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Surgeons General of the Past

(The fourth in a series of brief biographies)

Phineas J. Horwitz, son of a doctor who taught at the University of Pennsylvania Medical School, was born in Baltimore, Maryland on 3 March 1822. He was graduated from the University of Maryland in 1845 (and probably also from its Medical School) being appointed an Assistant Surgeon in the United States Navy on 8 November 1847. Doctor Horwitz's duties included able service at a temporary hospital in Tobasco, Mexico during the Mexican War and in various ships on what were then known as the Brazilian and African stations. For his Mexican service he received a commendation from Commodore M. C. Perry. In 1859 as Assistant to the Chief of the Bureau of Medicine and Surgery he designed and put into effect a system for tabulating casualties, and indexing the books of reference, reports of survey and certificates of disability and disease, so that records could be easily found in their proper places. He also personally examined and adjusted all of the Navy's pension cases that accrued during the Civil War, and wrote all the Bureau's official letters without the help of a single other writer or clerk.

Upon the death of Doctor William Whalen in 1865 he was appointed the fourth Chief of the Bureau. During his relatively quiet postwar term of office the USS IDAHO was used for nearly 2 years at Nagasaki, Japan as a hospital ship for the entire Asiatic Squadron. This was the first ship after the RED ROVER to be used solely and regularly for medical purposes in the American Navy. After leaving the Bureau 1 July 1869 Doctor Horwitz directed the operations of the U.S. Naval Hospital at Philadelphia, served at the Naval Asylum in that city, and acted as President of the Medical Examining Board. His rank was raised to that of Medical Director (comparable to Captain) in 1873. He was retired from the Navy in 1884 and died on 28 September 1904.

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CURRENT CONCEPTS IN THE TREATMENT OF WAR WOUNDS

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Much has been written about the surgery of war wounds, and after each major conflict many excellent articles appear telling of the lessons learned—lessons which many times were learned the hard way. Yet, by and large, the lessons have been ignored. Between wars—surgeons return to treating civilian injuries which are vastly different from the wounds of war—and so the lessons of war surgery, i.e., aggressive debridement, delayed closure, etc., are forgotten only to be painfully relearned or "rediscovered" after repeated failures.

The following is a report of 13-months' experience in the management of the casualties from the Vietnamese war. During this period over 900 missile wounds were treated. The patients in this series were exclusively combat Marines wounded in Viet Nam. Most of the casualties had received initial treatment at the Division Field Hospital and were then evacuated by air. Generally, they were received at this hospital within five to ten days after wounding.

Most of the wounds in this group were extremity wounds without fractures. Most were caused by fragmentation antipersonnel weapons such as grenades, mines, booby traps and mortars. All of these weapons impart initial velocities to variable-sized fragments as high as 6,000 feet per second. By comparison, the muzzle velocity of a 30 calibre rifle of World War I vintage was about 2,000 feet per second. When the velocity of a missile increases beyond 2,500 feet per second, its explosive effect becomes disproportionately greater and the relation of missile velocity to injury is no longer a linear one.

No attempt will be made here to discuss in detail wound ballistics or the effect of the ever increasing muzzle velocities on the production of the devastating wounds seen in today's combat injuries. The temporary cavitation and secondary missile effect caused by high velocity missiles have been thoroughly studied and many excellent works of this and other aspects of wound ballistics have appeared in the literature.

The missile wounds treated in this series were caused by several main types of weapons.

1. Fragmentation-antipersonnel weapons.

An infinite variety of wounds were produced by these weapons ranging from the small single isolated wound to multiple large wounds involving extensive areas of the body.

2. High speed rifles (M–14 class).

A substantial number of wounds were caused by this type of weapon. They were invariably perforating type wounds.

3. Machine guns (30 and 50 calibre).

Wounds from these weapons were less common, but by no means rare. Because of the weight and speed of the projectiles from these weapons, extensive tissue destruction was the rule.

4. Low velocity rifles (carbine class).

The most innocuous of all were the wounds caused by sniper rounds fired from weapons of this class. Because of the relatively low muzzle velocity of these weapons, tissue damage was generally localized to the missile tract.

Patients arrived at this hospital through the evacuation system several days after having been wounded. The majority had received initial treatment at the Division Field Hospital. Early in the series, it was noted that some patients had received only very conservative debridement, i.e., only the skin and subcutaneous wound had been enlarged and then a rubber dam drain had been inserted into the tract. As time passed and the experience with these wounds increased, more and more patients arrived with extensive debridement. However, the patient with perforating and deep penetrating wounds continued to be received with through and through rubber dam drains with little or no debridement.

In their subsequent management at this hospital, patients with fairly small wounds, e.g., carbine wounds or multiple but small fragment wounds,

were treated under local anesthesia. Generally, the wounds were freshened and closed without tension with fine silk sutures. If there was any tension the wound was resurfaced with a split thickness skin graft. None of the wounds treated under local anesthesia were the least bit complicated and their closure required little surgical skill. Yet, it was precisely in this group of patients that the worst results were obtained. Many of these "simple" wounds promptly became red and painful, and after the removal of a few sutures the wounds opened up widely and discharged purulent material. The large complicated wounds, on the other hand, which usually had been extensively debrided in the field were closed by various methods, depending on the indication, e.g., skin graft, local flaps, or even flaps from a distance, and these invariably went on to a successful result without problems.

Considerable difficulty was experienced in the beginning with the perforating wounds caused by high speed rifles or automatic weapons. Most of these patients, as mentioned above, were received with rubber dam drains placed through and through the missile tract with little or no initial debridement. Subsequent closure of these wounds without further exploration and debridement always was followed by wound infection and the wound had to be reopened. This led to "rediscovery" of the most important principle of war wound treatment: Adequate debridement of the entire wound and this necessitates exploration of the entire wound. The techniques of exploration vary considerably from one wound to the next. Many of the wounds can be adequately explored in the classic manner simply by excising the damaged skin, then retracting its edges. Each subsequent layer is enlarged by excision as necessary. In this manner, all regions of the injury are explored. In some cases, however, this is not feasible, such as in a tangentially perforating wound with the wounds of entrance and exit separated by a variable amount of normal skin. In these cases it is often easier to incise the normal skin and subcutaneous tissue. The normal muscles are then split or even transected to lay the missile path wide open. Only in this way can every vestige of damaged tissue (not always appreciated from the appearance of the initial wound) be removed. In many cases, even tissues which look normal, grossly, at operation show cellular damage when studied microscopically. After adequate debridement the entire central portion of the created wound can be sutured safely, and either one or both ends can be left open and closed a few days later.

An important part of the after care of the debrided and closed wounds is careful attention to the elimination of dead space, and adequate drainage. A war wound is not meticulously closed in layers as are most surgical wounds. These wounds, because of their extent, have broad surfaces which tend to ooze for long periods with the resultant collecting of blood and serum. Careful thought must be given to accurate placement and selection of the types of drains. The use of polyethelyne catheters connected to portable vacuum bottle suction has proven to be of great value in the prevention of post operative fluid and/or blood accumulation. The catheter drain should be of small calibre (equivalent to an 8 or 10 Fr) and its tip must be kept from injuring any important nerves or vessels. This can be accomplished by securing it with a loosely tied suture of fine catgut which will not prevent its withdrawal. The catheter, of course, must be placed in the most dependent part of the wound.

The actual method of wound closure, i.e., suture, skin graft or cover by local or distant flap, depends upon the wound and its location. Direct suture is certainly preferable, but this is done only when there is no excessive tension on the suture line. No suture larger than 4–0 was used in treating this group of patients. In fact, at least half of the wounds were closed with 5–0 and 6–0. Silk was used because of a personal preference, and no difficulties attributable to the suture material were encountered. Other wounds could have been closed by heavier suture, but the writer feels that this is contrary to the principles of good healing. Heavy sutures under tension will shut off much of the local capillary circulation and this leads to areas of focal necrosis, evident on the surface by deep welts and heavy cross-hatched scars. Wide wounds that could not be closed were resurfaced with split thickness skin grafts. The size of the grafts varied greatly from the smallest, hardly more than a razor graft, to large sheets over 60 square inches. If the bed is properly prepared, i.e., the wound cleared of all necrotic tissue and the grafts properly protected during the initial stages of healing, most of the grafts will survive completely. It is felt that skin grafting provides a quick simple method of closing open wounds, regardless of location. Usually skin is in abundant supply, easy to obtain, and the donor site presents no hazard of future disability to the patient. The natural tendency of the scar base on which the graft is laid to contract is actually an advantage since the original wound edges are gradually brought closer together and thus

what heavy sutures try to do in a hurry, nature will do over a period of time. Flap coverage was used in a good number of the wounds. Success or failure in these, again, was dependent upon the adequacy of wound debridement. Only one flap was lost because of circulatory difficulties.

Where there is massive contamination, antibiotics certainly should be used to provide a barrier of defense until the surgeon can render the wound fit to defend itself. It must be remembered, however, that no amount of antibiotics will debride a wound any more than a rubber dam drain will.

Except for the most superficial wounds, complete anesthesia, regional, spinal block, or general during debridement and wound repair is necessary. If the patient is not entirely free of pain in the wounds, the surgeon is unable to explore into its deeper portions, and a complete debridement is not possible.

It was observed that even if the smallest wound was excised and closed by suture or graft, the healing time and hospital days were considerable less than in those wounds left untreated. The following comparison of two patients will illustrate this point: Two Marines of about the same age received strikingly similar wounds (although at different times). These were perforating tangential wounds of the posterior thigh caused by sniper fire of the carbine class. The first patient was injured in March 1966. His initial treatment in the field consisted of the insertion of two rubber dam drains, one in each of the wounds of entry and exit. He was received at this hospital ten days post injury. His wounds were small and innocuous looking and, except for some mild tenderness in the area of injury, he had no complaints. Because the wounds were small it was felt that no further surgical treatment would be necessary after removal of the drains. Yet, it was almost three months before his wounds were completely healed and he could be discharged. The second was treated one hour after injury. Full and adequate debridement was performed, i.e., the skin and subcutaneous tissue between the wounds of entry and the wounds of exit were incised, exposing the missile tract completely. All damaged tissue was removed and the wound thoroughly irrigated with normal saline solution. The incised portion of the skin and subcutaneous tissue was then closed by direct suture, but the wounds of entry and exit were left open. The patient was evacuated by air three or four days later. On the ninth day post injury, the wounds of entry and exit were excised and closed with sutures. Eight days later, healing was satisfactory, the sutures were removed and at three and a half weeks post injury the patient was fully ambulatory and ready for discharge.

In conclusion then, it must be reemphasized again and again that excision of all devitalized tissue is the basic factor in the early treatment of war wounds. The patient's progress, good or bad, bears a direct relationship to the skill and thoroughness of the debridement.

No originality is claimed for these conclusions. As was mentioned in the opening paragraph, nothing is new except that which has been "rediscovered."

CRUSHED CHEST INJURY AND ARTIFICIAL VENTILATION*

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Dis Chest 50(4): 388-392, October 1966.

Crushing injuries of the chest have steadily increased in the past decade with the increase in number of cars and speed of automobile traffic. In a series of 1,678 persons injured, 1.5 percent had a crushing injury of the chest, and approximately 25 percent of all traffic deaths were due to chest injuries. Unfortunately, many injuries of the thorax occur at sites distant from medical centers. It is important, therefore, for the physician to familiarize himself with the emergency treatment of such patients. The purpose of this paper is to emphasize the use of internal pneumatic stabilization in the emergency treatment of patients with severe crushing injuries of the chest, and to question the necessity of open reduction in patients with a severely dislocated flail thoracic segment.

* Read at the III World Congress of Anesthesiology, Sao Paulo, Brazil, 1964.

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Material

Seventy-five patients with closed chest trauma were seen and treated at the Surgical Hospital of the University of Würzburg, Würzburg, Germany, from January, 1962 to February, 1964 (Table 1). Fifty-three of these patients had only mild trauma to the thorax and will not be discussed further in this paper. The remaining 22 patients had severe injuries of the chest. Thoracic injury alone was seen in eight patients and was associated with other severe injuries in the remaining 14. Four sustained an injury of the thorax and head; two of the thorax and abdomen; and eight had injuries of the chest associated with injuries of the head, abdomen, pelvis and extremities.

The 15 patients who required artificial ventilation with intermittent positive pressure breathing (IPPB) were divided into two groups. Group 1 contained the seven survivors, and group 2 the eight who died. The severity of chest injury was similar in both groups. Three had fractured sternum and three had ruptured diaphragm. Five had pneumothorax and eight had hemothorax. A traumatic wet lung was diagnosed in ten. Five showed no sign of traumatic wet lung, although they suffered from crushed chest injury. Eight exhibited paradoxic respiration. Abdominal injuries were more frequently encountered in group 2, and six of the eight in this group had such an injury. Head injuries occurred in both groups in four instances. However, the severity of head injury in group 2 was more extensive as evidenced by the sustained unconsciousness of the four with head injury in this group.

