51. Surgical Diagnostic & Therapeutic Procedures

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The purpose of this chapter is to describe some of the more common procedures used in the practice of surgery. Descriptions of operating room equipment, instruments, and facilities for emergency resuscitation are beyond the scope of this chapter and will not be presented.

Laceration

The healing of lacerations is dependent upon many factors, including the patient's age and nutritional and endocrine status, local temperature, blood supply, mechanical stresses, infections, and the presence of foreign bodies. Wound healing is discussed in Chapter 10.

The first step in the care of a simple laceration of the skin and subcutaneous tissues is cleansing and debridement of devitalized tissue. Irregular skin edges should be trimmed to allow accurate approximation of the wound. It is vital that hemostasis be achieved before wound closure is attempted. In closing the wound, subcutaneous tissues are approximated with fine catgut sutures and the skin is closed with interrupted sutures of fine nylon or other nonabsorbable material. Good cosmetic results demand accurate approximation of subcutaneous and epithelial layers. If the wound is grossly contaminated or is first seen more than 6-8 hours after the actual injury, it should be debrided, irrigated clean, and left open to allow healing by second or third intention. The wound is customarily dressed with iodoform gauze (to maintain skin edge separation) and is then covered with sterile dressings. Care must be taken not to close a contaminated wound (or a wound that contains a foreign body), since the end result is nearly always infection and abscess formation.

Wounds created by human or animal bites are heavily contaminated and are usually left open. After adequate debridement of devitalized and necrotic tissue, the patient should be treated with prophylactic antibiotics. If treated promptly, wounds about the head and neck may be closed because the blood supply to these areas is copious. Such procedures must be followed closely so that skin sutures can be removed and the wound opened at the first sign of infection. A culture should be taken immediately. In addition, further debridement may be necessary.

Management of Lacerations

Three things should be kept in mind in the management of lacerations: (1) prevention of infection, (2) preservation of function, and (3) the cosmetic result. The wound should be meticulously prepared by thorough mechanical cleansing, irrigation with isotonic saline, and surgical debridement of all necrotic tissue and foreign bodies. The area around the laceration is prepared with an appropriate antiseptic agent. Sterile drapes are applied around the wound. Lidocaine, 0.5% or 1%, is injected into the wound edges to obtain anesthesia before debridement of the contused tissues. Hemostasis is readily obtained by gentle pressure on the edges of the wound or by the use of fine absorbable ligatures. Raised flaps of skin should be thoroughly cleansed and their viability assessed. Irregular skin edges should be trimmed to allow accurate approximation.

Minor lacerations can be repaired by simple interrupted skin sutures of fine nylon. In facial lacerations, the most commonly used sutures are 6-0 or 5-0 monofilament nylon. In other areas of the body, 5-0 or 4-0 sutures are used. In deeper wounds, the fascia and subcutaneous tissue are approximated in layers with interrupted 4-0 or 3-0 plain catgut sutures. The skin is then approximated with interrupted fine nylon sutures. A dry, sterile dressing is usually placed over the wound for protection.

In facial lacerations, where the cosmetic result is of greatest importance, the finest possible suture material yields the best results. If the wound is clean and dry and no more than 3-4 mm wide, it can be closed with Steri-Strips instead of suture. This technic is especially useful in children and is performed as follows: (1) The skin is cleaned and dried. (2) Tincture of benzoin is applied to the skin and allowed to dry until tacky. (3) Half of each strip is placed on one side of the skin edge. (4) Gentle traction is applied to bring the 2 edges together. (5) The unattached half of each Steri-Strip is firmly placed on the opposite side of the wound.

In principle, if lacerations are deep, subcutaneous tissue must be approximated to eliminate dead space and to relieve the tension from the skin sutures.

Skin sutures should be left in place for approximately 7-10 days. Where the cosmetic result is important, skin sutures are removed in 2 or 3 days and the wound edges are supported with Steri-Strips or collodion strips. Care of the wound after repair of the laceration should include keeping the area clean and dry. Undue stress on the wound edges should be kept to a minimum. In some cases, immobilization with a splint may be necessary.

Abscesses

An abscess is a walled-off collection of pus. The terms boil, furuncle, and carbuncle denote abscesses in the skin and subcutaneous tissue. A boil is a collection of pus within the subcutaneous tissue. A furuncle is an abscess that originates in the sweat glands or hair follicles. A carbuncle is an abscess that has extended into the subcutaneous tissue and is multiloculated, with individual compartments formed by anatomic fascial attachments of the skin to the deep fascia. Common sites for a carbuncle include the nape of the neck and the pulp of the digits. Abscesses of the integument are usually caused by staphylococci; however, they may become secondarily infected by gram-negative organisms. They may also be the result of contamination from penetrating wounds (eg, those seen with drug abuse).

Management of Abscesses

Adequate incision and drainage are important in the management of abscess. Local or regional anesthesia may be used. A skin incision is made over the fluctuant area, and a closed hemostat is then inserted through the subcutaneous tissue into the center of the abscess. Care should be taken not to penetrate too deeply. Once the abscess cavity is entered, the blades of the hemostat are spread apart to break up loculations. If the abscess cavity is large, digital examination should be performed to confirm complete drainage. The skin incision should extend the entire length of the abscess cavity to afford adequate drainage. Cruciate incisions should be used only rarely.

