of Klippel-Feil Syndrome varies considerably from extremely rare to an incidence of 0.5 percent of spinal roentgenograms. Feil classified the syndrome into 3 categories: Type I - a massive fusion of the cervical spine, Type II - the fusion of 1 or 2 vertebrae, Type III - the presence of thoracic and lumbar spine anomalies in association with type I or type II. In a new classification system, type I patients have a single-level fusion; type II patients have multiple, noncontiguous fused segments; and type III patients have multiple, contiguous fused segments [2].

This anomaly can be associated with a variety of other clinical syndromes, including fetal alcohol syndrome, Goldenhar syndrome, and anomalies of the extremities [3]. Genetic and inherited etiology has been postulated [4,5]. Others have considered Klippel-Feil syndrome to be some type of global fetal insult which could explain the other associated conditions. In this case the mother had pregnancy induced hypertension in the antenatal period. Clinical presentation is varied because of the different associated syndromes and anomalies that can occur in patients with the syndrome.

Klippel-Feil syndrome is often detected as an incidental finding. Patients with upper cervical spine involvement tend to present at an earlier age than those in whom the involvement is lower in the cervical spine. Most patients present with a short neck and a decreased cervical ROM, with a low hairline occurring in 40-50% of patients, which is
Fig. 1 a & b: X-ray skull AP & LAT shows brachycephaly.

Fig. 2: X-ray chest AP view shows multiple hemivertebrae, rib fusion and scoliosis seen in our patient. Decreased range of movement is the most frequent clinical finding. Rotational loss is usually more pronounced than is the loss of flexion and extension. In our study the cervical vertebral anomaly was found extending from CV6 to DV6 level and the child has a limitation of extension of the neck. Other patients present with torticollis or facial asymmetry. Neurologic problems may develop in 20%.

Fig. 3: X-ray pelvis AP shows dislocation left hip with shallow acetabulum.

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of patients resulting from hypermobility at one level. Occipitocervical abnormalities are the most common cause of neurologic symptoms [6]. In some patients with Klippel-Feil Syndrome, the scoliosis is congenital due to the involvement of the thoracic or lumbar spine. Our patient has scoliosis of thoracic spine. In addition to fusion anomalies in the cervical spine, cervical spinal canal stenosis can occur. While uncommon, this condition can increase the risk of neurological involvement [7].

Anomalies of the craniocervical junction can cause instability at lower segments. Traumatic tetraplegia has been reported following minor trauma. A Sprengel anomaly occurs in 20-30% of patients. The ROM of the shoulders must be checked, and the patient should be examined for an omovertebral bone a osteocartilaginous connection that tethers the scapula to the spine [3]. The omovertebral bone ossifies with age, further limiting the ROM. A computed tomography (CT) scan best demonstrates the presence of an omovertebral bone. However, this feature can also be detected through palpation or radiographs.

Hensinger et al [7] showed that renal anomalies are common in individuals with Klippel-Feil Syndrome. Minor renal anomalies including dual collecting system, ectopia, and bilateral tubular ectasia were reported in 6 out of 41 cases. Major renal anomalies comprising hydronephrosis, absence of a kidney and a horseshoe kidney were seen in 10 patients. Dubey & Ghosh et al studied and concluded that hearing was impaired in 15 of 41 patients tested. Early audiometric and otologic evaluation is indicated in all children when the diagnosis of Klippel-Feil Syndrome is established [8]. Other less common anomalies associated with Klippel-Feil syndrome include kyphosis, spinal stenosis, basilar impression, cranial asymmetry, deformed dens, cleft supernumerary lobes of the lung, patent foramen ovale and enteric cyst [9]. Congenital dislocation of hip has not been associated with the Klippel-Feil Syndrome. However, in the present case the left hip shows congenital dislocation of hip and brachycephaly which was confirmed radiologically.

Patients with Klippel-Feil Syndrome present at different ages with varying clinical manifestations.