TABLE 1—75 PATIENTS WITH CLOSED INJURIES OF THE CHEST
(Jan. 1962—Feb. 1964)

	Number of Patients	IPPB	Survived	Died
Mild to moderate injuries without complications	53	—	53	—
Severe injuries				
Thorax	8	4	4	—
Thorax and head	4	2	2	—
Thorax and abdomen	2	2	—	2
Thorax and head pelvis abdomen extremities	8	7	1	6
TOTAL	22*	15	7	8

* Seven of the 22 patients were not ventilated and of these patients, five survived and two died.

Treatment

The major pathologic abnormalities of our patients with a crushed chest injury were lung trauma, paradoxic motion of the chest wall, and traumatic wet lung. These pathologic abnormalities led to inadequate pulmonary ventilation which in turn produced hypoxia, hypercapnia, atelectasis, pneumonitis. In these severely injured patients, artificial ventilation with IPPB markedly improved pulmonary function. This was accomplished by connecting a cuffed tracheostomy tube to a positive pressure breathing machine.

Restoration of pulmonary function, decompression of hemopneumothoraces, and the treatment of shock were the important features of the therapy. Often all three were accomplished simultaneously in the emergency room. In our patients, artificial ventilation with IPPB was begun soon after the patient's admission to the hospital or whenever it was deemed advisable. The Bird Mark 8 Respirator was employed in all cases. In the first few patients assisted ventilation was instituted; however, in the remaining patients controlled respiration was preferred. The patients did not attempt to override the machine as long as the Pco_2 was 5 to 10 mm Hg lower than normal. This was accomplished by mild hyperventilation which maintained the arterial CO_2 tension at approximately 30 mm Hg. Voluntary respiratory efforts were eliminated and the patients required less sedation and appeared relaxed. The IPPB was continued for one to 25 days.

Those with hemothorax or pneumothorax were treated with temporary intercostal catheter drainage. Circulatory failure secondary to hypovolemia was corrected by transfusion of whole blood and plasma expanders.

Once the life threatening complications were corrected, the care of the tracheostomy became very important to avoid secondary complications. Sterile precautions were taken to prevent unnecessary contamination of the airway. The nursing staff was instructed to use sterile gloves and sterile catheters during each aspiration. Since aspiration was done and as frequently as nearly 10 to 20 minutes, unnecessary trauma to the tracheal mucosa was avoided. Cultures with sensitivity tests of tracheal secretions were obtained at regular intervals and appropriate sys-

temic antibiotics were given. Frequent changes of the patient's posture enhanced the drainage of bronchial secretions into the trachea where they were removed. In some cases, bronchial toilet under direct vision with the bronchoscope was necessary due to retained secretions.

Those who needed prolonged artificial ventilation required special humidification of the inspired gases. We used a heated nebulizer†† to maintain high humidity, which prevented crusting of bronchial secretions. Bronchodilators were used when indicated.

Results

One patient in group 1 was dismissed from the hospital with a tracheal cannula in place. He is now a pulmonary cripple; however, he had had severe pulmonary emphysema prior to the accident. Three are restricted in their physical activities. One 12-year-old boy has no physical restrictions, and the hospital stay of two others was prolonged due to other reasons.

The cause of death of three patients in group 2 was cardiac arrest in two and severe head injury in three. One with an extensive head injury developed severe bronchopneumonia, which contributed to his death. Two died of pulmonary embolism, and one had an associated undiagnosed adrenal medullary insufficiency. One died from uncontrolled hemorrhage from both internal mammary arteries.

Studies of pulmonary function were done in four patients after injury and are summarized in Tables 2 and 3. Although three had only minor complaints, the results of these tests indicated severe restrictive abnormalities in all cases. Unfortunately, the studies which were done did not clearly elucidate the degree of restrictive disease.

Discussion

Crushing chest injuries have always carried a high mortality rate due to ventilatory insufficiency. Proper treatment of these patients depends upon the correction of the ventilatory insufficiency and accompanying shock. One must immediately establish a clear airway, carry out a careful tracheobronchial toilet, and institute adequate alveolar ventilation once the diagnosis of ventilatory insufficiency is made.

Artificial ventilation with IPPB appeared to correct ventilatory insufficiency and produced internal pneumatic stabilization. This form of treatment for patients with a crushed chest injury was first introduced by Avery, Mörch, and Benson.

Intermittent positive pressure breathing impeded paradoxic movements of a flail segment, and was thus lifesaving. However, IPPB was not able to reestablish correct anatomic position of multiple doubly fractured ribs with severe dislocation (Fig. 1, not shown).

Test of pulmonary function from this study indi-

†† Puritan heated nebulizer, Puritan International S.A. Baltimore, Maryland.

TABLE 3—TEST OF PULMONARY FUNCTION ON FOUR PATIENTS AFTER CRUSHED CHEST INJURY

Patient		FEV 1.0″ ml.*	FEV 1.0″ / V.C. %	FEV 1.0″ / FVC** %	I / E
Age	Sex				
60	F	1260	60	37	1 / 1.18
59	M	660	40	22	1 / 1.46
70	M	930	77	31	1 / 1.07
50	M	720	65	18	1 / 1.58

* FEV 1.0″—Timed Vital Capacity in 1 second.
** FVC—Predicted vital capacity.

TABLE 2—TEST OF PULMONARY FUNCTION ON FOUR PATIENTS AFTER CRUSHED CHEST INJURY

	Patient		f		Vo_2 L./min.		Vo_2 ml./min.		MBC L./min.		V.C. ml.	
	Age	Sex	Pred. Norm.	Pt.	Pred. Norm.	Pt.	Pred. Norm.	Pt.	Pred. Norm.	Pt.	Pred. Norm.	Pt.
1.	60	F	14-16	20	7.10	12.60	210	390	59.00	27.00	3450	2100
2.	59	M	14-16	21	6.00	7.25	180	270	53.20	17.25	2950	1650
3.	70	M	14-16	18	6.09	9.18	190	270	44.43	20.52	2962	1200
4.	50	M	14-16	26	8.05	11.70	240	180	74.20	16.55	3905	1110

cated the presence of restrictive disease in all patients following recovery from the accident. Because of this finding, we now believe that open reduction of the dislocated flail segment may reduce the post-traumatic thoracoplasty-like effect in those patients. However, open reduction is certainly not necessary as an initial treatment since internal pneumatic stabilization is effective in alleviating ventilatory insufficiency.

The seven patients who survived may have died had not artificial respiration been used. However, prolonged artificial respiration with IPPB certainly has its own risk. The most serious complications are tension pneumothorax, reduced cardiac output, alveolar hypoventilation with CO_2 retention, and contamination of tracheobronchial tree and lungs. Tension pneumothorax must be avoided and its presence should be ruled out in the initial phase of emergency treatment, especially when thoracentesis must be done. Reduced cardiac output can be further accentuated in the hypovolemic patient by IPPB. Because CO_2-tension is difficult to detect clinically, regular determinations of arterial CO_2 plus O_2 tensions are necessary.

Sometimes it is difficult to decide when a patient can benefit from artificial ventilation. One cannot rely on the determination of arterial blood gases alone. We believe that either significant elevation of the Pco_2 above the level of 60 mm Hg or steadily rising values of the Pco_2 are definite indications for artificial respiration. One with a normal Pco_2 value may need artificial ventilation, since it does not indicate how the normal ventilation was achieved. One at the border of compensation can be tipped into respiratory failure by the slightest additional complication. One of the two patients who died without artificial respiration had a Pco_2 which was not elevated (32 to 44 mm Hg), and it was interesting to note that he had fractured nearly all the ribs of his left hemithorax. Retrospectively we now believe that this patient was a good candidate for prolonged artificial respiration with IPPB. This thought was confirmed by the necropsy examination which showed evidence of central respiratory failure.

The clinical impression of the status of the patient is the single most important factor which can determine whether artificial ventilation is required. However, the impression of the effectiveness of ventilation by inspection can be difficult. A normal respiratory pattern does not necessarily mean the patient has an adequate alveolar ventilation. This is specially true in the presence of hemorrhagic shock, as shown in the studies of Gerst and co-workers, and Freeman and Nunn. The work of these authors, as well as our own, shows that during hemorrhagic hypotension the ratio of physiologic dead space to tidal volume may increase to 75 percent. This means the decision to ventilate a patient artificially must be made from the impression of the patient's clinical status and from the determination of the arterial blood gases.

We would like to emphasize that oxygen therapy, intercostal nerve block and tracheostomy, as the initial or only treatment of patients with minor crushed chest injuries, are important. Artificial respiration should be employed either when ventilation is insufficient or when the work of respiration is too great for the patient. Through the use of artificial ventilation we believe that no patient today with intact lungs who has sustained a crushed chest injury alone, should die from respiratory insufficiency.

Summary

Fifteen patients with severe crushing injury of the chest were artificially ventilated with IPPB. They were divided into two groups; group 1 contained seven survivors and group 2 contained the eight who died. It was concluded that the associated injuries were frequently responsible for the final outcome. The indications for the use of artificial ventilation with IPPB were discussed, and the initial emergency treatment of patients with a crushed chest injury was reviewed.

(The references and omitted figures may be seen in the original article.)

REVERSIBLE POSTSTENOTIC BRONCHIECTASIS*

Theodore Drapanas MD†, Ralph Siewers MD‡, and John H. Feist MD§,
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N Eng J Med 275(17): 917-921, Oct 27, 1966.

Rupture of one of the major bronchi is now regarded as a relatively frequent complication of severe closed thoracic trauma. Although the common complications of this type of injury, including un-

controlled pneumothorax with or without hemothorax and progressive mediastinal and subcutaneous emphysema, are well recognized, a significant group of injuries remains in which fracture of the bronchial cartilage will occur without extensive leakage of air, presumably because the mucosa and membranous wall of the bronchus remain intact or because such tears will become sealed by adjacent structures. Such a complication probably occurs in some crushing chest wounds, and the patient may recover completely, with no residuals. It is more likely, however, that the injured bronchus, now lacking its normal cartilaginous support, will become progressively involved, with scarring resulting in stenosis, stricture or even eventual complete occlusion. Initially, this complication may go unrecognized until the patient returns weeks or months after the initial thoracic injury with complete atelectasis of the involved portion of the lung.

The first known case of survival after traumatic rupture of a bronchus was described in 1927 by Krinitzki in a patient who survived for twenty-one years after a complete rupture of the right-main-stem bronchus with total atelectasis of the right lung. In 1947 Kinsella and Johnsrud reported that 19 of some 38 patients recovered, as reported in the literature up to that time, but in all of them, permanent collapse of the involved lung resulted. In each, the rupture occurred in the main-stem bronchus, at the carina or within a few centimeters of it. In 1949 Griffith reported the first case of total atelectasis to be treated successfully by excision of the strictured segment of the left bronchus and restoration of bronchial continuity by anastomosis, performed eight months after injury. Since that time many reports have appeared documenting the successful surgical correction of this type of lesion as late as fifteen years after the initial injury, followed by complete restoration of function of the involved lung.

Pertinent to the entire problem of bronchial reconstruction after trauma with stenosis of the bronchus is the question of the relation between atelectasis and bronchiectasis in the obstructed lung and the further question of whether bronchial reconstruction should be attempted in the face of advanced bronchiectasis in these patients. To our knowledge very little information is available in the literature concerning the rapidity of the development of bronchiectasis and whether or not it can be reversed by adequate bronchoplastic procedures.

Case Report

L. P., a 36-year-old man, was admitted to the accident room of Presbyterian—University Hospital in coma and in moderate respiratory distress, having been injured as a front-seat passenger in an automobile accident. Examination showed severe facial lacerations and abrasions, a comminuted fracture of the left supracondylar femoral shaft and a left midclavicular fracture. The blood pressure was 100/60, the pulse 100, and the respirations 36. A film of the chest revealed a partial left pneumothorax and an emergency tube thoracostomy was performed. Over the next few hours marked subcutaneous and mediastinal emphysema developed. Emergency bronchoscopy showed bright-red blood in the left-main-stem bronchus but no break in the continuity of the bronchus was recognized. A tracheostomy was performed, the left leg was immobilized, and the facial and ocular lacerations were repaired.