Carbuncles on the neck are best managed by total excision. Care should be taken that the advancing edge of the infection in the multiloculated compartments has been excised. The wound is packed open. Rapid closure by wound contraction without the need for skin grafting is the rule.

After evacuation of the abscess cavity, the wound should be drained by loosely inserting a strip of plain or iodoform fine-mesh gauze. Excessive oozing may be controlled by packing the cavity more firmly. Firm packing must be removed after 6-12 hours and replaced by loose gauze so that drainage is not impeded. Antibiotics are usually not used except when there are systemic manifestations of infection or persistent localized cellulitis in the region. The indications for antibiotics may be liberalized in treating wounds in special areas (eg, the hands) because the consequences of uncontrolled infection may be more severe.

Management of Other Pyogenic Infections

The treatment of cellulitis and lymphangitis due to nonsuppurative infection of the subcutaneous tissues consists of rest, heat, elevation, immobilization, and antibiotics (see Chapter 11). If the inflammatory process does not respond after 48 hours of therapy, suppuration and abscess formation should be suspected and drainage of any recognized collection is indicated.

When there is infection of the face, especially in the nasolabial area (the area with its border extending from the nasolabial fold to the outer canthus of each eye), aggressive antibiotic therapy is indicated because infection in this location carries a hazard of intracranial septic thrombophlebitis by spread from the nasal veins into the cavernous sinus. Morbidity is severe and the mortality rate high when this occurs. Areas in close proximity to the occipital, mastoid, and frontal emissary veins should be of similar concern.

Management of Dental Abscess

Alveolar or apical abscess is usually related to poor oral hygiene and carious teeth. With necrosis of the dental pulp, periapical abscess causes severe pain and localized osteomyelitis around the root of the tooth. With further extension, the abscess will rupture through the buccal mucosa. If the abscess is pointing in the buccal mucosa and submucosal fluctuation is demonstrated, the abscess should be drained through an incision parallel to the gum margin. The patient should be given systemic antibiotics, and the tooth should be removed or root canal therapy should be done by a dentist. Occasionally, a periapical alveolar abscess will erode through the mandible to the outside of the face. Treatment in such cases is directed toward removal of the abscessed tooth, which is usually decayed and slightly loose.

Superficial Lesions

Excisional biopsy of subcutaneous tumors or skin lesions in an ambulatory patient is easily performed under local anesthesia. Infiltration of the skin and subcutaneous tissue around the lesion with 1% or 0.5% lidocaine will provide adequate anesthesia. The general principle in excisional biopsy is to make a skin incision that allows removal of the entire lesion with a margin of normal tissue. Hemostasis must be maintained to prevent seroma or hematoma formation, which will lead to wound complications. An elliptic incision should be made around the lesion parallel to the lines of skin tension. The incision should include a margin of 1-2 mm of normal skin. The lenght of the incision should be at least twice the width. Following removal of the lesion, the edges of the skin should be undermined to facilitate approximation without tension or puckering. The subcutaneous layer may be closed with interrupted fine catgut sutures if necessary to eliminate the dead space. The skin should be closed with fine monofilament sutures. If the lesion is in the subcutaneous tissue, a linear skin incision is placed over the center of the lesion along the lines of skin tension. Skin flaps are created and the lesion is completely excised with a margin of normal subcutaneous tissue. Following excision of such a lesion, subcutaneous tissue layers may be sutured or not depending upon the size and extent of the wound. For small wounds, a few skin stitches may be all that is necessary. A dry sterile dressing should then be applied.

Intravenous Cannulations

The indications for catheterization of a major vein are to establish an avenue for administration of blood and fluid during resuscitation, to measure central venous pressure in monitoring patients, and to administer intravenous hyperalimentation in malnutritional states. The sites most commonly used are the subclavian, internal and external jugular, basilic, and saphenous veins. The surgeon must be thoroughly familiar with the anatomy of these vessels before the procedures are attempted.

Standard Leg Cutdown

The origin of the long saphenous vein can be used for intravenous cannulation for the administration of fluids and blood, but cutdowns in this location in adults are often complicated by thrombophlebitis. The vein always lies anterior to the medial malleolus. A small transverse skin incision is made. Blunt dissectin is done with a small curved hemostat to identify the saphenous vein, which usually lies just superficial to the deep fascia and periosteum. The saphenous nerve must be separated from the vein. Plain catgut (3-0 in adults and 4-0 or 5-0 in children) is used to encircle the vein on both sides of the site of cannulation. The distal ligature is tied and gentle traction is applied to put the vein on stretch. The surgeon is best positioned at the foot of the bed, facing the patient. A transverse or longitudinal venotomy is made, depending on personal preference.

The transverse venotomy is quickly accomplished by inserting a No 11 Bard-Parker scalpel blade through the midportion of the vein with its cutting edge directed distally. The blade is then turned 90 degrees, directing the cutting edge upward and incising the upper half of the vein. This maneuver creates a small lip to grasp in exposing the lumen.

A small mosquito clamp is used to dilate the vein. A plastic cannula of appropriate size is inserted into the lumen and secured in place with the proximal ligature. The skin is closed with 4-0 or 5-0 nylon sutures, allowing the cannula to exit through the skin incision. Antibiotic ointment and a sterile dressing are applied at the cannula exist site.

