ANESTHESIA FOR NAVAL AIR PERSONNEL: EXPERIENCES AT A NAVAL HOSPITAL

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ANESTHESIA for naval air personnel is never uninteresting and never routine. The condition of the patient varies from that of the normal healthy young male to the seriously injured man with many wounds and in profound shock. This change in the type of patient to be treated usually takes place in a matter of minutes and circumstances may not permit of any warning.

It is necessary to have an organization capable of instantly adapting itself to caring for these emergencies. However, a discussion of organization will not be given. Organization is no problem in a well-established, well-equipped, and well-commanded naval hospital. No naval hospital is devoted to a particular branch of the service or service personnel. This naval hospital is situated in an area given over largely to the training of naval and marine air personnel of all ranks and grades. Consequently, most of the patients have been engaged in naval and marine air activity. The experience presented here is not based on a large series of cases because a great number were not available. It is no violation of military secrecy to state that the number of accidents occurring in naval air training was phenomenally low.

Plane accidents occurring on the ground or in the air are different from the accidents seen in ordinary civilian or industrial practice. The men injured are much more seriously hurt, both as to the extent and severity of their wounds. These injured men are casualties of war presenting all the anesthetic problems of this type of patient. However, they have two distinct advantages in their favor. They have not been injured in the dirt and confusion of the battle lines and they are usually in the hospital a very short time after the accidents. This latter fact may not be true in all cases, however, since some crashes occur in isolated forest or swampland.

From January 1, 1943, to August 1, 1944, a period of nineteen months, 1885 patients were treated in the operating room, with a corresponding number of anesthetics. The division of these cases into the various surgical specialties is seen in table 1.

The opinions and assertions expressed herein are the private ones of the writer and are not to be construed as official or reflecting the views of the Navy Department or the Naval Service at large.

These figures do not reveal the true incidence of operations at this hospital but represent only those cases requiring the presence of an anesthetist. Consequently, such operations as tonsillectomy, circumcision, cystoscopy and similar operations in which the anesthesia may be instituted by the surgeon do not appear here. Also not to be discussed is the anesthesia for the out-patient department, since it varies not at all from that employed in private practice.

TABLE 1

DIVISION OF CASES

General Surgery	1192
Orthopedic Surgery	318
Proctology	159
Ear, Eye, Nose, Throat and Dental Surgery	100
Urology	71
Neurosurgery	34
Thoracic Surgery	11
Total	1885

The anesthetic agents and their combinations used in these cases are outlined in table 2.

Consideration of the anesthetic agents and their combination reveals a difference in the proportion in which these agents are used in military practice as opposed to civilian practice. Spinal and intravenous anesthesia were used in the greatest number, while inhalation anesthesia was used in the smallest number of cases. Its relative infrequency of use, plus the fact that many of the cases were done by using the open drop and pharyngeal insufflation methods, was the instrumental factor in determining not to obtain cyclopropane or ethylene. The value of

TABLE 2

ANESTHESIA

Inhalation	
Ether closed—CO_2 absorption	6
Ether closed—suspension laryngoscopy	2
Endotracheal ether—CO_2 absorption	60
Pharyngeal insufflation	6
Open drop ether	3
Open drop vinethene	1
Local and Regional	
Procaine 2%	302
Procaine 2% plus pentothal	2
Procaine 2% caudal	2
Procaine 2% popliteal block	1
Procaine 2% paravertebral block	2
Procaine 2% field block and lumbar paravertebral block	1
Procaine 2% brachial plexus block	2
Metycaine 2%	9
Metycaine 2% intercostal block	1
Metycaine 2% brachial plexus block	16
Ethyl chloride spray	1
Intravenous	
Pentothal	448
Pentothal and GOE	49
Spinal	
Procaine 5%	689
Procaine 5% unsat.—pentothal added	31
Procaine 5% unsat.—local added	2
Procaine 5% unsat.—GOE added	8
Procaine 5%—elective supplement	5
Metycaine 10%	15
Metycaine 10%—elective supplement	2
Pontocaine 1%—glucose 10%	205
Pontocaine 1%—glucose 10%—elective supplement	9
Fractional spinal	
Procaine	1
Pontocaine	4
Rectal (Basal narcosis)	
Avertin	2
Total	1885

these anesthetic agents is freely admitted. However, the explosive hazard they present, their potency, and the possibility of their use by unskilled personnel were potential disadvantages felt far to outweigh the advantage of their use in a very few cases.

CONSIDERATION OF PATIENT AND CHOICE OF ANESTHETIC

Surgical cases and anesthesia problems in this service may be roughly divided into two groups. The first group comprises those cases seen in any naval activity full of healthy young men. They are represented by appendectomies, herniorrhaphies, hemorrhoidectomies, etc. There are practically no anesthesia problems encountered here.