The vital signs remained stable, and by the 3d hospital day x-ray study showed complete expansion of the lung. On the 14th hospital day markedly decreased breath sounds were noted over the entire left side of the chest. X-ray examination revealed almost total atelectasis of the entire left lung. Bronchoscopy demonstrated complete obstruction in the left-main-stem bronchus, 1.5 cm beyond the carina. A filiform esophageal dilator was passed by this area of obstruction, and copious quantities of thick, purulent secretions were obtained. Three subsequent dilatations were performed over the next week, but after each, the area of stenosis rapidly closed down. On the 26th day after injury a selective cinebronchogram revealed a severe, sharply localized stenosis of the midportion of the left-main-stem bronchus, with fixed caliber throughout the respiratory cycle. There was complete atelectasis and advanced cylindrical and saccular bronchiectasis of the left lower lobe and lingula, without any airflow during respiration. The remainder of the left upper lobe was only partially aerated and showed similar bronchiectatic changes.

At thoracotomy on the 28th day after injury the left lung was almost completely atelectatic and could be inflated only with extreme difficulty by the anesthetist. Approximately 2 cm from the carina there was an area of bronchial stenosis involving 4 cartilaginous rings, which were fractured in multiple places. A 2-cm healed laceration of the posterior

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membranous portion was present in the area of the stenosis. The stenotic bronchus was excised and large quantities of thick, creamy mucus were aspirated from the lung. Removal of this mucus was facilitated by manual compression of the lung and by direct aspiration with a catheter through the distal bronchial stump. Bronchial continuity was restored with an end-to-end anastomosis of the cut ends. The postoperative course was completely uneventful. Bronchoscopy immediately after operation and again on the 15th postoperative day showed an adequate lumen, through which the bronchoscope could be passed.

Cinebronchography on the 8th postoperative day revealed that almost complete resolution of the previously noted bronchiectasis had occurred except for a few saccular dilations in scattered areas of the lower lobe and lingula. Postoperative films of the chest showed complete expansion of the left lung, with minimal pleural reaction. Cinebronchography, again repeated 1 month after bronchoplasty, now revealed only occasional bronchial beading in the areas of prior bronchiectasis, nearly normal airflow throughout the left lung and minimal concentric expiratory buckling of the healing bronchial anastomosis. Six months after operation the patient was completely asymptomatic and was actively employed as a laborer. The film of the chest was normal.

Discussion

The fact that bronchiectasis may be reversible was first pointed out by Findlay in 1935 in a description of 2 children with lobar atelectasis. When the atelectatic lobes re-expanded, bronchiectasis within them disappeared. He called this "compensatory bronchiectasis." His observations were confirmed in 1936 by Jennings, who similarly reported that cylindrical lobar bronchiectasis disappeared in 2 adult patients as the result of atelectasis after severe acute bronchitis. Additional cases of reversible bronchiectasis have been well documented by Fleischner (1941) and by Blades and Dugan (1944). The latter group named this "pseudobronchiectasis" and described 4 patients with cylindrical bronchiectasis resulting from primary atypical pneumonia, which disappeared after recovery.

Little clinical information is available, however, on the etiology of the bronchiectasis in patients with bronchial obstruction. Moreover, reports of experimental studies in animals are conflicting. In an excellent study in dogs, Adams and Escudero (1938) concluded that 2 factors were necessary for the production of bronchiectasis—namely, incomplete bronchial obstruction and infection of the bronchial tree. Tannenberg and Pinner (1942) reached somewhat similar conclusions in stating that "the causation of bronchiectasis is inflammatory infiltration of bronchial walls with accumulation of exudate in the bronchial lumina; the latter is prevented from draining because of the artificially produced bronchial obstruction."

The complete regression of the marked cylindrical and saccular bronchiectasis noted in our patient gives strong clinical confirmation to the classic experimental studies of Nissen and Croxatto and Lanari on the pathogenesis of bronchiectasis after bronchial stenosis. They postulated that partial or complete bronchial obstruction is followed by atelectasis and subsequent "mucous bronchodilation" secondary to the contained secretion of the mucous glands; furthermore, the bronchial dilatation is directly related to the increased intraluminal pressure. They further postulated, but were unable to prove, that this type of bronchiectasis was reversible if the factor of secondary infection was not introduced. In other experimental studies Webb and Burford demonstrated complete recovery and normal function of lungs in dogs after reanastomosis of *totally* occluded bronchi even for periods as long as nine months after the production of the obstruction. They did not consider the question, however, of whether bronchiectasis had developed in the obstructed lung segments. Paulson and Shaw, Mahaffey and his associates and others have all recommended that bronchial anastomosis is indicated for complete traumatic bronchial occlusion even though a patient is seen months or even years after the initial injury. To these concepts we would further add that even though severe bronchiectasis is noted at an early stage with bronchial stenosis, bronchoplastic procedures may still be feasible, with complete restoration of function and with anticipated reversal of the bronchiectasis.

Summary and Conclusions

A patient who sustained a traumatic rupture of the left-main-stem bronchus secondary to closed trauma to the chest is described. Progressive stenosis of this bronchus resulting in complete atelectasis of the lung occurred two weeks after the initial injury, and cinebronchography revealed extensive cylindrical and saccular bronchiectasis of the left lung. Resection of the bronchial stricture with end-to-end anastomosis of the left-main-stem bronchus was performed approximately one month after injury. Post-

operative bronchograms showed almost complete reversal of the bronchiectasis within eight days of operation. Repeat bronchograms one month later showed a normal tracheobronchial tree.

This case lends clinical confirmation to the concept of the rapid development of bronchiectasis as the result of bronchial obstruction and atelectasis and to the reversibility of the bronchiectasis if correction of the stenosis can be accomplished at an early stage.

(The references and figures may be seen in the original article.)

PROLONGATION OF SPINAL BLOCKS WITH VASOCONSTRICTOR DRUGS

Daniel C. Moore MD, L. Donald Bridenbaugh MD, Phyllis A. Bagdi MD, Phillip O. Bridenbaugh MD, and Herbert Stander, Seattle, Washington.
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The addition of vasoconstrictor drugs to the local anesthetic solution injected into the subarachnoid space to prolong the duration of anesthesia was first suggested by Braun in 1900. With the use of this technique over the years, many controversies have arisen. The disagreements involve the following principal points: Some physicians believe that if the blood supply to the spinal cord is compromised by drugs, hypoxia of the spinal cord may result with subsequent neurologic complications; others do not agree as to the type and dosage of vasoconstrictor drug which should be employed to assure safe and consistent prolongation of single dose spinal block; lastly, systemic toxic reactions to the vasoconstrictor drug could occur.

This study was undertaken to evaluate the safety of injecting ephedrine sulfate, epinephrine hydrochloride—adrenalin—or phenylephrine hydrochloride—neosynephrine—into the subarachnoid space, and their prolongation of spinal block with tetracaine hydrochloride—pontocaine.

Method

A tally sheet and a method of coding were prepared; 30 items were listed on the tally sheet for coding. Included were vital statistics and physical status of the patient; the amount of vasoconstrictor and local anesthetic agent injected into the subarachnoid space; the operation; the duration of both the surgical procedure and the anesthesia; the time at which the spinal block had to be supplemented with a general anesthesia while the operation was being performed, that is, "the operative duration" provided by the local anesthetic solution; and the complications, such as, prolonged spinal anesthesia, lesions of the spinal cord, meningitis, cranial nerve involvement, and permanent paralysis.

The data upon patients who had had spinal blocks from 1948 through 1964 were transferred from punch card anesthetic records to the tally sheets. From 1948 through 1960, keysort record cards were used and beginning in 1961 those approved by the Committee on Clinical Anesthesia Study of the American Society of Anesthesiologists, Inc. An anesthesiologist sees the patient preoperatively, tells him that he is to have spinal block anesthesia, and observes the patient postoperatively. After hospital discharge, these patients are followed up for a period of from 1 to 3 months by the surgeon. Should neurologic disorders attributable to or related to the spinal block develop in any of these patients, the anesthesia department would be informed. Of the 8,851 patients, approximately 80 percent were from this Clinic and have returned to this private institution for all of their medical needs, which assures a continuing survey of them during their life.

For identification of records, each tally sheet was assigned a number and each anesthetic record a corresponding figure. The data from the tally sheet were transferred to standard 80 column cards by a keypunch operator and verified by another. The cards were read into a computer and stored on magnetic disks for processing. A programmed sort through 11,162 records produced the data.

Results

Of the 11,162 single-dose spinal block anesthesias, vasonconstrictor drugs were injected into 8,851 patients: tetracaine-dextrose with epinephrine in 6,643 patients; tetracaine-dextrose with phenylephrine, 1,719 patients; tetracaine-dextrose with ephedrine sulfate, 85 patients; tetracaine-distilled water

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with epinephrine, 211 patients; tetracaine-distilled water with phenylephrine, 192 patients; and tetracaine-distilled water with ephedrine sulfate, 1 patient.

Regardless of the volume or dosage of the local anesthetic solution, the dose of epinephrine was 0.2 milligram—0.2 milliliter of a 1:1,000 solution—that of phenylephrine 5 milligrams—0.5 milliliter of a 1 percent solution—and ephedrine sulfate 50 milligrams—1 milliliter of a 5 percent solution. Single dose ampules of these agents were used, and they were heat sterilized in the spinal tray, along with the equipment, local anesthetic drugs, dextrose, and distilled water.

The usual dose of tetracaine and the dermatome level of anesthesia sought were as follows: urologic surgery, 10 to 12 milligrams of tetracaine and a sensory level of the eighth thoracic dermatome; gynecologic surgery, 12 to 14 milligrams and the sixth thoracic dermatome; upper abdominal procedures, 14 to 18 milligrams and the third thoracic dermatome; lower abdominal procedures, 10 to 16 milligrams and the fifth thoracic dermatome; and lower extremity procedures, 6 to 10 milligrams and the tenth thoracic dermatome. Most lumbar punctures were carried out at the second or third lumbar interspace. In the majority of instances 10 percent dextrose equal to the volume of 1 percent tetracaine was used to make the solution hyperbaric. In all instances, we elicited free flow of spinal fluid before and after the subarachnoid injection.

Epinephrine prolonged the duration of spinal analgesia by 50 percent. Phenylephrine extended the duration of block by 100 percent. Ephedrine sulfate did not significantly lengthen the duration of anesthesia. Solutions of tetracaine produce anesthesia of the abdominal wall and viscera for a period of from 75 to 105 minutes and of the lower extremities for 120 to 150 minutes. With the addition of 0.2 milligram of epinephrine to a tetracaine solution, intra-abdominal anesthesia is extended to 120 to 135 minutes and that of the lower extremities to 180 to 225 minutes. The addition of 5 milligrams of phenylephrine to a tetracaine solution results in intra-abdominal anesthesia of 135 to 210 minutes and block of the lower extremity for 300 to 345 minutes.

No permanent neurologic sequelae were known to have occurred in the patients studied.

Discussion

The mode of action of vasoconstrictor drugs in prolonging the action of local anesthetic agents when injected into the subarachnoid space is not definitely known. The principal theories are that vasoconstriction of the blood supply of the spinal cord slows absorption of the local anesthetic agent, and vasoconstrictor drugs, through a direct action on the nerves, produce anesthesia. The first of these 2 theories is generally accepted, although the evidence is not completely conclusive.

The report of Biberfield, indicating that epinephrine injected into the subarachnoid space produced marked ischemia of the spinal cord prompted Barker to discontinue this technique. Also, the 2 instances of neurologic complications after injection of procaine and epinephrine into the subarachnoid reported by Franke caused further concern. The experiments of Wu and his associates in 44 rhesus monkeys indicated that single dose injections of relatively large quantities of ephedrine sulfate, epinephrine, and phenylephrine subarachnoidally caused no permanent neurologic sequelae. Marked sensory and motor involvement resulted only if massive doses of these drugs were used in the monkeys.

In our study in man, we know of no neurologic complications occurring from the injection of 0.2 milligram of epinephrine, 5 milligrams of phenylephrine, or 50 milligrams of ephedrine sulfate into the nonpathologic subarachnoid space with the single-dose spinal technique. The dosages of vasoconstrictor drugs used by us were infinitesimal when compared with those of Wu and his associates. For example, in a patient weighing 45 kilograms or 100 pounds the quantity of epinephrine per kilogram was 0.0044 milligram and that of phenylephrine 0.11 milligram. In monkeys, the minimal and maximal doses of epinephrine per kilogram were 0.08 and 1.1 milligrams, while those for phenylephrine were 3 and 9 milligrams.