Cannulation of the Basilic Vein

Central venus cannulation through the basilic vein is best done by a surgical cutdown unless the patient has large, prominent arm veins that permit the percutaneous approach. In hypovolemic shock, the peripheral veins are usually collapsed, and time is often wasted in multiple attempts to cannulate them percutaneously. Surgical cutdown is preferred under these conditions. The patient is placed in the supine position with the right arm abducted 90 degrees. The antecubital area is prepared and draped aseptically. After infiltration of local anesthetic, a small transverse skin incision is placed anteromedially proximal to the antecubital crease over a demonstrable vein. A venous tourniquet may be helpful to delineate the vein. After the vein is isolated, the tourniquet should be removed. A ligature is placed around the vein distally, and gentle traction is maintained. A small venotomy is made with a pointed scalpel blade. The lumen of the vein is gently dilated by the insertion of a mosquito clamp. A premeasured catheter whose length equals the distance from the cutdown site to the suprasternal notch is inserted. This distance corresponds to the distance from the venotomy to the superior vena cava. When positioned, the tip of the catheter will be in the right location to measure central venous pressure. To confirm its location, chest x-rays can be obtained when a catheter with radiopaque markers is used. If the catheter does not have an x-ray marker, radiopaque dye can be instilled into the catheter when the chest film is taken. One of the more common pitfalls, inadvertent entry into the jugular vein, requires repositioning of the catheter.

The catheter is then secured with a ligature around the proximal segment of the basilic vein. The wound is closed with several skin sutures. Antibiotic ointment is placed around the catheter exit site.

One of the complications of this type of cutdown is inadvertently opening the brachial artery. One should always feel for a pulse before incising the vessel, but the pulse may be difficult to detect in shock. If an opening is made in the brachial artery, it should be repaired immediately with several sutures of fine cardiovascular silk. Care must also be exercised in identifying peripheral nerves in this region which may, at times, be mistaken for veins.

Cutdown of the Saphenofemoral Junction

The saphenous vein can be surgically approached at its junction with the femoral vein. The groin area is aseptically prepared and draped. After infiltration with local anesthetic, a small transverse incision is made over the saphenofemoral junction approximately 3-4 cm lateral and inferior to the pubic spine. Dissection is carried through the subcutaneous tissue, isolating the saphenous vein and identifying the saphenofemoral junction. A ligature is placed distally around the saphenous vein, a small venotomy is made, and a catheter is passed through the saphenous vein into the femoral vein as far as the inferior cava. The appropriate length of the catheter may be estimated by measuring it from the cutdown site to the umbilicus. The cather is secured with a ligature at the sapheno-femoral junction. The wound is closed with interrupted catgut sutures in the subcutaneous tissue and nylon sutures to the skin. Antibiotic ointment is applied to the catheter wound site.

Venous Catheterization

Percutaneous Subclavian Catheterization

The patient should be supine and in a slight Trendelenburg position to avoid air embolism during this procedure. This is especially important in hypovolemic shock, since the veins are usually collapsed. The head is placed in a neutral position or turned to the opposite side. The infraclavicular area is widely prepared aseptically. A small skin wheal is made with 1% lidocaine solution approximately 1 cm below the midportion of the clavicle. A large-bore needle attached to a 2- or 5-mL syringe is introduced through the skin wheal and directed toward the suprasternal notch. As the needle is advanced, slight negative pressure is applied to the syringe by pulling back on the plunger; when the vein is entered, blood will flow back freely. At this point, the syringe is removed and a catheter of appropriate size is inserted through the needle and advanced gently. After the catheter is advanced the desired length, the needle is withdrawn slowly and manual pressure is applied over the puncture site. The catheter is then secured in place with a small skin stitch to prevent if from slipping into the vein or being pulled out inadvertently. Antibiotic ointment is placed over the puncture site to minimize ascending bacterial contamination.

The major complications resulting from subclavian catheterization are air embolism, embolization of a sheared-off catheter, pneumothorax, hematoma formation, and laceration of the subclavian artery.

To avoid catheter embolization, the catheter should never be withdrawn through the needle, because a segment of the soft plastic may be sheared off by the beveled point inside the lumen of the vein, allowing it to float freely to the heart. Both catheter and needle must be withdrawn at the same time. Moreover, once the catheter is advanced, it must not be manipulated back and forth in an attempt to advance it further. If the catheter cannot be advanced to the desired length with ease, both the catheter and the needle should be removed and a different site used for cannulation.

To prevent formatin of hematoma after the needle is withdrawn, gentle pressure should be applied over the puncture site. Pressure should be maintained while the patient is taken out of the Trendelenburg position. Gentle compression maintained for several minutes will allow the puncture site to seal around the catheter.

If the subclavian artery is entered, the needle is withdrawn immediately and manual pressure is maintained over the puncture for 10-15 minutes or longer.

Pneumothorax, due to inadvertent puncture of the cupula of the lung, occurs less often with the infraclavicular approach than with the supraclavicular approach. With the infraclavicular approach, the position of the first rib prevents advancement of the needle into the pleural cavity. Auscultation of the chest should be done after the procedure is completed, and a portable chest x-ray should be obtained routinely.

