

posterior lip of the wound (Fig. 189). In amputations near the hip or through the trochanters, no other operation than that by long anterior and short posterior flaps leaves a wound that is easily drained. When there is any question as to the vitality of the long anterior flap, it is an easy matter to include with it a varying thickness of the muscular tissue.

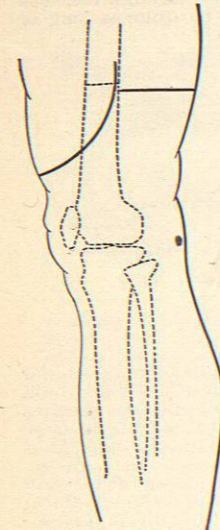


FIG. 189.

When an amputation of the thigh is demanded for senile or diabetic gangrene, it is essential that the flaps shall be short. The circular amputation, with short liberating lateral incisions and circular division of the muscles in different planes, without question gives the best results.

A study of Table I. shows that amputations of the thigh are associated with a mortality that is largely responsible for the high death rate attending major amputations in general. The fatality of this operation in civil practice increases as the trunk is approached.

According to Macleod and Legouest, this applies equally to amputations for gunshot injury. According to the statistics of Otis, this view, which is generally entertained, must be modified. Of 768 amputations for gunshot injury, made in the upper third of the thigh, 53.8 per cent. died. Of the 1,866 amputations made in the middle third, 44.5 per cent. died. Of 2,901 operations in the lower third, 53.6 per cent. succumbed.

The general mortality attending the operation is represented by 6,229 cases, with 3,310 deaths, the mortality being 53.8 per cent.

By modern methods the mortality of amputations has been greatly reduced. From the sources above quoted, of 465 amputations of the thigh, 79, or 17 per cent., were fatal. Of 154 amputations for disease done at the Newcastle Infirmary, 10 died. Of 20 done at the Cincinnati Hospital, only 3 died.

AMPUTATION AT THE HIP.—The first idea of this operation, the most formidable of justifiable surgical procedures, appears to have originated with Morand and two of his pupils, Volker and Puthod, who practised it on the cadaver in 1738. A year later, Le Dran taught the operation in his practical courses, and presented a report on its feasibility to the French Academy. In 1740 Ravaton proposed to amputate at the hip joint on a patient, but was dissuaded therefrom by other surgeons in consultation. In 1756 and 1759 the Paris Academy offered a prize for the best treatise on the justifiability of the operation and the best method of performing it. Of forty-four contestants, thirty-four supported the operation, the prize being awarded to Barbette, who concisely mentioned the indications that made it necessary. That life could continue after loss of the lower extremities had been shown by the following case: "In 1748, there came to the hospital of Orleans, a lad fourteen years of age, who was the subject of ergotism. Gangrene of both lower extremities had supervened, extending on the right side to the hip joint, and on the left to the trochanter. The suppuration which was established almost separated the right thigh, the round ligament and great sciatic nerve alone holding it to the trunk. Lacroix, surgeon to the hospital, completed the separation of the member. This operation succeeded so well that four days later he also amputated the left thigh. There was neither hemorrhage nor pain, and the patient progressed well till the tenth day, when fever supervened, and death followed fifteen days after the first

operation." In 1778 Perault removed the entire thigh in a case of traumatic gangrene "of several months' duration," in which a complete recovery ensued in eighteen months.

Although in 1774 and 1778 Kerr and Thomson made the first amputations at the hip through living tissues in cases of coxalgia, both operations terminated fatally, and the procedure was not again resorted to till the last decade of the past century. Amputation at the hip in reality owes its existence to the wars of the French Revolution. In 1794 the elder Blandin performed it thrice, with one recovery. During his different campaigns, Larrey repeated the operation seven times and gave it a standing among surgical procedures, although it is doubtful whether any of his cases recovered. In 1812 and 1815, Brownrigg and Guthrie, after repeated failures, were enabled to report successful amputations at the hip for gunshot injury. The first operation in this country was made in Kentucky in 1806, by Brashear, for compound fracture, and ended in recovery.

The most comprehensive statistics of the operation in question have been collected by Otis, Lüning, and Ashhurst. Over three-fourths of all the operations have been made since the introduction of anesthesia, and fully two-thirds of the entire number were performed later than 1860. Up to 1875 Lüning was enabled to collect but 497 well-authenticated cases, while in 1881 Ashhurst was enabled to tabulate 633 operations, since which time over 100 cases have been added to the list.