With phenylephrine, the patient may experience occasional prolonged hypoesthesia in the legs and feet, lasting for from 8 to 12 hours. In 1 instance, prolonged spinal block occurred after tetracaine-epinephrine had been administered for the removal of the appendix in a 19 year old male. Anesthesia of the lower extremities persisted for 36 hours, and, according to the patient, muscular weakness of the lower extremities for 8 months. In this instance, no demonstrable neurologic changes were present after a 1 year period, except for his claim that, at times, he was impotent; he played football and was an outstanding college quarterback.

Wu's experiments resulted in systemic response to the larger doses of ephedrine sulfate, epinephrine,

and phenylephrine. We observed no systemic response to the small doses of phenylephrine or epinephrine injected into the subarachnoid space. Evidently, small doses of these drugs are slowly absorbed from the subarachnoid space. If both systemic response to the vasoconstrictor drug and minimal anesthesia occur, they constitute positive evidence that all the solution was not injected into the subarachnoid space but that most of it was deposited in the epidural space. The reports of Ward and Brockmeyer and their associates corroborate this observation.

Ephedrine sulfate was used in 86 patients and then abandoned because it did not significantly increase the duration of analgesia and relatively larger doses, i.e., 25 to 50 milligrams had to be employed. Such quantities significantly increase the usual rate of gravitation of hyperbaric solutions and make an isobaric or hypobaric solution hyperbaric.

Controversy exists concerning the individual effectiveness of epinephrine and phenylephrine if injected into the subarachnoid space. Bray and his associates, and Adriani reported a 26 to 50 percent prolongation of tetracaine saddle block analgesia with epinephrine but only a 0 to 10 percent with phenylephrine. Sergent and Dripps reported a statistically equal 40 percent extension for tetracaine spinal anesthesia with 1 milligram of phenylephrine and 0.5 milligram of epinephrine. Bonica and his associates, using a graduated dose scale for phenylephrine—1 to 5 milligrams—depending upon the tetracaine dose, observed a 48 percent prolongation for phenylephrine and 42 percent for epinephrine. Brockmeyer and Crawford and their associates described a series of patients given phenylephrine-potentiated tetracaine spinal anesthesia in which 3 and 5 milligram doses resulted in 100 percent prolongation. The impression from the literature is that epinephrine in doses of 0.25 to 0.5 milligram will extend subarachnoid block anesthesia by about 50 percent, whereas phenylephrine in doses varying from 1 to 5 milligrams prolongs subarachnoid block from 10 to 100 percent.

The brunt of the controversy over which of these 2 vasoconstrictor drugs is the more efficient potentiator of spinal block probably involves the region anesthetized as well as the dosage. With tetracaine, the lower extremities remain anesthetized longer than does the abdomen. Therefore, like areas must be compared—an epinephrine-potentiated spinal block for surgical procedures of the lower extremity must be compared with a phenylephrine-potentiated spinal block for a similar procedure, not with a phenylephrine-potentiated spinal block for intra-abdominal surgical procedures.

By reviewing like comparisons and operative durations, we can conclude that, regardless of the volume or dosage of the local anesthetic solution, the optimal dose of epinephrine in the subarachnoid space is 0.2 milligram and that of phenylephrine, 5 milligrams. In a few instances, 0.5 milligram of epinephrine was employed, and it prolonged anesthesia in some, but not all, of the patients by 15 minutes more than a 0.2 milligram dose. We reasoned that more than doubling the dose of epinephrine to extend anesthesia an additional 15 minutes was not warranted. In a few instances, 2, 3, or 4 milligrams of phenylephrine were used instead of 5 milligrams, but these doses were not as effective in prolonging the duration of anesthesia. Crawford and Ausherman substantiate this finding.

Summary

Vasoconstrictor drugs were added to tetracaine solutions to be injected into the subarachnoid space in 8,851 patients to determine an optimal dose which would safely and consistently prolong the duration of spinal block for a significant period of time. Epinephrine, 0.2 milligram, extends anesthesia approximately 50 percent; 5 milligrams of phenylephrine approximately 100 percent; and 50 milligrams of ephedrine sulfate did not prolong the duration. No known serious neurologic complications resulted in this study from the use of these dosages in the nonpathologic subarachnoid space. Although epinephrine and phenylephrine do prolong spinal block anesthesia and appear to be innocuous when injected into the nonpathologic subarachnoid space, they should not be employed routinely, but only if the duration of the operation will exceed the usual duration of the local anesthetic agent if used alone.

(The references may be seen in the original article.)

RETINAL DETACHMENT: USE OF HUMAN CENTRIFUGE IN TREATMENT

R. W. Neault MD, Section of Ophthalmology, T. G. Martens MD, Section of Ophthalmology, C. F. Code MD, Section of Physiology, A. C. Nolan MD, Fellow in Physiology.* *Mayo Clin Proc 41(3): 145-149, March 1966.*

In the treatment of elevated retinal detachments, the ophthalmic surgeon can often use the force of gravity to advantage during the preoperative period. With bed rest and proper positioning of the patient, an elevated retina will frequently show some degree of settling. It would be ideal if, in all cases, the retina could be made to flatten preoperatively and to reappose itself to the choroid. For various reasons, however, this ideal cannot always be achieved.

For some time it has been our desire to use our human centrifuge in an attempt to settle elevated, detached retinas. It seemed to us that perhaps a retina which was elevated and which failed to settle during bed rest, for some reason or another, could be settled more effectively by subjecting it to the force of controlled and carefully directed acceleration. With recognition of the fact that retinal settling and reapposition to the choroid may be deterred by the presence of restraining vitreous bands or of fixed retinal folds, our interest was concerned primarily with determining whether the retina could be moved through the vitreous by centrifugation.

First Test of Method

The first test of the method was in a case of retinal detachment of a type in which the desired reapposition of the retina to the choroid could not be achieved with bed rest.

The patient, a healthy 18-year-old high school athlete, had a greater-than-180° superior disinsertion of the retina of the left eye. This detachment was of traumatic origin and was of approximately 2 weeks' duration. The detached superior retina was folded downward so that it covered both inferior quadrants except at the extreme periphery. This detachment would be in the group described by Cibis and co-workers [1] as those detachments with giant breaks with inverted or rolled-over retinas. Almost the entire superior choroid in this eye was bared. The fold in the retina followed a curved line between the 8 o'clock meridian inferior nasally and the 3 o'clock meridian temporally. The fold passed just superior to the optic disk. A correspondingly large field defect was present, and the visual acuity in the involved left eye was limited to finger counting in the superior nasal quadrant and hand movements in the extreme superior temporal quadrant. The appearance of the eye on ophthalmoscopic examination was such as to have been confused, on cursory examination, with that of an elevated inferior detachment.

The patient underwent a complete general physical examination to ascertain his state of physical fitness and to aid in estimating his tolerance to centrifugation. After consulting with members of our Section of Physiology,† it was deemed reasonable to centrifuge this patient. Information relative to the nature of the retinal detachment and the position of the superior leaf of the retina in the left eye was analyzed and proper positioning of the patient on the centrifuge was determined.

Centrifugation was carried out with the patient in different positions in order to take advantage of the changing position of the retina in relation to the direction of the force during the course of treatment. As a preliminary precautionary measure, one of us (A.C.N.), who is an experienced subject in such tests, was centrifuged in the various positions planned for the patient. In general, we attempted to keep the line of force perpendicular to the detached retinal leaf while at the same time not subjecting the entire patient to force in the negative direction. At the suggestion of the physiologists, a number of fixation lights were provided for the patient. These lights were disposed both vertically and horizontally. By having the patient, on our direction, fixate different vertical lights during centrifugation, we could take advantage of small changes in the retinal position without interrupting centrifugation for repositioning. This allowed us, within certain limits, to

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† The original discussions of the possible application of human centrifugation to the problem of reapposing an elevated retina were with Dr. E. H. Wood, Section of Physiology.

keep the folded retinal leaf at a position approximately perpendicular to the direction of the applied force. In addition, by changing the gaze from right to left in a horizontal direction relative to the patient, the entire extent of the detached leaf of the retina could in effect be "scanned" or "massaged" with a force greater than gravity. By this arrangement we attempted to achieve, as nearly as possible, perpendicularity between the line of force and all points of the detached retinal leaf.

During centrifugation the patient was accompanied by one of us as an observer (A.C.N.), and was maintained in close contact with the control room and observers through the use of an intercommunication system.

Centrifugation was carried out at levels between 2 and 2. 7 G. The force was applied to the patient's body in a transverse direction. Total centrifugation time, 2 hours and 15 minutes, was accomplished in five sessions. Centrifugation was tolerated best by this patient without premedication. However, he was not allowed to eat anything prior to a session. A transient, unpleasant sensation was experienced by the patient when the centrifuge was stopped.

The patient was responsive and intelligent enough to be able to detect and report changes in the extent of the visual field of the left eye during centrifugation. Interestingly enough, during the course of centrifugation and at the instant that the superior leaf of the retina was elevated above the macula, the patient reported restoration of "central vision." Subsequent testing of the apparently uninvolved left macula revealed a near visual acuity of 14/21 (American Medical Association reading card).

After centrifugation, the line of apposition of the superior retina to the choroid was found to be approximately horizontal and about 5 disk diameters above the optic disk. The edge of the detached retina was still dependent, but its lowest extent was above the optic disk and macula. A limiting barrage of partially penetrating lesions was applied along this new line of apposition (surgical diathermy). Although the patient has been dismissed from the hospital, it is too early to comment on what may be the final result of our efforts. We intend to follow this case carefully, and, if it seems necessary and appropriate, further centrifugation and treatment will be carried out.

Summary

An 18-year-old boy with a greater-than-180° superior disinsertion of the retina of the left eye (of traumatic origin) of 2 weeks' duration was subjected to forces greater than gravity on the human centrifuge. By appropriate positioning of the patient, the line of force was kept approximately perpendicular to the detached retinal leaf. The detached retina was moved through the vitreous so that some reapposition to the choroid occurred.

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(The figures may be seen in the original article.)

AN UNUSUAL PORTASYSTEMIC SHUNT

W. O. Griffen Jr. MD PhD, R. H. Dietzman MD and E. T. Peter MD PhD, (From the Department of Surgery, College of Medical Sciences, University of Minnesota, Minneapolis, Minnesota.)

Gastroenterology 51(4): 537-538, October 1966.

Makeshift shunts between the portal and the systemic circulations, although rare, may be successful in the management of bleeding from esophageal varices. As implied by the term "makeshift," these shunts are often constructed because of the small size of the splenic vein or because of thromboses involving much of the portal venous system. The following account records the anastomosis of a short gastric vein, end-to-side, to the left renal vein to control such hemorrhage.

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Case Report

J. H. (Hospital no. 1029970, patient of Drs. James H. Kelly and Paul T. Moran of St. Cloud, Minnesota), a 43-year-old white man, was admitted to the University of Minnesota Hospitals on December 20, 1964, for the first time. Except for recurrent urinary tract infections and an atypical

pneumonia in 1961, he was well until 1962, when he developed symptoms of peptic ulcer. Upper gastrointestinal X-rays showed a deformed duodenal bulb. He was treated with diet and antacids and was well until admitted to another hospital in November 1964, after 3 weeks of upper abdominal postprandial distress, radiating to both sides and into the back. He gave a history of having melena for 1 day and had had a 20-pound weight loss associated with anorexia. Upper gastrointestinal series demonstrated increased rugal folds of the stomach, suggestive of lymphosarcoma. A Bromsulphalein (BSP) test at that time showed 26% retention in 45 min; a serum glutamic-oxaloacetic transaminase (SGOT) was 68; and he had hypoprothrombinemia.

Exploratory laparotomy 5 days prior to admission to the University of Minnesota Hospitals revealed thrombosis of the portal, superior mesenteric, splenic, and epiploic veins. Liver biopsy showed nonspecific lymphocytic infiltration of periportal areas. He began to bleed from the upper gastrointestinal tract postoperatively, and after he had received 4500 ml of blood in 2 days he was transferred.

On admission he had a grade III systolic murmur loudest at the apex and radiating to the base. A spleen tip could be felt. The liver edge was 3 cm below the right costal margin. No masses were felt. There was some epigastric tenderness where the midline scar was healing well. Rectal examination was normal. Hemoglobin on admission was 10.8 g per 100 ml and a white count was 5950 per mm.^{3} Platelets appeared decreased. His prothrombin time was 12.5 sec with a control of 11.2. The bilirubin was 0.4 mg per 100 ml, total, with 0.1 mg per 100 ml, direct. Alkaline phosphatase was 10 King-Armstrong units. A barium swallow showed large esophageal varices. A platelet count on admission was 24,000, but rose to 124,000 the day prior to surgery. He required 1000 to 1500 ml of blood each day to maintain his hemoglobin.