The second group consists of those cases occurring as a result of mishaps to air personnel either in the air or on the ground. These cases, it may be stated again, are much more serious than the usual case seen in civilian or industrial practice. Anesthesia becomes a very important consideration and at times may literally mean the difference between life and death. Examples of the injuries seen in this group are: compound fracture of the skull; multiple lacerations of the face, head, and hands; burns; extensive and multiple fractures; extensive and deep soft tissue propeller wounds. One group of four cases had nearly identical injuries. These men all were in planes which crashed from a height of about 500 feet. The injuries sustained were: compound fracture of the skull; compound fracture of the tibia and fibula; multiple severe lacerations of the face, hands, and scalp; fracture of the scapula; fracture dislocation, ankle.

In all the cases rises the problem of shock and its treatment. It can only be repeated that the value of plasma cannot be stated strongly enough. It has been life-saving in many instances.

Of prime importance to the anesthetist is the necessity of considering every victim of a plane crash as having an intracranial injury. This must be thought of even in the cooperative, seemingly alert, and well oriented patient. The experience here has been that practically all survivors of plane crashes remember nothing of their experiences for twenty-four to forty-eight hours after their accidents. One patient was apparently mentally normal with no sign of central nervous system involvement only to become unconscious within twenty-four hours and eventually to expire. Postmortem examination performed when indicated on crash victims usually reveals multiple petechial hemorrhages throughout the brain but most marked in the brain stem area. This means that the first consideration of the anesthetist is to avoid any anesthetic agent which produces unconsciousness. The interference with the metabolism of the central nervous system and the depression caused by inhalation and intravenous anesthetic agents may be fatal when added to the central nervous system already depressed by injury.

This is a situation which helps local and spinal anesthesia to appear on the records more often than in civilian practice.

Victims of plane crashes must be considered as having thoracic injuries also. They usually exhibit signs of lung consolidation of greater or lesser degree, thought to be caused by hemorrhage. One case of multiple severe injuries as a result of a plane crash terminated fatally the fifth day after the accident. The cause of death was bleeding into both lungs to such a degree that practically all alveoli were destroyed. At postmortem examination the lungs appeared to be a solid mass of hemorrhagic tissue. Although intravenous and inhalation anesthesia may have no bearing on such lung changes initiated by trauma, the avoidance of that type of anesthesia removes a possible complicating factor.

Lacerations may be sutured primarily in aviation accident cases with every expectation that they will heal. This is not comparable with the treatment of battle casualties and adds to the time given to the first treatment of the patients. This is an important consideration for anesthetist and surgeon. A quick survey of the condition of the patient is made by the surgeon and anesthetist and decision made as to the surgical procedures and the type of anesthesia which will be safe and satisfactory for the estimated required time.

The patient who has crashed in an isolated area and has not been found for several hours and then has been transported a considerable distance to the hospital is given shock treatment and only absolutely necessary first aid. Operative procedures on patients with extensive injuries may consume several hours. This would be fatal in these cases. The temptation to treat these injured men is great because they usually appear to be in good condition on admission. However, a moderately prolonged operation plus the necessary anesthesia more often than not sets up an irreversible and fatal shock reaction. Consequently, the anesthetist confines his activities to preparing these men for operation when their condition permits.

Not one instance of intra-abdominal injury has occurred in survivors of plane crashes. Perhaps the safety belt explains this fact. Whatever the reason, there has been no experience with this type of case. Mishaps on the ground among air crewmen have led to intra-abdominal injury. These occur mostly as a result of being crushed by hangar doors or being caught between tractors and some other vehicle or object. The result is a compression injury to the chest or abdomen very similar to that seen after the underwater explosion of depth charges when men are swimming in the area. Only one of these cases came to operation. This man had a complete disruption of his duodenum and extensive retroperitoneal soft tissue damage. He presented the moot question as to whether or not spinal anesthesia should be used in the presence of shock.

EXPERIENCE WITH SPINAL ANESTHESIA

It is recognized that spinal anesthesia is a form of regional anesthesia. However, it is given a column in table 2 because of its importance. Of interest is the number of spinal anesthesias with procaine which were unsatisfactory. These represent 5 per cent of the total number of procaine spinals. On the other hand, spinal anesthesia induced by metycaine 10 per cent and pontocaine 1 per cent-glucose 10 per cent was satisfactory in all cases. The cause of dissatisfaction with the procaine spinals was in most cases a duration of anesthesia of only fifteen to twenty minutes. In several instances anesthesia was never satisfactory at any time even though there was some obtundation of pain sensation for a few minutes.

