REGIONAL ANESTHESIA FOR SURGERY OF THE THORAX AND ABDOMINAL WALL *

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The value of regional anesthesia depends largely on the familiarity with the various procedures and the skill of the individual in the use of this form of anesthesia. A knowledge of anatomy is essential. Cooperation of the patient and gentle handling of the patient by the surgeon materially contribute to the success of the various procedures.

The anterior divisions of the thoracic nerves are twelve in number, on each side. Eleven are situated between ribs and the twelfth lies below the last rib. According to Gray, each nerve is connected with the adjoining ganglion of the sympathetic trunk by a gray and white ramus communicans. The intercostal nerves are distributed chiefly to parietes of the thorax and abdomen. The first two intercostal nerves supply fibers to the arm, in addition to sending branches to the thorax. The next four thoracic nerves usually are limited to the thorax. The next five thoracic nerves, that is, the seventh to eleventh, supply both the thorax and the abdomen, and the twelfth thoracic nerve is distributed to the abdominal wall and the skin of the buttock (Fig. 1). The foregoing short description of anatomy includes practically all the nerves involved in the description of the anesthetic blocks to follow.

All operations involving only the skin and the superficial fasciae (for instance, excision of a lipoma or gland) may be performed successfully after a field block has been completed. Assuming that a tumor was to be removed, the field block would consist of a wall of 0.5 per cent. solution of anesthetic agent, with or without epinephrine, injected intradermally and subcutaneously at a distance of about 2 cm. from the tumor. To perform this procedure, a skin wheal is first made by placing the bevel of the needle flat on the surface of the skin. Before the needle is advanced into the skin, slight pressure is made on the plunger so that a small loss of anesthetic solution onto the skin surface will result, but as the point of the needle enters the skin and as the bevel of the needle is being buried in the tissue, constant pressure on the plunger deposits the anesthetic solution in the tissue. This procedure permits some degree of anesthesia to be produced even before the whole of the bevel is buried. Introduction of the needle with the bevel facing outward (that is, away from the skin) would allow escape of the solution until the whole bevel was buried and would be much more painful than the procedure I have described, in which the

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bevel is maintained in a position facing the skin. An 80 mm. needle is then attached to the syringe and the intradermal and subcutaneous injection is made (Figs. 2 a to b, b to d, a to c, and c to d). As the needle advances (sagittal section in Fig. 2), constant pressure is exerted on the plunger so that the anesthetic solution is deposited in front of the point of the needle; at point b of the sagittal section in Figure 2, the point of the needle is represented as advancing toward the surface of the skin to form a wheal, for reinsertion of the needle to continue the line of infiltration, b to d, in left-hand diagram. The same procedure
is repeated to form the lines a to c and c to d in the left-hand figure. This procedure produces some degree of anesthesia in the tissue before the needle enters the tissue, so that most of the discomfort attending the forward movement of the needle is thereby allayed. After the diamond-shaped injections in Figure 2 have been completed, the needle

![Diagram](image)

**Fig. 2.** Left, diamond-shaped intradermal and subcutaneous injections surrounding small tumor; sagittal figure (top), subcutaneous injection in which needle is advanced from a to b, and at b the needle is brought toward surface of skin to form a wheal of anesthetic solution; lower right, infiltration deep to tumor, at points b and c. This is also done at points a and d.

is passed beneath the tumor and the anesthetic solution is distributed deeply to obtain a complete anesthesia (lower right-hand diagram in Fig. 2). If the tumor is small it is well to mark its location by an "x" scratched into a skin wheal of anesthetic solution prior to performance of the field block. This will prevent losing of the location of small tumors by infiltration of the tissues with the anesthetic agent.

Local anesthesia for benign tumors of the breast is produced in a similar manner. No anesthetic solution need be injected into the gland itself.

Simple amputation of the breast may be done successfully after the following local anesthetic procedure has been completed. An initial skin wheal is made, the 80 mm. needle is passed through the skin wheal and the breast is surrounded by intradermal and subcutaneous injections of 0.5 per cent. solution of anesthetic agent, with or without epinephrine (Fig. 3a). The breast is then raised and retracted with the anesthetist's left hand, and the needle of the syringe is passed deeply behind the breast (Fig. 3b). As the needle is being advanced and withdrawn a constant pressure is kept on the plunger, to distribute the anesthetic agent evenly into this region. The needle is inserted behind the breast at various points, so that the anesthetist can be sure complete anesthesia has been achieved (Fig. 3a).
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Radical amputation of the breast under regional anesthesia requires the complete cooperation of the patient. For this cooperation, adequate premedication is essential. For satisfactory anesthesia the anesthetist must do brachial plexus block, paravertebral block, or intercostal nerve block, extending from the first to the eleventh thoracic nerves, inclusive, and surround the field of operation with a wall of anesthetic solution injected intradermally and subcutaneously.