Indications for workup vary individually. For the orthopedic surgeon, the most frequent indications for surgery depend on the amount of deformity, its location, and its progression with time. Other indications include instability of the cervical spine and/or neurologic problems. These indications can occur with craniocervical junction anomalies and when two fused segments are separated by a normal segment. Some patients present early in life with complex cervical and cervicothoracic deformity that is progressive and disfiguring. Some of these patients require cervical spine fusions to prevent progression. Other patients may develop compensatory or associated congenital scoliosis, which also can be progressive over time and requires fusion to prevent progressive deformity.

Plain radiography is the basis for the diagnosis of Klippel-Feil Syndrome. Initial studies should include radiographs of the cervical spine. If anomalies are found, careful assessment of the craniocervical junction is necessary to detect anomalies at this level. Flexion-extension radiographs are indicated if instability is suspected at the craniocervical junction or if two fused segments are separated by an open segment. Plain radiographs of the entire spine must be obtained to detect other spinal anomalies. Examination of the chest is required to rule out involvement of the heart. Examination of the chest wall for possible rib anomalies, such as multiple rib fusions, is necessary. Rib fusions can be revealed with plain radiography. Ultra sound scanning is performed, to visualize the kidneys. Intravenous pyelography should be performed if further definition of a kidney abnormality is required.

CT scanning often is more useful at the spinal level: for patients being evaluated for surgery, CT scanning with 3-dimensional reconstruction can be valuable in assessing anatomy. A unilateral unsegmented bar or cervical stenosis may be revealed on a CT scan, helping the physician to plan the surgical procedure. Magnetic resonance imaging (MRI) is indicated in patients with neurologic deficit. Flexion-extension MRI may reveal cord compression and is useful in evaluating spinal stenosis. In patients with neurologic deficits, an MRI of the entire spine should be obtained to search for central nervous system anomalies such as a
syringomyelia. To conclude we report a case of Klippel-Feil Syndrome which presented with congenital dislocation of hip and delayed milestones.

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SCORPION STING ENVENOMATION – AN EXPERIENCE IN INHS KASTURI, LONAVLA

Surg Cdr S Dutta

Key Words: Scorpion sting manager, Scorpion Envenomination, Prazosin, Signs and Symptoms

INTRODUCTION

Death due to severe scorpion envenomation is common in the developing tropical and subtropical countries in Africa, Latin America, China, India and middle east [1]. There are around 650 species of scorpions present all over world. India has 99 species of which 45 species belong to Buthidae family. Deaths are more common in infants and children. Mesobuthus tamulus (Indian red scorpion) is the most common poisonous species found in India causing 30% to 40% fatality [2]. The most common cause of death is pulmonary edema [3]. Severe envenomation causes autonomic storm with profuse release of catecholamines causing symptoms and signs of vomiting, severe sweating, excruciating pain at sting site, increased salivation, tingling and numbness, priapism, tachycardia, tachypnea, transient hypertension, hypotension and pulmonary edema [4]. Myocardial dysfunction, hyperglycemia, increased free fatty acid, increased RBC osmotic fragility, acute pancreatitis, hepatic necrosis, DIC, ARDS and cardiogenic pulmonary edema also have been documented [5].

Anti scorpion venom serum (AScVS) is a lyophilized monovalent enzyme refined immunoglobulin specific for Indian red scorpion is being manufactured by Haffkine Biopharma, Mumbai. It effectively neutralizes circulating and body fluid scorpion venom [4]. The previous mortality rate from poisonous bite has been reduced from 25% — 30% to 2-5% with the use of Prazosin. More and more primary health care hospitals are using Prazosin as first line therapy [2]. Some centers also had favourable response with insulin-glucose infusion.

MATERIAL AND METHODS

Fourteen patients of scorpion sting treated were studied prospectively. Confirmation of species was possible only in one case. Diagnosis was made by detailed history and clinical presentation. Local & systemic envenomation symptoms were carefully noted. Blood pressure, temperature, pulse and respiratory rate were monitored hourly. ECG was recorded 4 hourly. Auscultation of lungs was done every two hours to detect pulmonary edema. Local injection Lignocaine, injection antihistamine, IV glucose, IV hydrocortisone and oxygen had been used in 6 cases. Oral prazosin was used in only one case.