This experience was not new and it coincided with that of other men on the hospital staff. The technic of induction of spinal anesthesia was the same in all cases. The procaine crystals were diluted in spinal fluid to a 5 per cent solution or 50 mg. per cubic centimeter. Therefore, it was assumed that the fault was inherent in the procaine crystals. The very dependability of metycaine and especially pontocaine-glucose was felt to add further evidence in support of this belief.

Many men object to the use of pontocaine in spinal anesthesia because it is reported to be more toxic than procaine. Adriani (1), using cocaine as standard one, gives the toxicity of procaine as one fourth and that of pontocaine as three to five. However, the dose of pontocaine is ten times smaller than that of procaine. This appears to be sufficient answer to the objection to pontocaine on the grounds of toxicity.

The various anesthesia technics will not be presented in this paper. The hyperbaric pontocaine-glucose solution was used according to the principles and technics first developed by Sise (2) and further perfected by Eversole, Hand, Nicholson, Schuhmacher and others at the Lahey Clinic (3, 4, 5).

Except for one hemorrhoidectomy in which no anesthesia was obtained, the unsatisfactory spinal anesthesia occurred mostly in abdominal or superficial abdominal (i.e., herniorrhaphy, appendectomy) surgical procedures. The obvious course was then followed. Procaine was used mostly for short anorectal procedures, urologic procedures about the scrotum, excisions of cyst teratoma, and short operative procedures on the lower extremities. Procaine is still used in many appendectomies and herniorrhaphies because it is easier to obtain in the naval service. Pontocaine-glucose, being an open purchase drug, was reserved for all upper abdominal surgery and cases of uncertain duration. Fractional spinal, using either procaine or pontocaine-glucose, was used for all gastrointestinal resections and other intra-abdominal procedures thought to require more than two hours.

There were two cases of pontocaine-glucose spinal in which anesthesia was not obtained within five minutes. The cause was assumed

to be faulty technic in lumbar puncture. As had been pointed out by nearly every writer on spinal anesthesia, in these cases the bevel of the needle bisects the dura and lies half within the subarachnoid space and half within the epidural space. These circumstances permit spinal fluid to be aspirated with little or no difficulty. However, the injection of the spinal anesthetic agent is necessarily accomplished under slight pressure. This seems to be sufficient at times to cause most of the anesthetic agent to be injected in the epidural space. With this in mind, when no anesthesia was obtained in five minutes the patients were immediately given another full dose of anesthetic agent. The same interspace or another was used for lumbar puncture. There was no untoward effect on blood pressure, pulse, or general physical condition of the patient. There was no accumulative effect of the anesthetic agent and no prolongation of anesthesia time. The five-minute rule with pontocaine-glucose is considered satisfactory and the repetition of the attempt at spinal anesthesia is regarded as a safe procedure.

Spinal anesthesia has been used here without incident in the presence of shock when the cause of the shock was not considerable hemorrhage. Spinal anesthesia is considered as a means of preventing or alleviating shock caused by painful injuries such as fractures and perforated gastric ulcers to the trunk and lower extremities. The blocking of painful stimuli to the central nervous system by spinal anesthesia usually brings a sigh of relief from the patient. The objection that spinal anesthesia given in the presence of shock may further decrease blood volume, further lower blood pressure, and cause an already present anoxia to become more severe was satisfactorily met by employing oxygen, the readily available fluids including plasma and whole blood and the peripheral sympathetic stimulants such as ephedrine and neosynephrin. It is not meant to imply that spinal anesthesia may be used promiscuously in the presence of shock. It should be used only after consideration of all factors and only when every means of combating shock and anoxia is available and in use or ready for immediate use. This type of anesthesia gives operative conditions of unparalleled benefit to the surgeon and the patient in a very few minutes. The patients must be carefully watched and intelligently handled under ordinary conditions. It follows that these efforts must be doubled in the severely injured or badly debilitated patients.

EXPERIENCE WITH PENTOTHAL

Pentothal is used extensively and appreciated greatly. The 2.5 per cent solution has been employed routinely. There have been no cases of phlebitis or slough from accidental subcutaneous injection, and no untoward depression following the use of this solution.

Pentothal in the presence of shock and its apparent ability to delay shock as commented on by some surgeons and anesthetists cannot be commented on here since there has been no experience along these lines.

Pentothal alone is not considered a satisfactory anesthetic agent for abdominal operative procedures. Necessary muscular relaxation is not obtained until the patient is dangerously depressed by the pentothal. Consequently, there have been only two abdominal surgical procedures done using pentothal as the major anesthetic agent, with nitrous oxide and oxygen and a small amount of ether as supplementary agents. These cases were appendectomies performed on nurses who made special requests for this type of anesthesia.