To facilitate the performance of an intercostal nerve block it has been found of advantage to have the patient clasp his or her hands behind the head. This takes the arms away from the sides of the body and gives the anesthetist much more room in which to work. To perform intercostal nerve block, the anesthetist must identify the ribs by number. Depending on the intercostal nerves to be anesthetized, skin wheals are made in the midaxillary line opposite the ribs corresponding to the particular intercostal nerves concerned. The technic is somewhat similar to the technic of Bartlett, except that it is done unilaterally. Through the skin wheal over the particular rib a 50 mm. needle is advanced to the rib. The needle, integument, and subcutaneous tissue are then pulled downward gently so that the tip of the needle slides under the lower border of the rib. The point of the needle is then advanced 0.5 cm., which brings it into proximity with the intercostal nerve. Occasionally hyperparareesthesia is noted when the nerve is touched directly with the point of the needle; infrequently the point of the needle enters one of the accompanying blood vessels. Aspiration on the plunger will determine whether or not the needle has penetrated such a vessel. The anesthetist should attempt to get the point of the needle as close to the nerve as possible. Three to 5 cc. of a 1 per cent. solution of anesthetic agent, with or without epinephrine, is injected.
into this region (Fig. 4). It is well to allow at least ten minutes to elapse before the operation is begun, to allow the anesthetic solution to take complete effect.

If thoracotomy involves only one rib, toward the posterior part of the thoracic wall, paravertebral block is made of four thoracic nerves, of which two supply the intercostal spaces immediately above the rib to be resected and two the intercostal spaces below the rib to be resected. The operative field is surrounded by a wall of 0.5 per cent.

Fig. 4. Upper left, position of needle in relation to intercostal vessels and nerve; lower right, diagrammatic representation of position of skin wheals in the midaxillary line.

solution of anesthetic agent, in a manner similar to that of the previously described intradermal and subcutaneous technics of injection. If thoracotomy involves a portion of one or more ribs on the lateral or anterior part of the thoracic wall, it is simple to do intercostal nerve block and to surround the region to be operated on with a wall of anesthetic solution. In doing intercostal nerve block, the nerve or nerves corresponding to the rib or ribs to be operated upon and the intercostal nerve supplying the intercostal space immediately above the site of operation are anesthetized.
Operations on the costal cartilages or sternum can be successfully carried out under unilateral or bilateral intercostal nerve block, as the case may demand, and local infiltration in a manner similar to that employed for thoracotomy.

Field block of the abdominal wall may be performed with several variations in technic. The one to be described briefly will produce anesthesia sufficient to permit the surgeon to make an incision down to, and through, the peritoneum. Usually, block of the abdominal wall is combined with some form of general anesthesia. A skin wheal is made 1 fingerbreadth below the xiphoid process. The needle is passed through the skin wheal and is pointed laterally; then an 0.5 per cent. solution of procaine hydrochloride or benzoyl-gamma-(2 methylpiperidino)-propanol hydrochloride (metycaine) is injected intradermally and subcutaneously and into the rectus sheath to a point just medial to the lateral border of the rectus sheath. By bringing the point of the needle toward the surface of the skin after this line has been infiltrated, a skin wheal is made through which the next needle may be passed. This line of infiltration is 1 fingerbreadth below the costal cartilages. The needle is passed through the skin wheal and then pointed distally and the anesthetic solution again is injected intradermally, subcutaneously and into the rectus sheath to a point below the umbilicus. The procedure is repeated on the other side of the abdomen (Fig. 5). This procedure, when successfully completed, blocks the seventh to eleventh thoracic nerves. There are variations of this abdominal block. Block of only one side of the abdomen and infiltration of the midline may be done, depending on whether the incision for the operation is on the right or left side of the abdomen.