Percutaneous Catheterization of the Internal Jugular Vein

The patient should be supine and in a slight Trendelenburg position. A small skin wheal is made with local anesthesia at the midportion of the sternocleidomastoid muscle at its posterior border. A needle with a syringe attached is introduced through the skin wheal and passed behind the muscle. As the needle is advanced toward the suprasternal notch, gentle negative pressure is applied on the syringe. Once the needle enters the jugular vein, blood will be drawn back. The syringe is then removed and a catheter of appropriate size is passed through the needle into the internal jugular vein for the desired distance. The needle is then withdrawn while the catheter is held in place. As the needle is withdrawn from the vein, gentle pressure is placed over the puncture site for several minutes to allow a hemostatic seal to form around the catheter. The patient is taken out of the Trendelenburg position, and the catheter is secured with a simple skin stitch.

The internal jugular vein can also be approached anteriorly. The patient is prepared as above except that the head is extended and turned to the opposite side. The needle is introduced overlying the juncture of the sternal and clavicular heads of the sternocleidomastoid muscle and is directed inferiorly toward the clavicle at an angle of about 45 degrees from the coronal plane. The internal jugular vein usually lies deep to this area. If the internal jugular is not entered, the needle is withdrawn and then redirected several degrees laterally. The common carotid artery is avoided because it is medial and posterior to the internal jugular vein. Once the vein is entered, blood will be aspirated freely into the syringe. The syringe is removed and a 15- to 20-cm catheter is advanced. The needle is then withdrawn and the catheter secured to the skin with a simple skin stitch. Antibiotic ointment is placed at the puncture site as with the subclavian cannulation.

The major complications of internal jugular puncture are a large hematoma (secondary to carotid arterial puncture), catheter embolization, and, rarely, pneumothorax. If the common carotid artery is entered, the needle should be withdrawn and gentle pressure maintained over the puncture site for 10-15 minutes or longer. Precautions in avoiding catheter embolization are the same as described for the subclavian cannulation. Pneumothorax can be avoided if the manipulation of the needle is confined to the neck and the needle is not advanced too far into the inlet of the thoracic cavity.

Percutaneous Approach to the External Jugular Vein

The external jugular vein is a subcutaneous structure that runs vertically across the sternocleidomastoid muscle from the inferior tip of the parotid gland to the posterior triangle of the neck. The patient is positioned in a slight Trendelenburg position with the head extended and turned acutely to the opposite side. The external jugular vein should be visible, but it can be accentuated if the patient performs a Valsalva maneuver. Cannulation of this vessel is done as descibed above for cannulation of the subclavian or internal jugular vein.

Swan-Ganz Flow-Directed Catheter

The Swan-Ganz catheter, by allowing measurement of pulmonary artery pressures, gives useful information for regulating the rate of fluid or blood administration in patients with unstable cardiac conditions. It is also helpful in analyzing the cardiac status of a patient with a borderline cardiac index.

Although various technics have been used to insert Swan-Ganz catheters, percutaneous placement into the subclavian or internal jugular vein is preferred. The initial steps are described in the preceding section. After the needle is in the vein, a flexible guide wire is inserted down the lumen. The needle is then withdrawn, and a specialized introducer is passed over the wire. The guide wire is then withdrawn, and the Swan-Ganz catheter is inserted through the introducer, advanced into the superior vena cava, and secured in place. Once the catheter is in the superior vena cava, it is connected to a pressure-sensitive transducer and the pressures are displayed on the oscilloscope. The catheter is then advanced through the right atrium, the tricuspid valve, and into the right ventricle, at which point the tracing shows systolic pressures of approximately 20-30 mm Hg. The balloon at the tip of the catheter is then inflated and the catheter is gently advanced. With each ejection of blood from the right ventricle, the catheter with the balloon inflated is carried by stepts through the pulmonary valve and into the pulmonary artery. When this point is reached, the pulse pressure narrows; the systolic pressure remains at approximately 20 mm Hg, but the diastolic pressure increases to approximately 10 mm Hg. Once the catheter is in the pulmonary artery, it is further advanced with the balloon *deflated* until it reaches one of the secondary branches of the pulmonary artery. The balloon is then reinflated to obtain a wedge pressure: marked systolic fluctuation disappears in afavor of a mean pressure of approximately 6-10 mm Hg, ie, the normal pulmonary wedge pressure. This pressure is a direct transmission of pressure in the left atrium.

The balloon is then deflated, the catheter is secured in place in the antecubital area with a ligature around the vein and catheter, and the skin is closed with interrupted sutures. A second skin stitch looping around the catheter may be applied for extra security to maintain the catheter in place. Antibiotic ointment is placed around the catheter exit site in the skin, and a dry dressing is applied. The catheter should be flushed with heparinized saline solution periodically to avoid clotting its tip.

Tracheostomy

Airway obstruction can occur as a result of trauma to or congenital deformities of the nose or larynx, tumors, infections, or paralysis of one or both vocal cords at birth. The most rapid way to establish an airway when the obstruction lies above the midpoint of the trachea is to install an endotracheal tube via the mouth or nose. A laryngoscope is used to visualize the vocal cords, and the endotracheal tube is then passed into the upper trachea. The patient should then be taken immediately to the operating room where a tracheostomy can be done under local or general anesthesia while the patient is oxygenated through the endotracheal tube. Sometimes it is necessary to perform a bedside tracheostomy, but when possible it is better to move the patient to the operating room.