It has been used most extensively for orthopedic surgical cases. No particular muscle relaxation and no great depth of anesthesia is required in these cases. The combination of pentothal and 50 per cent nitrous oxide and oxygen has been very effective and satisfactory. The addition of a small amount of ether further lessens the amount of each agent necessary for satisfactory anesthesia. Postoperative nausea and vomiting have been encountered rarely. The patients are awake shortly after the operation is completed and thus offer no nursing problem.

As a result of poor preoperative preparation and bad judgment on the part of the anesthetist, one complication of pentothal administration gave many anxious moments. The patient had been given his breakfast on the morning of operation by an inexperienced corpsman. In spite of this, three and one half hours later induction of anesthesia under pentothal was begun. After 0.7 Gm. had been administered, an oral airway was inserted. There was an immediate severe laryngeal spasm and vomiting of the entire undigested breakfast. Needless to say, this combination nearly produced a fatality. These particulars are mentioned because many men using pentothal in military service and civilian life are not aware of or forget the fact that pharyngeal and laryngeal reflexes are hyperactive in light pentothal anesthesia. Consequently, a severe laryngeal spasm may be set up upon stimulation from any area of the body. It is also necessary to refute a surprisingly widespread belief that in the preoperative preparation of patients for pentothal anesthesia food and fluids need not be considered. Just as much precaution is necessary as is employed for inhalation anesthesia. No food or fluids after midnight of the night before operation is a good rule. No elective surgical procedures are done under any type of anesthesia if this rule has been violated.

This experience further proved the value of having suction always at hand during any operative procedure. A laryngoscope and endotracheal tubes, conveniently located, are also important adjuncts of emergency treatment. The ability to use these instruments undoubtedly saved the life of the man mentioned previously and probably prevented serious pulmonary complications in several other patients in whom excessive mucous secretion in the mouth and throat developed during anesthesia.

A rubber nasopharyngeal airway is used in nearly every pentothal anesthesia. It is tolerated more easily than the oral airway and does not require great depth of pentothal anesthesia for insertion. It has been of inestimable value in these cases in maintaining a clear airway. The one objection to its use is the possibility of causing nasal hemorrhage. This was encountered in two cases, but the hemorrhage was not severe and the bleeding soon stopped. The advantages are felt far to outweigh the disadvantages.

At times it was necessary in emergencies to fashion nasopharyngeal airways from Magill endotracheal tubes. The proper length was determined by measuring the distance on the tube from the external opening of the nares to the tragus of the ear. This trick is known to many anesthetists but not to men who are forced by circumstances to give anesthesia. Its value is evident.

A very simple but practical piece of equipment has been used here to great advantage. It is a wooden screen fashioned after the mastoid screen illustrated in a nursing manual (6) used at the Manhattan Eye, Ear and Throat Hospital. It consists of a base and top, each 12 inches long and 8 inches high, and two supports, each 8 inches high and 1 inch wide. The base is made from a heavy piece of wood, while the top is very light. The top piece swings on the two supports by means of two pieces of leather. The leather is a substitute for metal hinges which could not be obtained.

This anesthesia screen has been of great value to the anesthetist. The light top may be allowed to rest on the head of the patient or on some part of his face or may be supported by other means. Drapes may be secured over this equipment, leaving the space between and around the supports as a wide opening through which the anesthetist may observe his patient and control the anesthesia.

Surgical procedures about the face, head, neck, and shoulders are now being accomplished with none of the tug-of-war which was likely to exist between the surgeon and anesthetist in order to secure optimum exposure for each to work. This screen is cheaply and easily made and renders very satisfactory service in securing exposure for anesthetist and surgeon.

EXPERIENCE WITH LOCAL AND REGIONAL ANESTHESIA

This type of anesthesia rated third in the frequency of its use at this hospital. It was early ascertained that not every patient was a fit subject for local or nerve block anesthesia. Patients with neuropsychiatric disorders, or those who were extremely nervous, did not cooperate under this type of anesthesia. Members of the Hebrew race generally did not react well to local, nerve block, or spinal anesthesia.

All lacerations except those which included the peritoneum were repaired under local anesthesia. In most instances the use of procaine 2 per cent was satisfactory. However, at times a nerve block for an

hour or longer would be required. Metycaine 2 per cent proved most satisfactory in these cases. The metycaine anesthesia would often last two hours. This effect was noted particularly in the brachial plexus blocks. The average duration of metycaine anesthesia was one and one-half hours.