RESULTS

Total 14 cases were studied. 10 cases had reported within 4 hours and the rest reported within 8 hours of sting. Hypertension and tachycardia were noted in four cases. Local symptom were present in all cases. AScVS was not used in any of the above cases. Eight cases who had severe tachycardia reverted to normal after four hours. One of the patient had received oral prazosin. None of our patients had hypotension. One patient had fine crepitation in lung bases which responded to diuretics. Two patients had severe rash, but responded to hydrocortisone and antihistamine.

DISCUSSION

Scorpion sting causes massive release of catecholamines and suppresses insulin secretion. Lipolysis and FFA level increases, which are arrhythmogenic. Sympathetic and parasympathetic stimulation causes tachycardia, transient...
hypertension, myocardial dysfunction and pulmonary edema.

Earlier the mainstay of treatment was symptomatic and was consisting of Inj. Atropine, frusemide and steroids. Presently with better understanding of pathophysiology newer therapies with insulin-glucose infusion, prazosin and AScVS are increasingly being used in peripheral health setup.

REFERENCES

A CHALLENGING CASE OF JAUNDICE IN PREGNANCY

Surg Cdr S Srinivas, Sug Cdr JP Lazarus, Surg Capt Mohan W Malse

Key Words: Jaundice, Pregnancy

INTRODUCTION

The liver diseases which occur in third trimester and related to pregnancy such as HELLP Syndrome (Haemolysis, elevation of liver enzymes and low platelet count), pre-eclampsia or eclampsia with hepatic involvement and AFLP (Acute fatty liver of pregnancy) may present in a similar fashion and progress to liver dysfunction. HELLP Syndrome is more often a variant of severe pre-eclampsia. The association with primigravida, multiple gestation and amelioration with delivery in pre-eclampsia, HELLP and AFLP makes it essential for the clinician to differentiate these syndromes from liver disorders unrelated and coincidental to pregnancy which do not improve after delivery [1].

Against this background an interesting case of jaundice in pregnancy is presented with the aim of re-emphasising the fact that the liver disease is a rare complication of pregnancy, but when it occurs, it may do so in a dramatic and tragic fashion both for the mother and the infant. Diseases like acute fatty liver of pregnancy (AFLP) may begin innocuously with mild symptoms and liver enzyme abnormalities but, if left untreated, can progress to jaundice, liver failure and death” [2].

CASE REPORT

A 24-year-old primigravida reported on 05 Jul 06 at 31 weeks 05 days period of gestation, with hitherto uneventful and uncomplicated antenatal period, complaining of loss of appetite, occasional nausea / vomiting, mild fever and high coloured urine of ten days duration. There was no history of pruritus, clay coloured stools, epigastric / hypochondriac pain, headache, blurring of vision, or oliguria. There was no history of any drug intake such as salicylates, tetracycline or sodium valproate, and blood transfusion. Contact with a case of jaundice or pre existing chronic liver disorder.

On examination, icterus was the only positive finding. She was conscious, fully oriented with no pallor, oedema, tremors, engorged neck veins or lymph node enlargement. Pulse was 80/min regular and BP: 120/80 mm Hg; no abnormality could be detected in respiratory, cardiovascular or central nervous systems. Per abdomen, there was no epigastric or hypochondriac tenderness. Uterus was of 32 weeks size, relaxed, with no malpresentation / malposition. Fetal heart sounds were normal. Estimated fetal weight was 1.5 to 1.8 kg.

Patient was advised admission and reported for the same at 1800 hrs on 05 July 06. Urgent investigation revealed no evidence of proteinuria, haemolysis, thrombocytopenia or derangement of coagulation function; polymorphonuclear leucocytosis (TLC: 19000/cm3, poly: 80%) elevated serum bilirubin (4.9 mg%) and Transaminases (SGOT: 1500IU, SGPT: 1300IU) with normal alkaline phosphatase. Haemoglobin 11.8 gm%; HbsAg, HCV, HIV status was negative. Blood urea and Serum creatinine levels were within normal limits (WNL).