The indications for tracheostomy include airway obstruction above the mid trachea or the need for prolonged assisted ventilation. Whenever there is infection in the larynx, an endotracheal tube should not be used any longer than necessary to do a tracheostomy, because of the high incidence of mucosal injury and stenosis that results.

To establish a tracheostomy, a 5-cm vertical or horizontal collar incision is made 5-10 mm below the inferior edge of the cricoid cartilage. Dissection is carried down to the surface of the strap muscles, and vertical dissection is then carried between the strap muscles to the anterior surface of the cricoid, the thyroid isthmus, and the trachea. The isthmus of the thyroid is mobilized by blunt dissection and pushed cranially to expose the upper tracheal cartilages. A square (2 x 2 or 3 x 3 mm) segment of the third or fourth tracheal ring is excised, and the opening is enlarged by incising the membrane for 2-3 mm above and below the ring from which the segment was removed. Hemostasis is achieved with clamps and gut ligatures. The smallest tracheostomy tube that will permit adequate ventilation of the patient (rather than the largest one that can be forced into the trachea) is then installed. The largest tube that should be used in men is a No 6; in women, No 5. Children 6-10 years old usually do well with No 3 tracheostomy tubes; younger children and infants require No 1 or 2. A low-pressure balloon-cuffed tube may be used if assisted ventilation or prevention of aspiration is necessary. The incision is closed with one or 2 sutures at each end, care being taken not to close the incision under the face plate of the tracheostomy tube, since this can result in subcutaneous emphysema, pneumomediastinum, and pneumothorax. A 10 x 10 cm sponge is cut two-thirds of the way up the center and placed under the face plate; the cloth tapes attached to the face plate are then tied tightly enough to prevent the tube from coming out of the trachea without being so tight that they occlude the external jugular vein. If a low-pressure balloon-cuffed tube is used, the balloon should be inflated only until the airway becomes airtight when the tracheostomy tube is temporarily occluded. It should be completely deflated 4 times per day and reinflated only until the airway again becomes airtight when the tube is occluded. Overinflation of a balloon cuff causes tracheal necrosis and stenosis.

Postoperative roentgenograms of the chest (posteroanterior and lateral views) should be taken to show whether the tube fits the trachea properly and to rule out pneumothorax. The tracheostomy tube should not be removed until it can be plugged continuously for 48 hours without impairing respiratory function. At that point, the tube is removed, and the stoma gradually closes in about 7 days.

Insertion of Chest Tube

(Tube Thoracostomy)

Tubes for drainage are inserted into the thoracic cavity to evacuate a pneumothorax, hemothorax, pleural effusion, or empyema (pyothorax). Experience has shown that attempts to remove intrathoracic collections with needle aspiration are usually unsatisfactory, and this technic is rarely employed except occasionally for a small pneumothorax.

Pneumothorax. If a tension pneumothorax exists, it should be immediately decompressed by a needle introduced through the second anterior intercostal space. A tube thoracostomy can then be performed unhurriedly.

For pneumothorax, a chest tube is usually inserted through the second or third anterior intercostal space in the midclavicular line and directed toward the apex of the thorax. The tube is attached to the suction device, and the rate of escape of air is indicated by the appearance of bubbles in the second of the 3 bottles. When bubbling ceases, this suggests that the pulmonary air leak has become sealed. Chest x-rays should be taken at intervals to verify full expansion of the lung. The tube is usually left in place for about 24 hours after the leak has sealed and full expansion has been achieved. It is then removed aseptically.

Hemothorax and pleural effusion. To evacuate a hemothorax or pleural effusion, a tube is usually inserted through the fifth or sixth intercostal space slightly posterior to the anterior axillary line. This level is preferable to a lower one, because it lessens the risk of penetrating the diaphragm during insertion of the tube and avoids later problems from the tube lying on the diaphragm. Drainage is just as satisfactory in this location.

Empyema. The tube is usually inserted over the center of the collection as determined by x-ray. With small collections, fluoroscopy is sometimes desirable to accurately pinpoint the site. After a stab wound is made, a large (40-45F) catheter is inserted to drain the pus. Loculations are often present and must be broken down with a finger in order to accomplish thorough drainage. If the pus is especially thick and contains fibrin or necrotic tissue fragments, it should be lavaged vigorously by injecting saline through the thoracostomy tube. In cases when adequate drainage cannot be obtained by tube thoracostomy, drainage via open thoracostomy and the creation of a pleurocutaneous flap (Eloesser) must be done (Chapter 21).