The frequency of injuries to the upper extremity made the brachial plexus block the most frequently used of nerve blocks. The technic advocated by Knight and outlined in the new book by Lundy (7) was used and found entirely satisfactory. In this procedure it is necessary to identify the clavicle on the desired side. Then the junction of the inner and middle thirds of the clavicle is ascertained. One finger-breadth above this level a skin wheal is made. This is repeated two fingerbreadths and one-half fingerbreadth above the clavicle. Local needles are then passed through these wheals until they impinge on the first rib. Two cubic centimeters of anesthetic solution is injected on the first rib and 8 cc. as the needle is being withdrawn. This is done through all three needles. For best results the intercostal nerves ending in the upper area must be blocked. This is done by means of a bracelet of anesthetic agent injected intradermally and subcutaneously around the arm just below the axilla. Anesthesia resulted in about twenty minutes. This procedure has the advantage of simplicity and less possibility of danger to important structures in this area of the neck.

The brachial plexus block by this technic was easy to teach to interns and other staff members. It was noted, however, that all had to be cautioned to remove the stilet from the local needles while they were being inserted. This was, of course, necessary in order to determine as soon as a blood vessel was entered.

Patients with traumatic wounds of the abdomen were operated on under spinal anesthesia, with one exception. This was done at the request of the operating surgeon and operating conditions were not satisfactory under the requested general anesthesia.

The operative repair of perforated gastric or duodenal ulcers was handled satisfactorily under single dose pontocaine-glucose spinal anesthesia. In most cases supplementary anesthesia of pentothal and nitrous oxide and oxygen was used to prevent nausea and vomiting. The result was good relaxation with quiet and even respiratory movements which gave the surgeon excellent conditions under which to work.

All thyroid surgery was done under endotracheal ether anesthesia. Two toxic hyperthyroid patients were given basal narcosis consisting of 80 mg. of avertin rectally. There was no distress from the avertin and the effect obtained was satisfactory.

Fractional spinal anesthesia, using either pontocaine-glucose or procaine, was used for stomach surgery and the exploratory laparotomy which ended in a colostomy when an inoperable carcinoma of the recto-sigmoid junction was found.

TABLE 3

EXPERIENCE WITH EACH DIVISION OF CASES

GENERAL SURGERY

Appendectomy	474	Incision, multiple furuncles	1
Amputation		Incision and drainage	
Arm	3	† Abscess	36
Leg	2	Ligation, vessel	
Aspiration		Saphenous vein	27
Knee	7	Postoperative tonsillectomy	1
Patellar bursa	1	Postoperative hemorrhoidectomy	1
Liver abscess	1	Mastectomy	14
Ball operation (pruritus ani)	1	Plastic operation, finger	1
Cholecystectomy	5	Removal of shell fragments	4
Cecostomy	1	Repair of	
Closure	1	Gunshot wound, abdomen	2
Colostomy	1	Gunshot wound, back	1
Clean and dress, burns	4	Gunshot wound, elbow	1
D & C	3	Gunshot wound, foot and leg	9
Excision of		Laceration, abdominal wall	1
Aneurysm, temporal artery	1	Laceration, face	25
Brachial cleft cyst	1	Laceration, hand and arm	18
Cyst teratoma	119	Laceration, head	17
Ingrowing nail	30	Laceration, knee and thigh	6
Ovarian cyst	1	Multiple stab wounds	3
Persistent urachus	1	Perforated gastric or duodenal ulcer	4
Sinus, abdominal wall	15	Stab wound abdomen	3
Sinus, buttock	1	Traumatic amputation, finger	17
Sinus, foot	1	Traumatic amputation, toe	1
Thyroglossal cyst	1	Traumatic disruption, duodenum	1
* Tumors, foreign bodies	92	Resection ovary and excision congenital vaginal septum	1
Xanthoma, retroperitoneal	1	Secondary closure, wound, foot	1
Exploratory laparotomy	4	Skin graft	14
Gastrotomy	1	Tendon repair	23
Gastrostomy	1	Thoracentesis	7
Gastric resection	2	Thyroidectomy	5
Herniorrhaphy	157		
Bilateral	9		
Strangulated	1	Total	1192
Incision, hematoma	4		

* Moles, fishhooks, scars, keloid, ganglion, enlarged lymph nodes, lipoma, bursae, sebaceous cysts, etc.

† Chin, scrotum, hand, arm, sacral region, foot, thigh, abdominal wall.

Pentothal was tried in several cases of mastectomy. Used alone, it was unsatisfactory because too much of the agent was necessary to keep the patient quiet. Combination with gas and ether was more satisfactory. Best of all, however, was the use of local anesthesia. This procedure was uncomplicated and effective. Following principles first described by Labat, a ring or diamond-shaped area of subcutaneous infiltration anesthesia was made around the involved breast tissue and well clear of it. The breast tissue including the lesion was then lifted clear of the chest wall and anesthetic agent infiltrated under it. This procedure will at times isolate a well circumscribed lesion and make the operation a much simpler job.