At operation on December 28, 1964, the portal venous system had numerous areas of thrombosis. Portal pressure was 37 cm saline; a simultaneous systemic venous pressure via a saphenous vein cutdown was 6 cm saline. The spleen was slightly enlarged and was removed because of the moderate hypersplenism noted preoperatively. Postsplenectomy portal pressure was still 37 cm over a systemic venous pressure of 8 cm saline. The splenic vein was not large and several branches contained clots. One of the short gastric veins high on the greater curvature was 1.2 cm in diameter and did not have any thrombus. It was long enough for anastomosis to the left renal vein. When the shunt was completed the portal pressure was 26 over 6 cm saline.

Follow-up barium swallow 2 months later showed that the esophageal varices had disappeared and he had no further bleeding episodes. Unfortunately, he succumbed on November 13, 1965. Autopsy revealed a large mural thrombosis in the right ventricle and massive pulmonary embolism with almost complete pulmonary arterial occlusion. The shunt was patent, and, although the external gastric veins were prominent, no varices were seen.

Discussion

Both Rousselot [1] and Linton [2] have mentioned the use of the gastroepiploic veins in the construction of portasystemic shunts. The former author considers these shunts as expediencies at the time of surgery, and rarely successful. Linton has published the results of such shunts in 5 patients, all of whom had postoperative bleeding. Large et al.[3] have presented a case of intrahepatic portal venous block secondary to polycythemia where an omental vein was shunted end-to-side to the left renal vein. Although the patient improved he continued to have bleeding episodes into all tissues, presumably secondary to the polycythemia. DeBritto and his co-workers [4] described 1 patient who had complete splenic vein thrombosis but with an enlarged right gastroepiploic vessel suitable for an end-to-side gastroepiploic renal vein anastomosis. The patient was well 50 days postoperatively and esophagram showed disappearance of the varices. As far as we have been able to determine, there has been no follow-up of this patient.

The present case represents another expedient shunt which for almost a year proved to be successful in the management of the gastrointestinal hemorrhage. The interesting features of this case were the extensive thrombosis throughout the portal venous system and the unusual pattern of varices in the patient. The bleeding which the patient demonstrated was not the typical variceal bleeding with massive hemorrhage, but rather a constant blood loss requiring multiple transfusions over many days. The shunt controlled the bleeding and it remained patent.

The pressure recordings during surgery deserve emphasis. Simultaneous measurement of the portal and systemic venous pressures defines the gradient across the liver. The difference between the two values is a more accurate estimation of the portal pressure. A saphenous or external jugular vein catheter is easy to put in preoperatively and will provide for the suitable measurements.

Summary

A case of bleeding esophagogastric varices is presented. Portal-systemic shunt between a short gastric vein and the left renal vein controlled the bleeding and remained patent until the patient's death almost a year later.

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MEDICAL ABSTRACTS

IATROGENIC FACTORS IN INFECTIOUS DISEASE

H. N. Beaty MD, R. G. Petersdorf MD FACP, (From the Department, University of Washington School of Medicine at King County Hospital, Seattle, Washington.) Ann Intern Med 65: 641-656, October 1966.

The authors propose a definition of iatrogenic disease, "disease that would not have occurred if sound therapeutic procedures had not been employed." This softens somewhat the impact of the actual facts and figures which they quote in the introductory paragraphs regarding the amounts of antibiotics prescribed in 1945 and in 1960 and the incidence of iatrogenic complications in hospitalized patients.

They then discuss their subject under the headings: Complications Due to Chemical Effects of Antimicrobial Agents (Hypersensitivity Reactions, and Toxic Reactions); Iatrogenic Infections; and Complications of Diagnosis and Treatment. Case histories illustrating the complications are reviewed and pertinent comments made. Among the complications noted are allergic reactions to antibiotic drugs, toxic reactions under which they include anemia, nephrotoxemia, phlebitis, gastrointestinal intolerance, peripheral neuropathy, ototoxicity, hepatotoxicity, stomatitis, glossitis, phototoxicity, antianabolic effects, thromboses and pain as common ones and hypokalemia, optic neuritis, curariform action, skin pigmentation, leukopenia, and bone lesions among the uncommon ones. All of this information on toxic and allergic reactions is presented in tabulated form.

Superinfections due to *Candida,* staphylocci, *Pseudomonas, Proteus,* and *Klebsiella-Aerobacter, Aspergillus, Mucor,* cytomegalovirus, and *Pneumocyctis carinii* are discussed under iatrogenic infections and under complications of diagnosis and treatment: thrombophlebitis; bacteremia; the risks of bronchoscopy, thoracentesies, pleural biopsy, tracheostomy; untoward reactions to topical anesthesia; increased susceptibility to infection induced by radiation therapy; aspiration pneumonia after recurrent aspiration of gastrointestinal contents; postoperative infections; bacterial shock after urological manipulation; and complications arising as a consequence of immunization.

The authors feel that the most important principle in the prophylaxis of iatrogenic disease is to administer drugs only when they are needed and to perform diagnostic procedures only when they are likely to yield meaningful information. They stress that they do not advocate diagnostic and therapeutic nihilism but do plead for diagnostic and therapeutic *equanimitas.*

EMOTIONAL AND SENSORY STRESS FACTORS IN MYOCARDIAL PATHOLOGY—NEUROGENIC AND HORMONAL MECHANISMS IN PATHOGENESIS, THERAPY, AND PREVENTION

W. Raab MD, (Department of Medicine, Cardiovascular Research Unit, De Goeslriand Memorial Hospital and University of Vermont College of Medicine, Burlington, Vermont.) Amer Heart J 72: 538–564, October 1966.

After an introduction in which Dr. Raab emphasizes the significance of emotion—related physiological and biochemical phenomena with regard to their direct interference in the metabolism and structure of the heart muscle, he discusses his subject under the following headings: Scope of the problem complex, Emotional and sensory stress-induced liberation of catacholamines; Influence of central nervous, emotional, and sensory stimuli upon cardiac rhythm, dynamics, and ECG; Emotion-induced, catacholamine-mediated angina pectoris and sudden death; Centrally and emotionally induced myocardial necroses and infarctions, emotions, adrenal corticoids, and myocardial damage; Emotions, sensory stress, and the vascular system; Emotional stress and

congestive heart failure; and Emotion-and-sensory oriented therapy and prevention.

The author's summary is as follows:

In the complex but increasingly perceptible pluricausal pathogenesis of degenerative (so-called "coronary") disease of the heart muscle, emotional and sensory stresses play a prominent, even though usually only contributory, role.

Scrutiny of the pertinent contemporary transdisciplinary world literature provides abundant experimental and clinical evidence for a potentially cardiotoxic over-production of sympathogenic catecholamines and adrenocortical steriods, resulting from emotional and sensory stress-induced stimulations of the central nervous system and the pituitary gland.

Fear, anger, and frustration, as well as, to a lesser extent, optical, acoustical, and thermal annoyances act as the most common potentially pathogenic stimuli.

These stimuli disturb, via the sympatho-adrenomedullary system, the oxygen economy of the myocardium (particularly in conjunction with predisposing coronary atherosclerosis, and with the often associated additional adrenergic manifestations of physical inactivity and of nicotine). Intramyocardial electrolyte shifts, due to catecholamine-induced local hypoxia, and superimposed corticoid-induced depletion of myocardial potassium may be assumed to constitute the most fundamental metabolic derangements involved.

There is only sparse evidence in favor of a significant contribution of emotional and sensory stimuli to coronary atherogenesis. However, stress-induced sympathetic and adrenal cortical overaction seems to affect the myocardium also indirectly by way of elevations of blood pressure and resulting hemodynamic strain.

Prevention and counteraction of emotional and sensory detriments to the myocardium are feasible through psychotherapy, environmental adjustments, physical reconditioning, and tranquilizing and/or directly antiadrenergic medication.

TREATMENT OF INTRAPULMONARY SHELL FRAGMENTS

I. Vogt-Moykopf MD and D. Krumhaar MD, (From the Surgical Clinic of the University of Heidelberg, Germany.) Surg Gynec Obstet 123: 1233–1236, December 1966.

This report is based on 55 patients with pulmonary shell fragments from World War II who were treated from 1950 to 1966. Eighteen pneumonotomies, 14 lung resections, and 9 thoracoplasties and decortications were done. Hemoptysis was the leading symptom and the most frequent indication for operative treatment. Simple pneumonotomies were done for fragments close to the pleural surface and when there was no surrounding pneumonitis, but lung resections were found to be safer when there was destruction and inflammation of lung tissue adjacent to intrapulmonary foreign bodies. Postoperative complications were similar to those following lung resection for inflammatory disease. Symptoms of destructive and inflammatory disease of the lung due to the presence of shell fragments were indications for surgery but the authors state that there is no need for surgical treatment in asymptomatic patients. Anterior and lateral roentgenograms of the chest and fluoroscopic examinations were routine diagnostic procedures but exact localization of intrapulmonary shell fragments required bronchography.

One patient died postoperatively of acute heart failure following segmental resection; atelectasis after segmental resection and lobectomy required treatment in three. Insufficiency of the bronchial stump after lung resection occurred in one and was followed by an empyema cavity; thoracoplasty was successful as a second stage procedure. Various minor complications such as pleural effusions or transient bronchopneumonia occurred but were not considered serious problems.

In the discussion, the authors emphasize that morbidity of pneumonotomies and lung resections to remove foreign bodies is much less favorable 10-20 years after war injury, 7.3 percent reported in the German literature, than when removal of the foreign bodies is done shortly after injury and before inflammatory reactions occur in the lung tissue, 0.9 percent.

TREATMENT OF SLOW HEART RATES FOLLOWING ACUTE MYOCARDIAL INFARCTION

Alan Harris and Rodney Bluestone, (From St. George's Hospital, London S. W. 1.) Brit Heart J 28: 631–637, September 1966.

The authors, at the outset, state that the immediate mortality in patients with acute myocardial infarction may be lowered by the prompt recognition and treatment of cardiac arrhythmias and that while ventricular fibrillation is the usual cause of sudden death, a frequent precursor appears to be a slow

rate due to slow nodal rhythm or complete atrioventricular block with episodes of asystole or ventricular tachyarrhythmia. Because of this, they feel that a better chance of survival seems likely if the slow rate is treated by artificial pacing since the heart rate can then be accurately controlled without drugs which may irritate the myocardium.

They report their experience of pacing 12 patients for slow rates secondary to acute myocardial infarction and summarize their experience as follows:

Eleven patients have been treated by artificial pacing for slow heart rates following acute myocardial infarction. One other patient with cardiac ischaemia was paced for syncopal attacks associated with severe angina and slow nodal rhythm. Of the 12 patients, 7 died; the cause of death in 5 was extensive myocardial infarction resulting in an irreversible fall in cardiac output despite satisfactory pacing, and in the other 2 a late recurrence of heart block. Drugs such as atropine and isoprenaline for slow rates following acute myocardial infarction have not proved entirely satisfactory, since their response is often unpredictable and dangerous arrhythmias may be produced. A good case can be made for always monitoring the cardiogram following cardiac infarction and treating any evidence of atrio-ventricular block by endocardial pacing. Since atrio-ventricular block may recur some days after recovery of normal conduction, artificial pacing should be continued for at least 3 weeks unless a reliable ventricular inhibited pacemaker is available. Ectopic foci may be safely suppressed during pacing by procaine amide or *B*-blocking agents.

ANTICOAGULANT THERAPY IN CORONARY ARTERY DISEASE

S. Wessler MD and L. W. Gaston MD, (From the Department of Medicine, Washington University School of Medicine and The Jewish Hospital of St. Louis, St. Louis, Missouri.) Circulation 34: 856–864, November 1966.

This article is a review of our present knowledge of anticoagulant therapy in coronary artery disease and is presented as a special article. Forty references are listed. Subject headings are: Acute Myocardial Infarction; Post-Myocardial Infarction, Long Term Treatment; Angina Pectoris and Coronary Insufficiency; Peripheral Embolization Following Myocardial Infarction, Management of Anticoagulant Therapy; Selection of the Patient; Administration of the Anticoagulant Drugs; and Laboratory Control. A table depicting the current concept of the coagulation system is shown.

The authors summarize the review with the following conclusions based on information available at the present time:

1. Anticoagulant therapy is clearly effective in treating and preventing venous thrombosis and pulmonary emboli.

2. If used in the treatment of acute myocardial infarction, anticoagulant drugs may salvage 3 to 4% of the treated population. This small gain is probably achieved by the prevention of thromboembolic episodes. While only a small percentage of patients are benefited, the actual number of persons salvaged is relatively great because of the large size of the population at risk. In the considerable majority of treated patients who do not benefit from coumarin drugs, the therapy need do no harm, if proper safeguards are employed in the selection of patients and the administration and laboratory control of the drug.