Technic of Tube Thoracostomy

The patient is positioned supine with the arm abducted at a 90-degree angle. The skin is prepared and draped aseptically. The skin and subcutaneous tissues are anesthetized with 1% lidocaine, and a 2.5-cm transverse skin incision is made over the superior border of the rib at the site selected for the tube. The pleural space is entered by blunt dissection with a curved clamp over the superior edge of the rib, which avoids injuring the intercostal vessels. The jaws of the clamp are spread, enlarging the opening enough to permit the introduction of a finger into the pleural cavity. Digital examination should be performed to confirm the absence of pleural adhesions; this will prevent inadvertent insertion of the tube into adherent lung parenchyma. If the lung is adherent, it can easily be separated by gentle blunt dissection with the finger. The chest tube is grasped with a clamp and inserted into the thorax and positioned for optimal drainage. During insertion, the tube may slide into a subcutaneous space, and the malposition may go unrecognized unless tube function is tested.

After the position is checked, the tube is connected to a disposable underwater sealed suction apparatus regulated to 10-20 cm water negative pressure. The tube should be fixed to the chest wall with No 0 silk sutures placed so that can be used to close the wound after the tube is removed. A sterile petrolatum gauze dressing is then applied.

Thoracocentesis

The optimal site for aspiration is selected by correlation of x-ray (or fluoroscopic) localization with the chest wall area of maximal flatness to percussion. Thoracocentesis is rarely productive when performed below the eighth interspace in the midaxillary line even if a large volume of fluid is present. The most common mistake is to choose a location that is too low: this results in an unsuccessful tap, because the diaphragm is sucked up against the needle. Shoulder and neck discomfort due to referred pain in the distribution of the phrenic nerve may suggest this complication. Persistent attempts to enter the pleural space may produce iatrogenic splenic injury as the needle is passed through the diaphragm.

The easiest position for the patient is straddling an armless straight-backed chair, facing the chair back with forearms resting on the top. The operator can sit on another chair behind the patient or to one side. A patient who becomes faint or dizzy can rest his or her head on folded arms without altering the position of the thorax. An alternative position is supine in bed. The affected side is slightly elevated by means of a folded towel placed under the hemithorax. The patient's arm is extended at one side, and the site of thoracocentesis is selected at the fourth or fifth intercostal space along the posterior axillary line.

The chest wall is prepared widely, using sterile precautions. A small skin wheal is raised with 1% lidocaine or comparable local anesthetic at the appropriate size. A 25-gauge needle is used, and the local anesthetic is injected as the needle is slowly advanced. When the parietal pleura is reached, minimal resistance will be perceived and more anesthetic is injected. A slight "popping" sensation is felt as the needle tip passes through the parietal membrane and enters the pleural space. The infiltration needle is withdrawn, and a small nick is made in the skin with a pointed scalpel. A short-beveled, blunt-tipped 13-gauge aspirating needle is attacked to a 50-mL glass (not plastic) Luer-Lok syringe by means of a 3-way stopcock that has both female and male Luer-Lok attachments. One hands pushes on the syringe as the other hand acts as a "brake" on the needle at the skin surface and the needle is introduced smoothly into the pleural cavity. Aspiration is facilitated by lubricating the syringe barrel and plunger with lidocaine solution throughout its full length at the beginning of the procedure. Steady, gentle withdrawal of the syringe barrel prevents the visceral pleura from being sucked up against the needle orifice and permits a free flow of even very thick, fibrin-containing exudate. The stopcock handle is turned to allow discharge of the material through the side-arm (with a short length of tubing attached) into a large sterile flask containing heparin. During collection, it is important for the nurse assistant to agitate the container gently to prevent clotting of the fluid, which otherwise will occur when the effusion is high in fibrin and protein content. When most of the fluid has been removed from the pleural space, it will flow freely only during the inspiratory phase of the respiratory cycle;

at this point, the patient is asked to take slow, gradual, deep breaths and to lean backward toward the side of involvement, holding onto the back of the chair.

More recently, we have been using a large Intracath to drain pleural infussions. The needle is fitted with a syringe and introduced into the pleural space over the superior aspect of the rib. Once the pleural cavity is entered, the syringe is removed and the catheter is inserted and directed into the most dependent position of the pleural cavity. The needle is then removed, and aspiration of the fluid with a 3-way stopcock attached to it is then performed as described above. The advantage of this technic is that one can alter the position of the patient without having a rigid needle sticking in the thoracic chest wall. This technic has been most helpful in reducing the incidence of pneumothorax following thoracocentesis.

When a known malignant effusion is being evacuated, it is best to stop just short of complete withdrawal of all obtainable fluid so that 20 mg of mechlorethamine or another antitumor agent dissolved in 50 mL of normal saline can be instilled into the pleural space. The needle is then withdrawn and the patient is placed for 1 hour supine, for 1 hour with the involved side down, and for 1 hour prone to distribute the medication over all serous surfaces. A chest x-ray should be taken 6-12 hours later, because there is usually a reaccumulation of fluid as a result of the chemical pleuritis caused by the irritant effect of mechlorethamine. Repeat thoracocentesis is then performed in an effort to tap the chest "dry" and give the pleural surfaces the best opportunity for adhesive fusion. Successful obliteration of the pleural space is the usual result and prevents further accumulation of fluid.

Lumbar Puncture

Lumbar puncture is an easily performed but frequently misused diagnostic tool that is potentially lethal. It should be done only in an effort to answer a specific clinical question - never "routinely" and never (unless essential to diagnosis) when signs of increased intracranial pressure are present.