In one case amputation of the arm was necessitated by the development of a gas gangrene infection. Roentgenogram revealed the gas to have extended as high as the axilla. The original injury was a severe laceration of the arm and a compound fracture of the humerus resulting from a propeller wound. Although the original repair had been satisfactorily completed under brachial plexus block, the amputation was done under inhalation anesthesia. This was necessitated because of the possibility of spreading the infection by means of the local needles. Infiltration anesthesia has been avoided in all surgical procedures on infections of any type.

The need for gynecologic surgery is, of course, the result of having nurses and WAVE personnel as patients. It is listed under general surgery because of the few cases represented. No anesthesia problems occurred in this group.

Table 4 illustrates the types of orthopedic surgery occurring in this series.

TABLE 4

ORTHOPEDIC SURGERY

Arthrodesis	2	Incision and drainage, osteo, acute	1
Arthrotomy	9	Myotomy	3
Arthroplasty	1	Manipulation	14
Biopsy, Ewing's tumor	1	Open reduction, leg, foot	34
Biopsy osteosarcoma	1	Open reduction, hand, arm	26
Closed reduction, hand, arm	53	Open reduction, epiphyseal separation, femur	1
Closed reduction, leg, foot	14	Osteotomy	4
Closed reduction, ribs	2	Reduction, dislocation	14
Coccygectomy	2	Removal, plate or Smith-Petersen nail	4
Exam. under anesthesia	10	Repair, recurrent dislocation shoulder	
Excision		Henderson	7
Bunions	4	Nicola	1
Carpal scaphoid	3	Sequestrectomy	8
Calcification, tendon	2	Preliminary fixation mandible with splints	1
Condyle, mandible	1	Skeletal traction	
Head of radius	2	Hand	32
Osteoma and osteochondroma	7	Skull	1
Hammer toe	2	Synovectomy	1
Semilunar cartilage	36	Spinal fusion	
Fixation clavicle, wire, pin	2	Cervical	1
Fasciotomy	1	Lumbosacral	3
Bone graft	2	Sacro-iliac	1
First aid and continued treatment—compound fracture skull, tibia and fibula, fracture dislocation ankle, fracture scaphoid	4	Total	318

Spinal anesthesia was a great factor in the surgical treatment of fractures of the lower extremities. It serves to allay and prevent shock from pain in its use an an anesthetic agent.

A great deal of orthopedic surgery is done in military hospitals. Operations such as open reduction of a femur may require good anesthesia over a long period of time. Pontocaine-glucose anesthesia was very effective here. Anesthesia would be present from three to three

and one half hours in lower extremities. This gave ample time for open reduction and the application of a cast without discomfort to the patient. No attempt was made to use procaine since in some cases when the semilunar cartilage of the knee was excised, the spinal anesthetic was unsatisfactory because of its short duration.

Open reduction of the femur was sometimes associated with some degree of shock. Intravenous fluid was started immediately after the anesthetic was given. If there was any indication of drop in blood pressure and rise in pulse rate, 250 cc. of plasma was given. As a result of these precautions this operative procedure was well tolerated.

The treatment of fracture of the outer third of the clavicle and fracture dislocation of the acromioclavicular joint sometimes involved the use of wires and pins. The best position for the surgeon was a difficult one for the anesthetist since the patient was placed on his abdomen and the surgeon was working high on the shoulder. This situation proved easy to handle when pentothal was used with a nasopharyngeal airway in place. The wooden pentothal screen previously described proved ideal here in giving the anesthetist easy access to the patient and giving the surgeon plenty of room in which to work. The patient's head was placed to the side opposite the operative site and the screen placed so that the light top rested on the side of the face. The space between the supports of the screen gave the anesthetist ample room in which to observe the patient.

Paravertebral block to relieve pain of fractured ribs was very effective in obtaining comfort and relief for a period of six to eight hours. Sometimes there was no recurrence of the pain.

In the summer months a surprisingly large number of cases of fracture of a cervical vertebra occur in this area usually as a result of diving into shallow water. In an attempt to secure reduction and maintenance of good position in these cases, positions awkward for the anesthetist and embarrassing to the patient's airway are necessary. Pentothal anesthesia with the nasopharyngeal airway was the most effective means of handling the problems of respiratory obstruction in these cases.

Table 5 represents the proctologic cases requiring operation.

TABLE 5

PROCTOLOGY

Excision of	
Anorectal polyp	3
Fistula-in-ano	20
Fissure in ano	4
Papilloma, rectum	1
Hemorrhoidectomy	126
Incision and drainage	
Periproctic abscess	5
Total	159

There were no anesthesia problems in this group of cases.