Ultrasoundography revealed normal texture and span of liver, bile ducts and gall bladder. There was no hepatosplenomegaly, hepatic vein thrombosis, dilated hepatic sinusoids or ascites. Antenatal USC scan was WNL.

She was diagnosed as a case of acute viral hepatitis and given bed rest. Oral tocolysis, steroids and Inj vit-K were administered. The basic underlying principle of management was to await acute phase of viral hepatitis to subside and to enhance foetal lung maturity.

On Day-2 of admission (06 Jul 06) she was having features suggestive of threatened pre term labour. The dose of oral tocolysis was increased (SALbutamol 4mg tid). She responded and remained asymptomatic.

At 15:15 hrs on 05 Jul 06, she developed sudden onset tachypnoea (RR 30/min), tachycardia (Pulse 130/minute) and BP: 160/80 mm Hg with no abnormal clinical findings of respiratory or cardiovascular system. She was shifted to ICU, nursed in a propped up position, oxygen was
administered by face-mask @ 3lit/min and IV line was maintained. She responded to this supportive therapy; tachypnoea, tachycardia settled and blood pressure returned back to normal.

A repeat ultrasound revealed a minimal left sided pleural effusion which was re-confirmed by X-ray chest. The repeat laboratory investigation revealed leukemoid reaction (TLC 48000/min) with polymorphonuclear leucocytosis. All other investigations were essentially same as before. LDH levels: WNL. Blood for MP and ICT: Negative. Leptospiral antibodies: Negative.

A review diagnosis of hepatocellular jaundice of possible viral aetiology with secondary bacterial infection was made. She was administered Parenteral antibiotics and chloroquine was exhibited.

The obstetric plan of management was watchful expectancy with hourly monitoring of prothombin time keeping the Fresh Frozen Plasma [FFP] stand-by.

On Day 3 (07 Jul06), she was in established preterm labour. Since 24 hours had elapsed from the time of administration of steroids, oral tocolysis was discontinued. There was no evidence to suggest coagulopathy, renal or CNS involvement.

At 1015 hrs on Day 3 with the earliest of derangement of coagulation dysfunction in the form of prolonged PT (Test: 22 sec, control: 14 sec), labour was augmented with Misoprostol 50 mcg (intra vaginally). FDP levels were also elevated. FFPs were transfused (5 units). The labour was uneventful and she delivered a preterm male baby at 1725 hrs on 07 Jul 06 weighing 1.8 Kg with good Apgar score - 1’-8/10 and 5’-10/10. There was no post-partum hemorrhage.

The mother was stable. On first post-natal day, repeat investigations showed a rapid fall in transaminases and serum bilirubin levels with normal USG findings and no evidence of pleural effusion. The prothrombin time was normalised after administration of FFP. All laboratory values normalized completely within four days of delivery. The lady was shifted from ICU to paediatric ward on 10 July, 06 to look after the baby. Finally both the mother and baby were discharged from the hospital on 26 July, 06.

RESULTS

The differential diagnosis of this case can be discussed under the following three broad categories.

a. Liver disorder coincidental to pregnancy.

b. Liver disorder related to pregnancy.

c. Chronic / pre-existing liver disorder in which pregnancy has supervened.

The last possibility is ruled out, as there is no evidence to suggest any possibility of pre-existing liver disease.

A. LIVER DISORDER COINCIDENTAL TO PREGNANCY:

Acute viral hepatitis is the only condition that remains to be differentiated in this particular case.

The points in favour of acute viral hepatitis are:

a. Commonest disease: 95% cases of jaundice are because of acute viral hepatitis. Pregnancy is no exception.

b. Elevation of serum transaminase to levels beyond 1000 IU is more commonly seen in acute viral hepatitis.

The points against the diagnosis of viral hepatitis are:

a. Coagulopathy in the absence of liver failure is unknown in viral hepatitis except viral hepatitis due to herpes simplex virus [3].

b. Rapid normalization of serum bilirubin within days during recovery phase is unlikely to occur in acute viral hepatitis. This is because of presence of delta bilirubin.

c. Hepatitis B, C and D are ruled out.

d. Hepatitis E would normally have had a fulminant course despite the termination of pregnancy.