Technic

The patient should be placed on one side in the fetal position. The lumbosacral area is prepared with an antiseptic solution; the skin over the L3-4 or L4-5 interspace is infiltrated with local anesthetic; and a 19- or 20-gauge needle is introduced with its bevel parallel to the spinal axis. (Since the spinal cord does not terminate before reaching approximately the level of L2, punctures at or above this level could damage the cord. Cisterna magna and lateral cervical punctures can be done, but only in special situations by experienced personnel.) The needle is connected to a manometer; if the opening pressure is elevated, only the fluid inthe manometer should be withdrawn.

Indications

A. Diagnosis of Hemorrhage: When subarachnoid hemorrhage is suspected, red cells in the cerebrospinal fluid will be diagnostic. Truly bloody fluid can be differentiated from the bloody fluid due to a traumatic tap because, with the latter, the fluid will become progressively clearer with each successive specimen. Bloody cerebrospinal fluid should be centrifuged and the supernatant examined for xantochromia. The degree of xantochromia will provide some index of the length of time the red cells have been in the fluid. Crenation of red blood cells is a meaningless sign. The presence of red cells in the fluid may be associated with a lowered cerebrospinal fluid glucose level, but the length of time the cells have been present does not affect the level of glucose.

B. Diagnosis of Infection. In the patient with purulent meningitis, lumbar puncture is usually diagnostic; the pressure will be increased; white cells will be present, the number and type depending on the etiologic agent; the protein will be increased; and the glucose will be decreased. Cerebrospinal fluid should be obtained for routine culture as well as for cultures for anaerobic bacteria, fungi, and tubercle bacilli.

A traumatic lumbar puncture may produce confusing cerebrospinal fluid findings.

The cerebrospinal fluid may be normal in cases of brain abscess, subdural empyema, or epidural abscess, although the pressure is frequently elevated. Cerebrospinal fluid findings in meningeal metastatic carcinoma may simulate those of meningitis but can frequently be differentiated by cytologic studies. Active neurosyphilis produces cerebrospinal fluid abnormalities, the exact findings depending on the type of involvement: serologic tests on blood and cerebrospinal fluid may be positive; the pressure may be increased; the protein and cell count (lymphocytes) may be increased; and the colloidal gold curve may be abnormal.

C. Evaluation of Spinal Trauma: In cases of spinal trauma, lumbar puncture is frequently done to determine if a block is present in the spinal fluid pathway. After the needle is inserted, the jugular veins are compressed while the examiner notes the rise and fall of cerebrospinal fluid pressure (Queckenstedt's test). When this test is performed, one should be prepared to proceed with contrast medium myelography if indicated.

Lumbar puncture is seldom useful following acute head injuries, but it may be useful in more chronic situations to determine the presence of blood or elevated cerebrospinal fluid pressure.

Contraindications & Side-Effects

Lumbar puncture should not be done in the presence of papilledema or other manifestations of increased intracranial pressure unless essential for diagnosis. ***Note:*** In such situations, lumbar puncture may be fatal.

At least 20% of patients will complain of headache and stiff neck after diagnostic lumbar puncture. This will be self-limiting but may persist for days. It is absent when the patient lies flat, and can usually be prevented if the patient remains flat for 12 hours after the procedure. It is presumably related to persistent leakage of cerebrospinal fluid at the site of needle puncture. The headache is occasionally associated with fever and is essentially an aseptic meningitis. Rarely, a septic process will result. Local structures in the area of the lumbar puncture, including the intervertebral disk, may be traumatized by the procedure, but this rarely happens.

Catheterization of the Bladder

Urinary catheters are introduced into the bladder for diagnostic purposes, as in blunt trauma with renal injuries or pelvic fractures, and for the relief of urinary retention, as in prostatic obstruction. Indwelling catheters (Foley) are inserted to allow for continuous monitoring of urine output.

The size of the catheter will depend upon the size of the patient. In men, catheters that are too small tend to bend and coil within the urethra. Size 18-22F catheters may be used in adults with very little trauma. In children, size 8-12F may be used.

Catheterization in Males

The genital area is draped and the penis held taut with one hand. The meatus and glans are prepared aseptically. The catheter can be introduced with a sterile gloved hand or with a sterile clamp. The catheter should be well lubricated with water-soluble lubricant. In some patients with bladder neck obstruction, the lubricant should be instilled into the urethra with a syringe before the catheter is introduced. As the catheter is advanced, there will be a momentary obstruction at the external sphincter. By maintaining gentle pressure on the catheter and keeping the penis perpendicular and taut, the catheter tip will usually overcome the sphincteric spasm and enter the bladder.

Before inserting a Foley catheter, the balloon is blown up to check its integrity. It is then deflated and the catheter introduced into the bladder as described above. The balloon is reinflated to the appropriate volume with sterile saline, and the catheter is connected to a closed drainage system.

If there is a tight urethral stricture, it will be necessary to use sounds or filiforms and followers to dilate the area of obstruction.

Catheterization in Females

The genital area is draped and the labia held apart with one hand. The labia and meatus are cleansed with antiseptic solution. With a sterile gloved hand or a clamp, the catheter is introduced and passed in the bladder.