Table 6 demonstrates the cases of urologic surgery.

TABLE 6

UROLOGY

Dorsal slit	1	Nephrolithotomy	1
Epididymectomy	2	Pelviolithotomy	1
Excision, spermatocele	1	Second stage Torek operation	3
Excision and drainage		Suprapubic cystotomy	1
Peri-urethral abscess	3	Ureterolithotomy	2
Hydrocelectomy	7	Varicocelectomy	36
Orchidectomy	5	Nephropexy	1
Orchidectomy and herniorrhaphy	1		
Orchidopexy	2	Total	71
Nephrectomy	4		

Pontocaine-glucose spinal anesthesia was again very effective in the kidney and ureteral surgical cases. One nephrectomy was done under general anesthesia. The patient was a young aviation machinist's mate who had an obviously ruptured kidney as the result of an automobile accident. He could not be brought out of shock. At operation his pulse was too rapid for accurate count and his blood pressure was 66 mm. systolic and 50 mm. diastolic. He was given nitrous oxide and oxygen, 65 per cent–35 per cent, for induction and then carried on ether by the closed method with carbon dioxide absorption. The kidney was found smashed into about twelve pieces. As soon as the kidney pedicle was clamped the patient began to improve. Thirty cubic centimeters of ether was used for the entire procedure and the patient reacted before leaving the operating room. Further convalescence was uneventful.

Table 7 reveals the Ear, Eye, Nose, Throat and Dental cases in this series.

TABLE 7

EAR, EYE, NOSE AND THROAT-DENTAL SURGERY

Caldwell-Luc operation	5	Mastoidectomy	13
Enucleation, eye	3	Myotomy, eye	2
Excision		Multiple extraction, teeth	50
Cyst, epiglottis	2	Reduction	
Cyst, mandible	2	Fracture, mandible-maxilla	8
Fibroma, vocal cord	2	Fracture, facial bones	1
Fibroma, pharynx	2	Tonsillectomy	8
Extraction, impacted molar	1		
Incision and drainage, peritonsillar abscess	1	Total	100

Pentothal proved very satisfactory in the eye operations since there was no activity of the eyeball to interfere with the operation. Postoperative nausea and vomiting have not occurred in this group of cases even though premedication with morphine and atropine was done in all cases. Local anesthesia was used in conjunction with pentothal in most of the cases. It tended to lessen the amount of pentothal necessary to secure good anesthesia.

The cases of multiple extraction of the teeth have been fully discussed in the *Naval Medical Bulletin* of August, 1944 (8). Endotracheal anesthesia has been of real value in this group of cases. Extraction of all teeth may be accomplished at one operation with complete safety to the patient. The dental surgeon has complete exposure and may take his time to do an alveolectomy or any other indicated procedure. These patients have no pain postoperatively and convalescence is not prolonged. In twenty-four hours they are up and about and eating a soft diet. There has been no postoperative tissue infection. All these facts enable these patients to be fitted with dentures weeks before this was possible when multiple operations and local anesthesia were employed.

The endotracheal tube was always inserted under direct vision with the laryngoscope. The value of this procedure was proved when two cases of cyst of the epiglottis were incidentally discovered. These were removed later.

Vinethene was used for the incision and drainage of the peritonsillar abscess. Induction was quick and easy and reaction was equally rapid and without incident.

Table 8 demonstrates the neurosurgical cases in this series.

TABLE 8

NEUROSURGERY

Application Tantalum plate over skull defect	1
Cervical laminectomy for bullet wound	1
Cervical exploration and excision of bone fragment	1
Curettage, osteomyelitis, frontal bone	1
Debridement and repair, compound fracture, skull	2
Elevation, depressed fracture, skull	2
Neurectomy and anastomosis	4
Partial hemilaminectomy	19
Subtemporal decompression	1
Thoracic sympathectomy, greater and lesser splanchnicectomy	1
Trephine, bilateral, skull	1
Total	34

Although most of these patients were in very serious condition, no real anesthesia problems existed here. The anesthesia was usually local field block. This type of anesthesia was effective and well tolerated in these cases.

The time for partial hemilaminectomy in this group frequently consumed more than three hours. Here again pontocaine-glucose proved its worth, with anesthesia in the back lasting consistently for three and one half hours. One hemilaminectomy was done under field block and subcutaneous infiltration down to the transverse process of all lumbar vertebrae in combination with a lumbar paravertebral block. This anesthetic proved very effective and was tolerated well.

Table 9 represents the thoracic surgical cases.