B. LIVER DISORDERS RELATED TO PREGNANCY

The following conditions need to be differentiated.

a) HELLP Syndrome:

Points against this syndrome are

i. Absence of haemolysis or low platelet counts

ii. Normal LDH levels [4]

iii. No features of PIH

b) Cholestasis of pregnancy:

Points against this condition are

i. Absence of pruritus.

ii. Normal alkaline phosphatase levels.

iii. Coagulopathy [5].
c) Acute fatty liver of pregnancy (AFLP)

It is a condition characterized by microvesicular deposition of fat within the hepatocytes (with portal sparing). Hepatocytes are swollen initially which eventually atrophy and liver is ultimately shrunken in size as the disease progresses. Macroscopically the liver looks like a soft yellow and greasy organ.

The incidence is 1 in 13,000.

The exact aetiology is not known. Both congenital and acquired mitochondrial abnormalities of fatty acid metabolism are reported.

Inherited deficiency of long-chain 3-hydroxyacyl coenzyme A dehydrogenase (LCHAD) is also a possible aetiological factor.

The disease occurs usually in the third trimester of pregnancy. Primigravidae with male foetus or multiple gestations are more prone to develop this condition.

The disease usually starts with mild symptoms such as nausea/vomiting, anorexia, epigastric/hypochondriac pain and jaundice develops within a week.

The laboratory abnormalities include haemoconcentration, leucocytosis, elevated serum bilirubin (<10 mg%), moderately elevated transaminases (<1000 IU), and prolongation of prothrombin time, decreased fibrinogen levels and elevated levels of fibrin degradation products.

USG/MRI/CT SCAN have been suggested to establish the diagnosis. But, these tests are of insufficient sensitivity and specificity.

Liver biopsy can be confirmatory but performing liver biopsy in a pregnant patient especially in a setting of coagulopathy can be risky.

If untreated, following complications can occur

- 50% - profound hypoglycaemia
- 55% - severe coagulopathy
- 60% - hepatic coma
- 50% - renal failure

In about 50% cases there is associated pre-eclampsia/eclampsia. The condition worsens by the time the diagnosis is made. The disease is either self-limiting or delivery arrests the progress and seldom recurs in subsequent pregnancies. The management therefore includes termination of pregnancy. Vaginal delivery is preferred. However, should there be any undue delay in the progress, Cesarean section may have to be performed before frank.

Coagulopathy manifests

The patient may require intensive medical support depending upon the severity of the condition. Transfusions with FFP, platelet concentrates packed cells or whole blood transfusions may be necessary [6].

Retrospectively; leucocytosis, elevated serum bilirubin, and transaminases along with onset of coagulopathy in a primigravida with a male foetus in third trimester of pregnancy in the absence of PIH, haemolysis or thrombocytopenia and rapid normalization of the laboratory abnormalities after delivery, it appears that this particular case is one of acute fatty liver of pregnancy, the florid manifestations of which were pre-empted by prompt termination of pregnancy at earliest evidence of onset of coagulopathy.

REFERENCES

INTEGRATED ORTHODONTIC AND RESTORATIVE MANAGEMENT OF LOST CENTRAL INCISOR

Surg Cdr (D) SS Chopra

Key Words: Avulsion, Pontic, Bonded retainer

INTRODUCTION

When a patient presents to an orthodontist with a missing anterior tooth secondary to trauma, the most common solution is to attach a pontic to a removable appliance such as a Hawley-type retainer. Such a technique is impossible, however, in situations where teeth adjacent to the pontic are being shifted orthodontically to align midlines or control spacing or during incisor retraction. A more useful method during active orthodontic tooth movement would be to attach the pontic directly to the archwire. Pontic refers to a replacement, artificial tooth or teeth that are mounted on a fixed or removable dental appliance.