3. In long-term therapy of patients who have recovered from acute myocardial infarction, it appears that men, especially below age 60, may be helped for the first 1 or 2 years after infarction.

4. More data are required to evaluate the role of anticoagulant treatment in patients with angina pectoris or coronary insufficiency. For the present, the physician may reasonably be influenced in the use of anticoagulant therapy by the recent onset of symptoms, the patient's age, and the family history.

5. Although appropriately controlled studies are lacking, it appears as though patients with peripheral emboli secondary to coronary artery disease may be benefited by anticoagulant therapy.

DENTAL SECTION

HISTOLOGIC STUDY OF CELLULAR MOBILIZATION AND REPAIR FOLLOWING A PERIOSTEAL RETENTION OPERATION VIA SPLIT THICKNESS MUCOGINGIVAL FLAP SURGERY

H. Staffileno, S. Levy, and A. Gargiulo, J Periodont 37(2): 117–131, Mar-Apr 1966.

This investigation was carried out to observe (1) the cellular mobilization in the soft and hard tissues of the periodontium following periosteal retention after mucogingival flap surgery; (2) the rate of repair of these tissues back to a functional state and (3) whether anatomical deformity resulted.

This investigation was conducted on three adult dogs with completely erupted permanent teeth. The surgery involved the free gingiva, attached gingiva and the alveolar mucosa in the buccal region of the mandibular premolar teeth. Each surgical procedure involved only one quadrant of either jaw at a time. Two vertical incisions, penetrating the fibrous periosteum, were made from the free gingival margin to the vestibular mucosa, one mesial to the first premolar and the other distal to the third premolar. A third incision was made at the bottom of the gingival sulcus. The size of the flap was approximately 10 mm. vertically by 36 mm. mesiodistally. This provided the outline of a flap which was made up of one-half of the papillary gingiva, as well as marginal, attached, and unattached vestibular gingiva. This flap was delicately dissected from the attached underlying tissue so as to leave a stump of tissue attached to the tooth and to the periosteum. The dissection was made in the deep layers of the lamina propia. This split-thickness gingival flap was severed at the line of reflection and discarded, leaving the periosteal connective tissue exposed. Healing took place by secondary intention.

Healing and repair were uneventful. The epithelium proliferated rapidly and covered the wound in seven days. Although other studies reported a technique problem of sustaining a desirable thickness of periosteum, in this study, all postoperative specimens taken in the early hours and days showed reasonably similar thickness of periosteal connective tissue over the bone. This consistency was attributed to the split technique that was employed. No osteoclastic activity was observed in the periodontal ligament structure. The limiting line seemed to fall within the marrow spaces. This is in contrast to reports of alveolar bone resorption in the periodontal ligament space induced by periosteal retention surgery.

This study supports the hypothesis that a split thickness mucogingival flap with periosteal retention results in, (a) minimal tissue destruction, (b) rapid repair, (c) slight alteration of the dentogingival junction and (d) maximum preservation of periodontal supporting structure.—Submitted by CAPT P. C. Alexander DC USN, 5th Marine Div, FMF, PAC.

ORAL TISSUE RESPONSE TO CHEMICAL ADHESIVES (CYANOACRYLATES)

S. N. Bhaskar, J. R. Jacoway, P. M. Margetis, F. Leonard, and K. C. Pani, Oral Surg Oral Med & Oral Path 22(3): 394–404, Sept 1966.

This report is devoted to an area of recent development in the field of experimental maxillofacial surgery. It deals with the preliminary data on the application of chemical adhesives in oral surgery, and represents a joint study conducted at the Walter Reed Army Medical Center.

In this investigation, methyl, ethyl, propyl and butyl cyanoacrylates were tested on experimentally produced tongue injuries in 100 rats.

Two of the most important steps in the management of oral wounds are hemostasis and alignment of the damaged tissue to its original form. Conventional methods are time-consuming and require highly trained personnel and well equipped facilities. The interest in the development of chemical adhesives has stimulated hope that they may be time and personnel saving adjuncts in the management of wounds. Results showed that the methyl group was the least desirable, whereas the butyl group exhibited qualities for possible future clinical application. —Submitted by CDR H. S. Kramer DC USN.

ORAL SURGERY-ORAL PATHOLOGY CONFERENCE NO. 18 WALTER REED ARMY MEDICAL CENTER

S. N. Bhaskar, J. Frisch, P. M. Margetis, and F. Leonard, Ora Surg Oral Med & Oral Path 22(4): 526–535, October 1966.

This article describes the effect of using butyl

cyanoacrylate in human oral tissues as a wound adhesive. It was applied as a thin spray in 105 patients in 276 applications following periodontal and oral surgical procedures, as a dressing.

It appears that butyl cyanoacrylate is a far better periodontal dressing than any in use at the present time. When applied on extraction sites, it produces immediate hemostasis. Over large areas of mucosal ulceration it produces transitory relief from pain and discomfort. The covering lasted about two days. Further studies of its application are being conducted.—Submitted by CDR H. S. Kramer DC USN.

PERSONNEL AND PROFESSIONAL NOTES

REQUEST FOR JOURNALS

Copies of all editions of the following professional journals for use in the Dental Officer Residency Training Program are urgently desired:

Journal of Oral Surgery
Journal of Periodontics
Journal of Prosthetic Dentistry

Send direct to: Dental Department, Naval Station, Treasure Island, San Francisco, California 94130.

NURSE CORPS SECTION

PROGRAMMED INSTRUCTION

A relatively new method of teaching called "programmed instruction" is gaining wide acceptance in nursing education as well as in other specialized fields and general education. One of the primary assets of this method is that it provides an efficient method of learning with or without the aid of an instructor. Programmed instruction may utilize such devices as teaching machines and films, however, in many cases merely paper and pencil are utilized. Because subject matter is presented in a step by step manner requiring that the student respond and learn the correct response to each step, this method of teaching is one in which the student can proceed at his or her own pace.

Recently the Nursing Division, Bureau of Medicine and Surgery, has recommended the following programmed instruction courses, published in the American Journal of Nursing, for reading by all Nurse Corps officer personnel:

1. "Programmed Instruction for Respiratory Tract Aspiration"
2. "Rehabilitation Aspects of Nursing"

CDR Florence K. Job NC USN, completed a project as part of a course in programmed instruction that she was enrolled in at the U.S. Naval Base, Great Lakes.This project was subsequently used as part of the staff education program in the U.S. Naval Hospital, Great Lakes in an attempt to determine the value of "programmed instruction" as a teaching method for Hospital Corpsmen assigned to the Nursing Service Department. CDR Job's remarks concerning "programmed instruction" and her views on how this method of instruction can be utilized in staff education programs for nursing service are presented in this issue. The title of the programmed course written by CDR Job is entitled "Nursing Care of the Patient with a Myocardial Infarction". Space does not permit publication of the course in the U.S. Navy Medical News Letter, however, interested individuals may contact CDR Job who is currently assigned as Chief, Nursing Service, U.S. Naval Hospital, Charleston, South Carolina 29408 for further information.

OCCUPATIONAL MEDICINE SECTION

HEALTH HAZARDS ASSOCIATED WITH WORK IN CONFINED SPACES

Morris Kleinfeld MD and Benjamin Feiner, New York, N. Y.,
JOM 8(7): 358-363, July 1966.

At all too frequent intervals, the industrial hygiene literature will report an overexposure of a worker to a toxic concentration of a chemical in a tank, manhole, or other confined space. Incidents of this type have been so commonplace that, unless they contain a unique feature, are usually deemed worthy of only a brief note in a journal or a short paragraph on the back pages of a newspaper. The increasing frequency of such incidents prompted steps by the American Standards Association to initiate a project on safety requirements for working in tanks and confined spaces.

In terms of acute exposures, such incidents constitute a significant cause of occupational disease and death. They have been given such wide publicity in the past that the potential hazards of entering a confined space should be clearly recognized. The usual physical difficulty in entering a confined space, the frequently greater difficulty in leaving one, and the uncertainty of what may be encountered should of themselves act as signals of danger.

Safe procedures have been reported and described time and time again. Why then do these accidents continue to occur? All too frequently, workers are killed by hydrogen sulfide in sewer manholes; by carbon dioxide in ships' holds; by trichlorethylene vapor in degreasing tanks; or by lack of oxygen in void spaces. These accidents continue to occur because of ignorance, apathy, and negligence in work situations requiring entry into a confined space. In many instances the confined space need not have been entered at all. A simple change in procedure such as high pressure water- or steam-cleaning would have obviated the necessity of entering a tank to clean it.

Characteristics of Confined Spaces

A confined space is one, usually with a relatively small volume, in which infrequent or irregular inspection, maintenance, repair, or cleaning operations are performed. It is frequently denoted in terms of unfavorable natural ventilation. New York State Industrial Code Rule 12, "Control of Air Contaminants in Factories," defines a confined space as "a space so enclosed that dangerous air contamination therein cannot be prevented or removed by natural ventilation through openings in the enclosure." Examples of conventional confined spaces which meet this definition include tanks, vats, reaction vessels, boilers, sewers, compartments in ships' holds, and degreaser pits. However, this definition does not include all work environments which should be considered confined spaces. It should be broadened to include the concept that a confined space is one in which one or more of the inherent safety features of an ordinary workroom do not exist. Thus, in addition to the absence of means of natural ventilation, a confined space may be considered as one wherein (1) the volume is so small that even uniform diffusion of evolving gases or vapors throughout the entire space would not always prevent the formation of a toxic concentration in the worker's breathing zone; (2) there would not be other workers in a nearby uncontaminated vicinity who could observe and rescue a suddenly overcome worker; and (3) the openings are so remote or small that ready access or egress for removal or treatment of an unconscious worker is difficult. By this definition, a small, poorly ventilated workroom in a basement or remote location of a plant, in which only one worker can enter with no other workers in sight or hailing distance, would constitute a confined space. An incident which caused death due to methylene chloride inhalation occurred in just such a workroom. This incident will be described below.

Concepts of Toxicity in a Confined Space Atmosphere

Along with this broadened concept of a confined space, we must include a broadened and precise concept of the term "toxic" and "non-toxic" and their application to confined spaces. For example, carbon tetrachloride is very highly toxic and methylene chloride is a relatively innocuous agent. Yet,

the former can be used safely with proper controls and the latter, which is generally considered a safe solvent, can cause death, particularly in a confined space. A simple hypothetical example will demonstrate this.

In a workroom 100 x 50 x 20 ft. (100,000 cu. ft.), with no natural or mechanical ventilation, uniform diffusion of a particular quantity of methylene chloride will create a concentration of 500 ppm, the threshold limit value. Under favorable conditions, this concentration can be safely tolerated by a healthy young male worker for 8 hr. a day for an indefinite period. This same quantity of methylene chloride, evaporated and uniformly distributed in a confined space of 10 x 10 x 5 ft. (500 cu. ft.) such as a tank, will result in a concentration of 100,000 ppm. This concentration will rapidly cause unconsciousness and even death if rescue is not prompt.

Such contrasting situations are frequently encountered in, for example, the use of a given type of paint in manual brush application to walls in a large workroom as compared with similar application to the interior surface of a boiler or water tank. Painting workroom walls in this manner usually presents no problem, whereas the same procedure in a confined space all too frequently does.

Thus, the use of terms such as "toxic", "non-toxic" and "safe", when applied to industrial air contaminants, can create false and dangerous illusions. A worker using a "safe" solvent in an ordinary large workroom at an operation not requiring local exhaust ventilation may not recognize any danger when he may be exposed to high concentrations of vapors of the same solvent at a similar operation in a confined space. The sense of smell cannot be relied on in such instances as a warning system because olfactory fatigue usually occurs rapidly. Familiarity and the pleasant nature of some odors also lessens the effectiveness of smell as a danger indicator.

In an absolute sense there are no non-toxic materials. There are toxic concentrations or toxic ranges of materials. Similarly, one should never assume that an operation in a confined space is a safe one, insignificant as the operation may appear. An operation of relatively long duration in a confined space will naturally present the greatest danger, but in many reported instances, exposures to high concentrations even for as short a time as it takes to retrieve a dropped object from within a tank have caused death.

Thus, the substances to be regarded as dangerous in a confined space can cover practically the entire spectrum of gases and vapors found in industry. These agents may be present in the confined space (1) as a consequence of the operation which is being performed, as when trichlorethylene vapor is released when cleaning the sludge from the bottom of a degreasing tank; (2) as an insidious effect incidental to the operation itself, as when oxygen deficiency is caused by fermentation in a grain silo; or (3) before entry, as in the case of hydrogen sulfide gas in a sewer.