Peritoneal Lavage

To diagnose intra-abdominal bleeding after blunt trauma, peritoneal lavage is more accurate than needle paracentesis in 2 or 4 quadrants. The principal indication is suspected intra-abdominal bleeding when the clinical findings are equivocal. Peritoneal lavage may be hazardous in unconscious patients or those unable to cooperate. Direct placement of the catheter with counter-traction on the fascia is used in this situation. If the patient has had previous abdominal operations, adhesions may be present that fix the intestines, and the abdominal catheter must be inserted with great care. False-positive results due to iatrogenic bleeding from mesenteric vessels are common in these patients.

Withthe patient in the supine position, the lower abdomen is prepared with iodine and 70% alcohol. The bladder must be empty. The skin and subcutaneous tissues are infiltrated with local anesthetic at the site where the catheter is to be introduced, halfway between the umbilicus and pubis. A small incision is made in the skin. By flexing the head, the patient can tighten the anterior abdominal musculature and a peritoneal dialysis catheter is advanced with a pop into the peritoneal cavity. An alternative technic is to make a 1-cm incision in the fascia and introduce the catheter under direct vision. This method is safer, especially in uncooperative patients or when adhesions are present. Once the catheter passes through the peritoneum, the stylet is withdrawn and the catheter is advanced gradually toward the hollow of the sacrum. If blood wells up in the catheter as it is advanced, a positive diagnosis of intra-abdominal bleeding is made. The catheter should be promptly withdrawn and the patient prepared for immediate operation.

Even with significant abdominal bleeding, it is unusual for gross blood to appear spontaneously in the catheter. Therefore, after the catheter is positioned, instill 1 L of normal saline or lactated Ringer's solution (not 5% dextrose in water) into the peritoneal cavity over 10-15 minutes. During the infusion, the patient should be encouraged to roll from side to side to distribute the fluid throughout the peritoneal cavity. Then place the empty infusion bottle on the floor and allow the fluid to return by gravity. Make sure there is an air vent by inserting a large-bore needle in the cap of the empty bottle.

A negative test is one in which the fluid returning into the bottle is clear or only slightly tinged with blood. If the color is as deep as rosé wine, there is intra-abdominal bleeding. One should familiarize oneself with the color of the different shades of red produced by 1, 2, 5, and 10 mL of whole blood mixed with 1 L of saline. A hematocrit of 1% or more inthe recovered lavage solution is indicative of significant bleeding.

Insertion of Scribner Shunt

Scribner shunts are used for hemodialysis in acute renal failure. The sites most readily used are at the ankle, where the long saphenous vein and the posterior tibial or anterior tibial arteries can be cannulated, and in the forearm, where the cephalic vein and radial artery can be cannulated.

The patient is placed in the supine position. The operative area is prepared and draped aseptically. Local anesthesia is achieved by infiltration with 1% lidocaine. Longitudinal skin incisions are made over the artery and vein. The vessels are dissected and isolated with 3-0 nonabsorbable sutures. The largest size Teflon cannula tip that will fit into the vessel with ease is selected and connected to a Silastic tube with a reverse U curve at the end. Heparin-saline solution is injected into the tubing and cannula to evacuate the air, and the free end of the Silastic tube is clamped. Through a longitudinal venotomy and arteriotomy, the cannulas are introduced into the vein and artery, respectively. They are secured in place with several ligatures around the vessel and tubing. The loop of the Silastic tubing is positioned under the skin, avoiding angulation or axial twisting of the vessel. The free ends of the tubing are brought out through separate small skin incisions and are reconnected to each other. A rapid flow should be noted inthe arteriovenous connection when the occluding clamps are removed. The operative site is closed with interrupted catgut sutures to the subcutaneous tissue and fine nylon sutures to the skin. Antibiotic ointment is applied around the tubing at its exit sites.

Arteriovenous Fistula

The internal subcutaneous arteriovenous fistula has almost completely replaced the Scribner shunt (external arteriovenous communication) for long-term maintenance hemodialysis in chronic renal failure and in temporary support of pre- and postoperative renal transplant patients.

The most common site for the creation of arteriovenous fistula is between the radial artery and the origin of the cephalic vein just proximal to the styloid process of the radius. This is easily accomplished in a side-to-side or end-to-side fashion with fine No 6-0 or 7-0 sutures. After a period of maturation, the venous channels dilate and become arterialized to allow repeated needle insertions for hemodialysis.

If the above vessels are not available, grafts have been used to create the arteriovenous fistula. The most popular is an autogenous saphenous vein joining the radial or ulnar artery at the wrist to a large antecubital vein or the basilic vein in the proximal arm. If the wrist arteries have been ligated previously or are too small, a U-shaped arteriovenous fistula can be performed between the brachial artery and the antecubital vein or basilic vein, looping a saphenous vein graft subcutaneously in the forearm. An arteriovenous fistula can also be created between the saphenous vein and the superficial femoral artery at the adductor canal. The saphenous vein in this technique should be removed from its original bed and tunneled in a more subcutaneous position for easy access by percutaneous puncture.

When a segment of autologous saphenous vein is not available, a homograft can be used. In addition to autogenous saphenous vein, bovine, and expanded polytetrafluoroethylene (PTFE; Teflon) grafts, Sparks mandrill graft, knitted Dacron, and glutaraldehyde-treated human umbilical vein have been used.