CASE REPORT

A 13-year-old girl reported with complaints of missing front tooth and protruding upper teeth (Fig. 1). She had lost her upper left central incisor at age 7 years due to traumatic avulsion on the playfield.

Clinical examination and study models revealed a Class III molar and Class I cuspid relation bilaterally. The maxillary dental midline was shifted 3mm to the left; the maxillary right lateral incisor had shifted to occupy the space of the central incisor (Fig. 2). The mandibular second premolars were impacted. The curve of Spee was accentuated at 3mm. Lateral cephalogram indicated a Class I skeletal pattern with protruding upper and lower anterior teeth.

The objectives of treatment were to level and align the teeth, retract upper and lower anterior teeth, create adequate space for maxillary left central incisor, eruption of lower second premolars, correction of upper dental midline and attain a Class I molar relation. The patient was treated with 0.018 inch Roth pre-adjusted appliance therapy after therapeutic extraction of all four first premolars. On attaining adequate space for the missing central incisor, an acrylic tooth, customized with composite resin was matched with the adjacent central incisor and attached to the archwire.

Fig. 1: Pre-treatment extra oral view showing marked maxillary dental midline shift.

Fig. 2: Pre-treatment intra oral frontal view showing missing left central incisor as cause of drifting and midline shift.

Fig. 1 to Fig. 2: Figures showing the pre-treatment views of the patient before the orthodontic treatment.

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with a pre-adjusted bracket turned 180° for better esthetics (Fig. 3). 

The appliance was debonded/debanded. A lower, canine-to-canine bonded flexible spiral wire retainer was given. A pontic was attached to the upper bonded flexible spiral wire retainer (Fig. 4). The case was followed up for a period of eight months into retention. There was no incidence of bonding failure of the flexible wires retainers. The patient was extremely satisfied with the temporary replacement of the missing central incisor and refused to undertake any further treatment in the form of implant retained prosthesis or a conventional bridge.

**DISCUSSION**

30% of children are exposed to accidental injuries to the teeth by the age of 15 years [1]. 0.5%-16% of all accidental injury to the teeth involve avulsion or total displacement of the tooth out of its socket. Upper anterior permanent central incisors are the teeth most frequently avulsed [2].

Avulsion injury is most frequently seen in children between the ages of 7-9 years. The periodontal ligament surrounding the erupting teeth is loosely structured and the alveolus is elastic at these ages. These factors offer only a minimal resistance to an extrusive force.

The common causes of injury are falls, collisions and accidents during common childhood activities such as contact sports, cycling, swimming, fights, etc. Premature loss of permanent teeth leads to drifting of the adjacent teeth leading to malocclusion and an unaesthetic appearance due to dental shift of midline. Orthodontic therapy in association with prosthodontic rehabilitation is usually required for such cases.

**Retention is usually necessary following**

Fig. 3: End treatment intra oral frontal view showing the riding pontic.

Fig. 4: Post treatment extra oral view.
due to the use of the 'riding pontic'. Regular follow up and oral hygiene instruction reinforcements ensured minimal peri pontic plaque accumulation and a healthy gingiva. This technique is economically more acceptable, non-irritating and non-iatrogenic. The technique of incorporating a pontic in the bonded flexible spiral retainer can be considered as a long-lasting reversible provisional treatment.

REFERENCES
30 year old serving soldier with history of RTA and compound fracture femur. Patient had a persisting ulcerative necrotizing lesion of the soft tissue of thigh not responding to antibiotic and repeated wound debridement. Patient had to undergo AK amputation.

Amputation specimen showed covering of black necrotic slough with edema and blackish discoloration of subcutaneous tissue and muscles. No bony involvement was seen.

H & E Sections of the tissue as shown in the photograph. Identify the organism.
Answer: Mucor species

Description

Section show the presence of aseptate, asymmetric right angle branching fungal hyphae with intense subacute inflammatory infiltrate of polymorphs, lymphocytes and macrophages invading the subcutaneous tissue and muscles. Multiple foci of invasion of blood vessel wall with fibrinoid necrosis and thrombosis seen.