Data on Confined-Space Incidents

Incidents occurring over the past 5 years and resulting from work in confined spaces were reviewed. Most of them demonstrated a number of common characteristics. A man enters a vat, tank, or sewer and sooner or later it is noticed that he is unconscious. A second man enters to help him and also collapses. This type of situation has been summarized in a statement which is overdramatic but uncomfortably close to the truth: "The first victim was murdered; the subsequent victims committed suicide." In brief, the first man was required or permitted to enter a potentially dangerous atmosphere with few or no safeguards. The other, in an instinctive and highly commendable rescue attempt, did not stop to consider that he too could succumb to the same conditions which affected the first worker.

It is noteworthy that of the 21 instances, approximately 57% resulted in 1 or more fatalities. In the 9 instances in which no fatality occurred, many of the workers involved were, however, seriously affected.

The operations or processes involved in these incidents included cleaning, repairing, entering, yeast pushing, painting, retrieving, drumming, and fire extinguishing.

Causative Agents

The known or suspected causative agents are listed below.

	Workers affected	
Causative agent	No.	%
Lack of oxygen	6	13
Trichlorethylene	6	13
Hydrogen sulfide	7	15
Carbon dioxide	4	9
Gasoline	2	4
Methyl chloroform	4	9
Methylene chloride	2	4
Methyl cyanide	3	7
Miscellaneous	12	26
Total	46	100

Lack of oxygen was the principal single cause. In many instances, oxygen is removed from the air by processes such as fermentation which simultaneously release carbon dioxide. In some of the cases listed above excessive carbon dioxide caused a lowering of oxygen content in the confined-space atmosphere and hence both contributed to the accident. Frequently, slow oxidation, such as that occurring during rusting of the walls in a deep, unused ship compartment, will remove oxygen from the air to a point where the atmosphere will not support life. The presence or use of gases such as carbon dioxide or nitrogen may replace the air in a confined space. The presence of carbon dioxide, which is frequently associated with the lack of oxygen, aggravates the problem of oxygen diminution. The other causative agents encountered were those usually involved in such accidents. They included hydrogen sulfide, which is frequently present in sewers, and solvents such as trichlorethylene, methyl chloroform, and methylene chloride, which are used industrially in a variety of cleaning and degreasing processes. One of these agents, methyl cyanide, is not normally encountered but was an ingredient in a protective coating being applied to the interior of a tank.

Types of Confined Spaces

The largest category of confined spaces consisted of tanks, vats, and similar enclosures with limited access and little or no ventilation. The remainder included grease pits, an underground transformer vault, and sewer manholes. Of particular interest was one incident occurring in a small room which might not ordinarily be considered a confined space but which met the broader definition of "confined space" given above. In this room, the causative agent was methylene chloride, which is considered to be a safe solvent. However, in this particular situation, the massive concentrations released caused two fatalities.

Recommended Safe Practices for Work in Confined Spaces

The safety procedures outlined below, if applied universally, would largely eliminate the deaths and serious illnesses which frequently result from unsafe conditions in confined spaces. They should be part of the safety manual of every large company with a well-established safety program and an industrial hygiene or safety engineering staff.

The problem of the small company, or the small outside contractor who may be called in for repair or maintenance work in a confined space, does not lend itself to so simple a solution. Such firms do not usually have a safety program and supervision of workers is apt to be casual. People having responsibility for safety may not be aware of the hazards themselves. Any program to educate management and labor in a small plant must impress on them that it is necessary (1) to provide adequate safety equipment; (2) to set up and enforce proper confined-space procedures; and (3) to view any entry into a confined space for any purpose for any length of time as a potentially dangerous operation requiring suitable safeguards.

Safety procedures for work in confined spaces may be outlined as follows.

Preparation and Testing Before Entry

1. When necessary, clean the space to remove all residual contaminants such as solvents and organic materials.

2. Check the atmosphere within the space for toxic airborne contaminants and oxygen concentration. Numerous direct-reading devices are available to monitor for the most commonly encountered contaminants. Special methods should be devised for most of the others.

3. Close and lock all valves and switches connected with the operation of the confined space to prevent accidental introduction of contaminants or starting of equipment within the space when it is occupied.

4. Purge the space by ventilating for as long as necessary to reduce any contaminants to safe levels.

5. Remove all possible sources of ignition if flammable or combustible materials may be present or created.

6. Provide such protective clothing as may be necessary.

7. Provide respiratory protective equipment if the need for it exists or can arise during occupancy. Such equipment must consist of supplied air or oxygen respirators, either of the hose or self-contained type, to provide protection in oxygen-deficient or massively contaminated atmospheres.

Safeguards and Precautions During Occupancy

1. If possible, provide continuous ventilation during occupancy. Such ventilation is mandatory when a contaminant is being continuously generated. Special purification techniques are also available, such

as the use of a chemical which absorbs carbon dioxide and releases oxygen.

2. Provide the worker with a harness attached to a life-line constantly held by a second, stand-by worker in the confined space. This will permit rapid removal of the worker in an emergency. A third worker should be within hailing distance to provide assistance if necessary.

3. If possible, provide a means of communication between the worker and the outside since the worker may suddenly begin to feel distress and not be able to summon help. Frequently, the bodily positions which are assumed in confined-space work may make it difficult for an outside observer to detect an unconscious worker. One simple method of communication is the use of an alarm which goes off at 5-min. intervals and rings until shut off by the man in the confined space. Prolonged ringing will signify trouble.

4. When flammable vapors may be present or released, all equipment should be spark- and explosion-proof. This includes equipment used for operations as well as for rescue purposes.

Rescue and Emergency Treatment

1. The two stand-by workers should be well trained in rescue techniques, first aid, and resuscitation.

2. Respirators, either of the supplied-air or self-contained type, must be immediately available for use by the rescue workers. If the worker in the tank does not normally use one, one should be available for him as well. These must be maintained in a constant state of readiness.

3. The worker should be removed from the confined space as soon as any sign of distress is evident. Contaminated clothes should be removed and emergency first-aid procedures, including resuscitation if necessary, should immediately be instituted by qualified personnel pending the arrival of a physician or removal to a treatment facility.

Summary

In 21 accidents during work in confined spaces, a total of 46 workers was affected. Negligence was the primary cause of death or injury. In each situation virtually no safety precautions were followed and no trained personnel were available to administer first aid immediately after the accidents occurred. Furthermore, in nearly all instances the accidents occurred in connection with the performance of maintenance and other special activities rather than in the course of routine operations.

Safeguards for work in confined spaces were outlined under three broad categories: (1) testing and preparation of the confined space before entry; (2) use of precautionary measures during occupancy; and (3) assurance of the availability of prompt rescue and adequate first aid should an accident occur.

REPORT OF AN INVESTIGATION OF THRESHOLD LIMIT VALUES AND THEIR USAGE

Committee on Industrial Hygiene and Clinical Toxicology, Harold H. Golz MD, Chairman, Waune, New Jersey, J Occup Med 8(5): 280-283, May 1966.

Promulgation of TLV's

For many years the Committee on Threshold Limits of the American Conference of Governmental Industrial Hygienists has published annually a list of TLV's. Each year, prior to publication, previously listed values are reviewed. If no change is indicated, these are carried forward under the heading "Recommended Values."

A second section of the booklet is titled "Tentative Values." This contains compounds previously listed for which changes in TLV are proposed, and new substances for which initial TLV's are proposed. When a previously listed compound is assigned a tentative value, it is removed from the list "Recommended Values." Substances assigned to the "Tentative List" remain there for at least 2 years. This 2-year tentative listing presumably was established to put interested persons on notice and to allow time for the presentation of dissenting data and opinions. After the 2-year period has passed, if no further revision is indicated, the substance is transferred to the "Recommended List"—where it assumes the status of a Recommended Value.

In 1964 the TLV Committee distributed for the first time a "Notice of Intent." This was a list of proposed new and revised TLV's that were on the Committee's agenda for action. Its purpose was to solicit comments and data.

Each year the booklet includes the following statement: "Threshold limits should be used as guides in the control of health hazards and should not be regarded as fine lines between safe and dangerous concentrations." Most persons skilled and experienced in the field of occupational health have used TLV's in this manner and have found them to be valuable tools in the management of health hazards of the industrial environment.

Misuse of TLV's

In the last few years there has been an increasing tendency to use TLV's in ways and for purposes for which they were never intended. These misuses include the following:

1. At least one attempt has been made to incorporate the entire list of TLV's in Federal legislation as standards of performance.

2. Many state and local health, labor, and safety departments give both the "Recommended" and the "Tentative" Values quasi or even de facto regulatory status.

3. TLV's are being cited increasingly in litigation and workmen's compensation actions as an official standard of performance, with the result that levels which exceed the TLV's are regarded as evidence of negligence.

These trends have apparently caused concern in the Committee on Threshold Limits for, in their publication "Threshold Limit Values for 1964," the following statement of policy was made for the first time:

Legislative Action. The Conference does not consider Threshold Limit Values appropriate matter for adoption in legislative codes and regulations and recommends against such use.

Despite this demurrer and the short interval since it was published, the 1964 list has already been incorporated into some state legislative codes.

It must be recognized that the existence of TLV's invites misuse, irrespective of what organization promulgates them. The improper use of these values, whether or not sanctioned by ACGIH, can profoundly affect industry in at least 4 ways: (1) by creation of unwarranted problems in labor relations; (2) by stimulation of unjustifiable claims in workmen's compensation actions; (3) by use of the values as evidence of negligence in legal actions; and (4) by forcing industry to institute unnecessary and costly changes in process and equipment, as well as in monitoring systems. Therefore, industry has a legitimate concern about the ways in which TLV's are determined and used.

It is recognized that ACGIH cannot control the way in which TLV's are used, but it is the only group that is potentially able to exert influence to encourage their proper use and to discourage their misuse.

Attitudes in Industry

In order to obtain a better definition of the problem to industry and to determine the attitudes and experiences of people in full-time occupational health work, the subject of TLV's was discussed informally with physicians and industrial hygienists. It was also discussed in meetings of various groups and industry associations.

The most significant thing that came out of these discussions was the remarkable amount of agreement on experiences, viewpoints, and attitudes. The majority of those interviewed thought that the Threshold Limits Committee is sincerely motivated, that it is genuinely solicitous of any evidence that might have a bearing on its deliberations, that it has shown some willingness to delay or even reverse its decisions when reliable dissenting data were placed before it, and that it has done a good job in discharging a difficult responsibility. Most agreed that the Committee is objective in its approach and few thought that it has acted in an arbitrary or capricious manner.

The expressions of dissatisfaction for the most part seemed to be prompted by proposed downward revisions of the levels for carbon monoxide, acetone, and other substances. It was felt that the evidence upon which the changes were proposed was meager and controversial, and it was assumed (probably correctly) that the proposed tentative values would be adopted as standards by local and state judicial and regulatory bodies.

Many people felt that the TLV Committee does not give sufficient consideration to the impact that new, and especially revised, TLV's may have on industry. The TLV Committee appropriately takes the position that its mandate is to guard the health and well-being of industrial workers. This position is above reproach if the TLV's are used as guides. A serious complicating factor in the usefulness of TLV's is industry's legitimate interest in the cost—

sometimes very great—that may be required in needless redesign of equipment and processes to meet a downward revision of a TLV.

It is significant that most felt that the Threshold Limits Committee could act only on the basis of factual data obtained in a systematic and scientific manner, and that it could not be expected to be influenced by empirical statements of experience unsupported by correlated and documented clinical and environmental data.

No one seriously questions that factual data derived from human experience are by far the most reliable basis for TLV's. The only significant source of such data is industry. Unfortunately, data of this kind are rarely available to ACGIH—either because industry has not taken advantage of its unique opportunity to develop them or because they remain hidden in industry's files for any one of several reasons.

It is in this area that industry has the greatest opportunity to make a significant contribution to the establishment of realistic TLV's and it is in this area that industry has contributed little. This is an important way in which industry can have a voice in the setting of TLV's and certainly a sustained effort along these lines is long overdue.

As evidence of the desire of the Committee on Threshold Limits to be objective and fair, the "Notice of Intent" is an important document. As a practical solution to a problem, it has not accomplished a great deal. For one thing, it does not seem to accomplish much more than has the list of Tentative Values, in the booklet issued annually.

There was substantial agreement that, to be meaningful, TLV's must be established by some group that is not only technically qualified but is also sufficiently interested to devote the considerable time and effort that are required and that, above all, can maintain a completely objective attitude. The ACGIH Committee meets these qualifications.