These cases were all done under local anesthesia using field block and intercostal nerve block. One patient having a rib resection thoracotomy became very nervous and restless and was given pentothal as a supplementary anesthesia. Shortly thereafter a bronchopleural fistula which had not been suspected allowed pus to drain into the trachea. The patient began to cough, had some laryngeal spasm, and became cyanotic. A Magill endotracheal tube was passed into the trachea blindly and the pus was aspirated through the tube. The condition cleared up quickly and the thoracotomy was finished without incident.

TABLE 9

THORACIC SURGERY

Closed thoracotomy	1
Closure, thoracotomy	1
Phrenicectomy	1
Repair, perforating wound, chest	2
Rib resection thoracotomy	6
Total	11

Blind intubation is a valuable and life-saving technic which should be known to every anesthetist. In emergencies of a nature similar to that mentioned, in which the anesthesia is light, intubation under direct visualization with a laryngoscope would be very difficult to accomplish. It is in these cases that the ability to intubate the trachea blindly becomes so important.

POSTOPERATIVE COMPLICATIONS

No chart was prepared on this subject because there were practically no postoperative complications. In one patient atelectasis developed which necessitated treatment by bronchoscopy and aspiration of a mucous plug in a bronchus. Bronchopneumonia developed in two patients who had spinal anesthesia for cholecystectomy. Three patients who had an appendectomy under spinal anesthesia had the same complications.

Postoperative headache developed in two patients who had pontocaine-glucose spinal anesthesia. The same complication occurred in about one in one hundred of the patients receiving procaine spinal anesthesia. Very few of these headaches were severe enough to require treatment other than bed rest for twenty-four hours. Patients with severe headaches were treated by administering 1,000 cc. of 5 per cent glucose in saline solution plus 7½ grains of caffeine with sodium benzoate subcutaneously. The patients were also placed flat in bed for twenty-four hours. This treatment was usually effective.

Approximately 10 per cent of all the patients receiving spinal anesthesia had some postoperative urinary retention. None of these reactions were severe and catheterization was necessary in very few cases.

The reason for this low incidence of postoperative complications is, of course, the fact that most of the men are young and healthy. In most cases, the ordinary operation causes no great discomfort, and disability lasts for only a short period of time.

SUMMARY

At this naval hospital, the incidence of the various types of anesthetics is quite different from that in the general civilian hospital. Spinal anesthesia comprised 52 per cent of all anesthesias, intravenous anesthesia 27 per cent, local and regional anesthesia 17 per cent and inhalation anesthesia 4 per cent.

Cyclopropane and ethylene were not used because of the low incidence of inhalation anesthesia and because some of the methods required in administering the anesthetic gases were not suited to these agents. These circumstances, along with the potential hazards of these gases should they be used by inexperienced personnel, were felt to be reason enough not to obtain cyclopropane and ethylene. The value of these gases, however, is freely admitted and the fact that they were not used did not indicate that they were felt to be unsatisfactory anesthetic agents.

Pontocaine-glucose proved the most satisfactory of the spinal anesthetic agents. It was dependable, provided good relaxation, did not cause undue depression, and lasted two hours for abdominal operations and three and one half hours for operations on the extremities and back. Procaine is still used a great deal because it is easier to procure in the naval service. Procaine was quite satisfactory for short procedures about the rectum, anus, coccygeal region, scrotum, and lower extremities.

All personnel injured in plane crashes had to be considered as having intracranial or thoracic injuries. For this reason, anesthetic agents producing unconsciousness were avoided in all such cases.

In this hospital with well-trained personnel and good equipment, spinal anesthesia in the presence of shock was employed to good effect in selected cases when the shock was not the result of excessive hemorrhage. It should be used only after careful consideration of all factors and the use of every means of combating the shock both before and after the spinal anesthetic has been administered. Special means must be taken by the anesthetist to prevent or overcome anoxia in the patient who is in shock.

Procaine 2 per cent local anesthesia was satisfactory in most cases. However, in nerve blocks and particularly brachial plexus block, metycaine 2 per cent gave satisfactory anesthesia of longer duration than was possible with procaine.

Pentothal in a 2.5 per cent solution proved quite satisfactory and no untoward results from its use have occurred here. Preoperative

preparation of the patient must be as carefully supervised as that for inhalation anesthesia.

Pentothal when used alone is not considered a safe anesthesia for abdominal operations. In combination with nitrous oxide, oxygen and ether, anesthesia considerations for the safety of the patient improve and become satisfactory.

Some means of suction should always be at hand in the operating room and ready for instant use. The ability to intubate the trachea blindly is a valuable technic worth acquiring. The ability to use a laryngoscope and intubate the trachea under direct vision is a tried and proved technic of life-saving value to the anesthetist.

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