REFERENCES


A 70 day old child presented with a history of recurrent distension of abdomen, regurgitation and constipation since birth. The child also had history of poor feeding and feed intolerance. However, there was no history of any vomiting. Barium enema performed is shown in Fig. 1.

What is your diagnosis?
Answer: Mucor species

Description

Section show the presence of aseptate, asymmetric right angle branching fungal hyphae with intense subacute inflammatory infiltrate of polymorphs, lymphocytes and macrophages invading the subcutaneous tissue and muscles. Multiple foci of invasion of blood vessel wall with fibrinoid necrosis and thrombosis seen.

REFERENCES


seen. A large 10-15 cm, segment of persistent corrugated or convoluted rectum (due to abnormal uncoordinated contractions of the aganglionic portion of the colon) can be seen in 31% of cases [3].

Hirschsprung disease should be differentiated from Meconium plug (small left colon) syndrome which is secondary to immaturity rather than absence of ganglionic cells and often resolves spontaneously after contrast enema. Differentiation is made on rectal biopsy.

Treatment

Treatment of the condition is predominantly surgical. The various surgical resection procedures of affected segment of colon are Swenson pull through procedure, Duhamel operation and Soave procedure.

In Swenson procedure, the entire aganglionic segment is resected down to the rectum, and an oblique anastomosis is performed between the normal colon and the low rectum. The Duhamel procedure uses retrorectal approach and a significant portion of aganglionic rectum is retained. The aganglionic bowel is resected down to the rectum, and the rectum is over sewn. The proximal bowel is then brought through the retrorectal space (between the rectum and sacrum), and an end-to-side anastomosis is performed on the remaining rectum. In Soave (endorectal) procedure, the mucosa and submucosa of the rectum are removed and the ganglionic bowel is pulled through the aganglionic muscular cuff of the rectum. The original operation did not include a formal anastomosis, relying on scar tissue formation between the pull-through segment and the surrounding aganglionic bowel. The procedure has since been modified by Boley to include a primary anastomosis at the anus.

REFERENCES

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9. **Rejected Articles**: Articles once rejected will not be entertained for reconsideration. Two copies of the article along with photographs/figures/tables will be sent back to the author. One copy will be kept with MJAFI office for record.

10. **Manuscript for various types of articles**:

   (a) **Original Articles**: These are scientific communications from research workers engaged in the field of medicine. The articles pertaining to the field of military medicine and those of general interest are published on priority.

       Format - Abstract (See 7 (b) above). Introduction should describe the importance and aim of the study. Methods should describe the research plan, the subject and the method used in that order explaining in detail the modus operandi for confirmation of disease and control of subjectivity. Data in tables or figures should not be duplicated in text; however, important observations may be highlighted.

       Inferences should be based on relevant statistical analysis. Discussion should include the limitations of the research plan, material and methods, considering both the purpose and the outcome of the study. Discrepancies from previous studies should be explained.

   (b) **Case Reports**: A case report should communicate a message that transcends the individual patient and should describe rare interesting facets of a particular disease or an unusual entity. The introductory paragraph should give general background and the specific interest of the case. In a series only one case should be described in detail and only salient features in other cases should be mentioned. Discussion should highlight unusual features of the case report and should not be a review of literature.

   (c) **Review Article and Update Article**: These are invited from experts in the field. Authors are requested to consult the Editor-in-Chief for prior approval of the topic.
(d) Methods in Medicine (including Drug and Equipment update): These are brief descriptions of a specific technique or procedure, modification of a technique, or equipment of interest and should be supported by relevant diagrams and results of clinical and/or field trials.

(e) ‘Letter to the Editor’ and replies: These should be brief offering objective and constructive criticism of published articles. These should be written on a non-letter head paper without greeting, salutation or signature. The name and affiliation should appear at the end of the letter. A short and pertinent title should be given. These should be accompanied by a covering letter.

11. SIZE OF TEXT:

The Table below provides guidelines regarding maximum permissible size of text as well as number of tables, figures and references.

12. Articles not adhering to the above specifications are likely to be rejected.

13. BIBLIOGRAPHY


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