The suggestion has been made that industry should be represented on the Committee. We do not agree with this, because of the possible inference of bias, although we do feel that it is important that the Committee maintain an awareness of industry's viewpoint and problems. Ways in which this could be achieved should be explored.

TLV's are intended only as guides and are based on considerations of the health and well-being of the industrial worker. Industry takes no exception to this. Nevertheless, TLV's are becoming increasingly more important in legal actions and they are being misused to industry's disadvantage. Under such circumstances, industry's problems must not be ignored.

As currently constituted, the Committee has 12 members. Four of them are physicians. With but one exception, members of the Committee have had limited experience in industry.

An important criticism of the Committee is the fact that so few of its members are physicians. The Committee exists to preserve the health and prevent disease of human subjects. To do this adequately, it must sift and evaluate evidence, much of which is of a clinical medical nature. It must interpret this evidence against a background of accumulated medical experience and consider it in the light of the predictable responses of human subjects. To a large extent the job requires clinical judgments on clinical data based on clinical experience. Greater representation by physicians, especially those more experienced in occupational medicine, would be more realistic.

In our opinion it is undesirable that far-reaching decisions on questions that are basically medical in nature are made by a committee two-thirds of whose members are not medically trained. Obviously, many technical skills are needed on the Committee, but we think that physician representation should be at least 50%.

Conclusions and Recommendations

1. The Committee on Threshold Limits of the American Conference of Governmental Industrial Hygienists has generally done an excellent job in discharging a difficult responsibility. Industry should give its encouragement and support to the Committee and should cooperate with it to the maximum feasible extent.

2. Threshold Limit Values are being used increasingly in ways and for purposes for which they are not intended.

3. ACGIH should be urged to make a greater effort to promote the concept that TLV's should be used only as guides, and to direct a major campaign toward members of the Conference to ensure that this concept is recognized, accepted, publicized, and practiced.

4. TLV's should be based upon substantial medical and environmental evidence that is acceptable to physicians and industrial hygienists qualified to render judgments concerning the materials in question.

5. With regard to "Tentative Values," the TLV Committee should be asked to consider carefully the following suggestions:

a. Remove the table of "Tentative Values" from the annual booklet of TLV's and publish it separately under the heading of "Notice of Intent." This would diminish the tendency to equate Tentative and Recommended Values, which leads to the use of Tentative Values as standards.

b. Publish the new "Notice of Intent" widely in scientific journals oriented to industrial health, along with documentation for the proposed new values.

c. Not assign TLV's until 2 years after publication of the "Notice of Intent."

6. ACGIH should be urged to modify the composition of the Committee to provide for greater physician representation.

7. The Committee on Threshold Limits should be urged to give greater consideration to the effects of its actions upon industry, for even under the most ideal circumstances TLV's are bound to be accorded regulatory status in certain quarters and evidential weight in legal actions.

8. We do not believe that industry should be represented directly on the Committee, but we do believe that an advisory committee of industrial physicians should be established.

9. It is of the utmost importance that industry make a concerted sustained effort to gather correlated clinical and environmental data that will contribute constructively to the establishment of realistic TLV's. Such data should be made known to the TLV Committee and preferably published. A certain amount of such information probably already exists in industry's files. However, industry must recognize that to have an effective voice in setting TLV's it must be willing to share its relevant data with the Committee.

10. A study should be made of the feasibility of establishing an independent or industry-supported clearinghouse for collecting toxicological, clinical, and exposure data. If properly organized, this could assure scientific accuracy, freedom from suspicion of bias, and anonymity of source.

EDITOR'S SECTION

NAVYMAN SAVES CHILD'S LIFE

Eighteen month old Arturo Ocampo, Jr. is a very lucky boy because of a very rare man. Arturo would not be alive today if it weren't for the efforts of Ralph D. Russell.

Russell, a Navyman for 20 years, was on the way to make a phone call near his home in San Patricio on September 17 when he heard cries for help of two women in an approaching car. He was soon confronted with a panic stricken mother holding a critically convulsed child in her arms. Quickly taking the child from his mother's arms he applied emergency treatment which prevented Arturo from swallowing his tongue. After the boy's breathing was restored, Russell rushed him to the San Patricio Veteran's Hospital in Caparra Heights.

A simple story, but one in which few men would have had the professional competence and presence of mind to react as did Russell. Russell says only, "I did what anyone else would've done if they had been in the same position."

CAPT F. W. Armington of the U.S. Navy Medical Corps commended Dental Technician First Class Russell for, "His prompt action in restoring the airway of the child, and in the institution of artificial respiration undoubtedly prevented the child from dying of asphyxiation."

Russell's Commanding Officer at Naval Communication Station Puerto Rico, CAPT N. W. Gill, congratulated Russell for his ". . . sincere devotion to duty and humanity . . . in keeping with the highest traditions of the U.S. Navy."

Mrs. Aurora Ocampo could but find the words, "Thank You," to express her deep appreciation.—Story by CT2 Alan W. Burton.

MEMBERS OF SWEDISH RESEARCH INSTITUTE OF NATIONAL DEFENSE VISIT THE NNMC

On 28 November 1966, MGEN Sven B. Hasselrot, Swedish Army (R), CDR Evert E. Schildt, Jr., Royal Swedish Navy and Mr. Henry Ingemar Widegren of the Swedish Research Institute of National Defense in Stockholm visited the National Naval Medical Center.

During their visit, CDR Schildt presented a copy of his book "Nuclear Explosion Casualties" to CAPT J. H. Stover, Jr., MC USN, Commanding Officer, U.S. Naval Medical School, for use in the E. R. Stitt Library of the National Naval Medical

Center. Pictured above, left to right, are Mr. Widegren, CDR Schildt, CAPT Stover and MGEN Hasselrot.—Public Affairs Office, NNMC, Bethesda, Md.

SENIOR FOREIGN MEDICAL OFFICERS' COURSE GRADUATES

The U.S. Naval Medical School, commanded by CAPT J. H. Stover, Jr., MC USN, graduated the 1966 class in "U.S. Naval Medicine" for Senior Foreign Medical Officers.

In addition to important aspects of U.S. Naval Medicine, this fourteen week course included field trips to certain U.S. Naval Activities and civilian institutions of significant medical interest.

Speakers at the Graduation Ceremony included RADM R. O. Canada MC USN, Deputy Surgeon General, U.S. Navy, and CAPT J. H. Stover, Jr., Commanding Officer, U.S. Naval Medical School, National Naval Medical Center, Bethesda, Maryland. Presentation of Certificates was made by CAPT William B. Hayler USN, Head, Foreign Naval Training Branch, Foreign Military Assistance Division, Office of the Chief of Naval Operations.

Graduates of this year's class include CDR Chihliang Yuan of the Republic of China, CDR Martin Kultzen and CDR Hans-Wilhelm Birker of the Federal Republic of Germany, CDR Agostino Di Donna of Italy, CAPT Kyu Ho Han of the Republic of Korea, LT Artemio Gragera Petiza of the Republic of the Philippines, CAPT Biriya Hotrabhavananda of Thailand, and LCDR Nguyen Sanh Nghia of the Republic of Vietnam.—Public Affairs Office, NNMC, Bethesda, Md.

CAREER OPPORTUNITY

The Bureau of Medicine and Surgery has a continuing program for the planning, development, and production of a wide variety of audiovisual materials, including motion picture films, scientific exhibits and television systems for Medical Department training requirements. The Bureau will be pleased to accept applications from medical officers with the rank of Commander interested in being assigned to this challenging field. Short courses will be arranged in a university to provide professional training in motion picture and television production and related communication techniques. Applications should be addressed to: Chief, Bureau of Medicine and Surgery, Department of the Navy, Washington, D.C. 20390, Attn: Code 31.

NAVAL MEDICAL DATA SERVICES CENTER

The newest member of the National Naval Medical Center family is the Naval Medical Data Services Center. The data services center was established on 1 July 1965 to provide for consolidation of automatic data processing services for the Bureau of Medicine and Surgery and NNMC Bethesda and component activities. The NMDSC is responsible for coordination and operation of integrated data processing services for naval medical statistical and other data systems on a world-wide basis as directed by BUMED and higher authority. CDR John E. Wells MSC USN is assigned as the Officer in Charge, NMDSC and the Director Data Processing Division, BUMED.

The data center is divided organizationally into three major divisions: *Systems Division*—providing systems analysis, development, and programming of automatic data processing procedures for the operation of integrated naval medical data systems and the guidance and direction of naval medical data processing installations; *Operations Division*—providing the operation of electrical accounting machine equipment, electronic digital computer equipment, data communications equipment, optical scanning equipment, and computer software programs; and *Statistical Division*—providing for the receipt, review, analysis, and control of data used in the preparation of statistical presentations, control and distribution of outgoing automatic data processing reports, and the release and control of all statistical data generated manually or by data manipulation equipment.

The NMDSC, as a BUMED command activity, is directing major efforts towards the development and

establishment of a Totally Integrated World-wide Naval Medical Information System for processing all Navy Medical workload and statistical data collected from 300 medical facilities ashore and 1,000 medical departments in ships, or a total of 1,300 activities, all of which will be provided by BUMED support activities having automatic data processing and transmission capability. It is planned to establish 4 regional computer centers with capability for data processing, transmission, and information interchange. The computer centers are strategically located at naval hospitals and medical centers to provide optimum regionalization of naval medical information and afford local computer support of major medical research programs. Each of these 4 computer centers will have as satellites all of the naval hospitals in its regional area. Each of the satellite naval hospitals will further act as data processing centers for smaller medical facilities in its particular area. Individual naval hospitals will possess capability to (1) prepare data cards for the hospital and assigned medical satellite activities, (2) transmit data electrically to the regional computer center and (3) receive printed output reports electrically from the regional computer center. For example, each naval hospital will transmit admission, disposition, and other changes on inpatients daily to the regional computer center. The regional computer center will process these changes, using standard programs, and electrically transmit to satellite hospitals the daily patient report—listing all remaining patients by professional service, ward, patient category, etc. Then the regional computer center will transmit the changes to the central computer center in Bethesda.

The results of this Naval Medical Information System contemplate improved management resulting in increased data processing and data communications capability at naval hospitals and medical centers; faster transmission, processing, and reporting of naval medical information for local, regional, and central management of medical care programs; elimination of periodic and special reports by field activities; and improvement in data retrieval capability for business applications, medical workload and statistics, and medical research.

The Naval Medical Data Services Center is presently installing a UNIVAC 418 Model II computer system as the keystone of the planned data processing and communications network. This computer system will provide data processing support to the National Naval Medical Center and its several component commands for business management, naval medical information, and medical research.—Public Affairs Office, NNMC, Bethesda, Md.

MEDICAL GROUP SEES TESTS AT AEROSPACE CREW EQUIPMENT LABORATORY SITES

Nine foreign medical officers who are currently studying Basic Naval Medicine at the Naval Medical School, Bethesda, Maryland, visited the Naval Air Engineering Center, Philadelphia, Pennsylvania, on October 23, 1966.

CAPT Roger G. Ireland MC USN, Director of the Aerospace Crew Equipment Laboratory, hosted the tour. The group toured the Laboratory facilities and received briefing from Laboratory personnel. They saw live and anthropometric dummy shots on the vertical ejection seat tower and the horizontal accelerator sled respectively.

The officers have toured various naval complexes in the United States under the sponsorship of the Chief of Naval Operations. The officers represented Colombia, Nationalist China, Germany, Italy, Korea, Philippines, Thailand, and Vietnam.—Public Affairs Office, BuMed.

OPERATING ROOM FIRE HAZARD

Certain direct recording instruments (Beckman Dynograph, Sargent SR, Sanborn, Texas Instrument Oscilloriter) use a wire stylus, heated by an electric current, which makes contact with a wax coated, heat sensitive paper. Because of the exposed hot wire and general construction, direct writers of this type should not be used in an explosive atmosphere. The authors describe a situation which might have resulted in tragedy. A Sanborn recorder was being used during an operative procedure. In attempting to examine a portion of the record the paper drive mechanism jammed. While trying to clear the fault a torn edge of the paper came in contact with the incandescent filament and ignited. A 6 x 2 in. portion of the paper burned vigorously until extinguished by smothering. Fortunately, a nonflammable anesthetic (halothane) was being used and no explosion resulted. However, the mere presence of an open, potentially uncontrollable, flame in the operating room, where oxygen and flammable materials were present, was a potentially dangerous situation. Recorders which do not operate on the heated stylus principle include Gross and Beckman ink writers and photographic types offered by various manufacturers.—Wald & Mazzia (New York, N.Y.), Anesthesiol 27:858 (Nov-Dec), 1966.—Republished from Clin-Alert, No. 315, November 30, 1966, by permission of Science Editors, Inc.

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