Tovell and Hinds described a type of abdominal block in which intradermal or subcutaneous injection is not made. After the patient has been anesthetized with a mixture of cyclopropane and oxygen or pentothal sodium administered intravenously, subfascial injection is done at various points along the costal margin and flank of the side in which the incision is to be made. Two injections into the upper part of the opposite rectus muscle complete the block.

The abdominal wall also may be anesthetized with bilateral block of the seventh to eleventh intercostal nerves inclusive. A technic similar to that described previously, except that injection is done bilaterally and not unilaterally, somewhat like the technic of Bartlett, has been of value on several occasions. By means of this technic, complete laparotomy has been performed without the addition of general anesthesia. This procedure has been found to be particularly applicable in cases in which the risk is poor and in which the surgeon wishes to operate with the patient under the influence of local anesthesia only. Intercostal block anesthesia and pentothal sodium administered intravenously have been employed and the combination has been very satisfactory in certain cases.
A low diamond-shaped field block, in which the acute angles of the block are situated just below the umbilicus and opposite the pubes, has been of value in operations on the bladder and prostate gland. The injection is done intradermally, subcutaneously and intramuscularly in a manner previously described (Fig. 6a and b). At a point opposite the pubes, the space of Retzius must be infiltrated in a fan-shaped manner, the needle passing behind the os pubis (Fig. 6c). Lundy wrote that since in this technic infiltration is not done in the line of incision, infection which possibly exists is not aggravated by the procedure. The diamond-shaped field block is represented in Figure 6d by lines g to e to h, and g to w to h.

For repair of an umbilical hernia, field block frequently is the mode of anesthesia of choice. With the hernial sac well defined, it is surrounded by a wall of anesthetic solution injected at least 2 finger-
breadths from the hernial sac. The neck of the sac may be manipulated and intestinal adhesions freed.

To carry out a local anesthetic procedure for an operation on an inguinal hernia, the anesthetist makes a skin wheal medial to the anterior superior iliac spine. A needle is passed through this point and an 0.5 per cent. solution of anesthetic agent, with or without epinephrine, is injected intradermally and subcutaneously and deeply, while the needle is traveling toward the umbilicus. The direction of the needle is then

![Diagram](image)

**Fig. 6a.** Intradermal, subcutaneous and deep injection of anesthetic agent; b, point of needle resting intramuscularly within the rectus sheath; c, needle passing behind os pubis into space of Retzius; d, diamond-shaped field block, g to e to h, and g to w to h. (Arc-shaped line x to y to z to k may be disregarded.)

changed, and it is passed through the original wheal and the anesthetic solution is injected again in a line running toward the pubic tubercle. This procedure serves to infiltrate well the line of incision and dissection which is to be used. From a point at the distal end of this line of infiltration, the anesthetic agent is fanned out, so to speak, over the suprapubic region (Fig. 5). Next, the cord is grasped between the thumb and index finger of the anesthetist's left hand at the level of the external inguinal ring or at the point at which the cord crosses the
pubis. The needle is introduced into the cord and 5 to 10 cc. of a 1 per cent. solution of anesthetic agent is injected slowly. Care must be exercised not to traumatize the structures of the cord. Production of a hematoma of the cord should be avoided if possible. To hasten diffusion of the anesthetic solution, the cord should be massaged lightly. Injection of the cord is not carried out in questionable or irreducible hernias.

One of the several reasons why regional anesthesia is not successfully accomplished and used more frequently is the fact that usually a proper intradermal injection is not made. The entire procedure of subeutaneous and deep injection may be successfully performed, and yet good cutaneous anesthesia may not result. Without proper intradermal injection the patient will experience pain when the skin is incised. To be certain that an adequate intradermal injection has been achieved, the anesthetist must deposit the anesthetic solution in a layer of skin which is sufficiently thin, so that the overlying skin resembles an orange peel, that is, by showing up the follicular indentations.

Another faulty procedure which frequently vitiates otherwise successful anesthesia is failure on the part of the anesthetist to place the anesthetic solution sufficiently well, so that it surrounds the desired nerves. The farther the solution has to travel to come into contact with nerves, the more dilute it becomes when it finally reaches them, and the less the degree of anesthesia will be. This is particularly true when intercostal nerve block is being done.

Proper preoperative sedation of the patient, a well performed local anesthetic procedure, and a surgeon who appreciates gentle handling of the patient are factors which in many instances will combine to achieve a very safe and satisfactory operation.

REFERENCES