The question of supreme moment in amputation at the hip joint is that which pertains to a complete, and yet safe method of controlling the circulation during the operation. Its importance becomes manifest from the fact that five per cent. of the patients operated on do not survive the operation, and that seventy per cent. of the deaths occur during the first five days (Lüning). To overcome this great and immediate danger of amputation at the hip, progress has been made in the direction of preserving the blood contained in the condemned part and by temporarily or permanently occluding the sources of its blood supply. By the use of the elastic bandage from the toes to the groin, and by keeping it in place during the operation (Erskine Mason), or, in cases of extensive suppuration of the extremity, by maintaining the latter in a vertical position for some minutes before the operation, a not inconsiderable amount of blood can be saved to the economy.

In 1860 Professor Pancoast first called attention to the practicability of compressing the aorta against the vertebral column by means of an abdominal tourniquet. A number of instruments have since been devised similar to that of Pancoast, by Lister, Skey, and Esmarch, and it is to one of these contrivances that most surgeons have recourse before proceeding to the operation proper. In the tourniquet of Esmarch, the aortic pad exerts its compression by means of an elastic band which is passed through its handle. In the absence of a tourniquet, a pad can be improvised by firmly winding a long roller bandage around the middle of a stick, which should be about a foot long and of the thickness of the thumb. The pad thus formed being placed in position, is retained by five or six turns of an elastic bandage around the abdomen (Esmarch). Professor Spence resorts to a similar procedure. Whatever tourniquet be used, it should be applied while the patient is lying on the right side, the

pad being placed a little to the left of the umbilicus (Fig. 190, Esmarch). The operation should not be commenced until the operator has satisfied himself that the circulation in the lower extremities is completely controlled.

It having been held, but without sufficient clinical evidence, that prolonged compression of the abdominal aorta is injurious from damage to the branches of the solar plexus, and by interfering with respiration, compression of the common iliac artery through the rectum has been advised and practised.

one-eighth of an inch thick, with a movable point attachment which is to be pushed through the soft parts in front of the joint, an inch above the level where transfexion is to be made with the knife. "The rod having been pushed through the soft parts, the point is removed and a rubber tube wound around the protruding ends of the rod in figure-of-8 turns. In this manner compression of all the soft parts in front of the joint is effected, and the flap can be made without loss of blood. After the vessels divided in the anterior flap have been ligated, the rod is introduced through the soft parts behind the joint in a similar manner before the posterior flap is made." Although tedious in its performance, this method of controlling hemorrhage is thoroughly practicable and promises good results. It has been successfully resorted to by Varrick in a case of traumatic amputation in a subject very anæmic from hemorrhage.

In 1890, Wyeth* described a bloodless amputation at the hip, which, while it appears to be an amplification of Trendelenburg's method, is exceedingly simple, and can be highly recommended for all amputations at the hip, save those rare cases in which the disease involves the trochanter. In these cases the transperitoneal ligation of the external, or, better still, of the common, iliac is to be preferred to the pins and constriction used by Trendelenburg and Wyeth. The accompanying diagrams (Figs. 191 and 192), inserted with Dr. Wyeth's permission, illustrate the method of the introduction of the pins.

The patient is placed with the hip well over the end of the table, and an Esmarch bandage is applied. With the bandage still in position, Dr. Wyeth's needles are inserted as follows: "Two steel mattress needles, three-sixteenths of an inch in diameter and a foot long, are used. The point of one is inserted an inch and a half below the anterior superior spine of the ilium and slightly to the inner side of this prominence, and is made to traverse the muscles and deep fascia, passing about half way between the great trochanter and the iliac spine, external to the neck of the femur and through the substance of the tensor vaginae femoris, coming out just back of the trochanter. About four inches of the needle should be concealed by the tissues. The point of the

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above the fixation needles and tied." The Esmarch bandage is then removed, and if the operation is to be completed according to Dr. Wyeth's plan, a circular incision is made, the skin flap is turned up, the muscles are divided at the lesser trochanter, and the bone is sawed through. All vessels are then tied. The remaining portion of the femur is then removed by division of the attachments of the muscles.

Methods.—Although a large number* of methods of amputation at the hip have been devised, only a few of

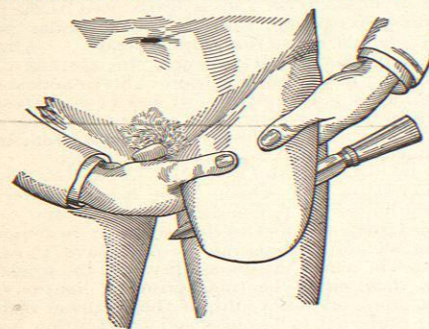


FIG. 193.

them are of practical value, and are, therefore, commonly employed. The methods which will be considered are, that by musculo-tegumentary flaps, that by cutaneous flaps and circular division of the remaining soft parts, and that by a high circular amputation with subsequent excision.

Musculo-tegumentary Flaps.—Amputation at the hip can be most quickly accomplished by means of antero-posterior muscular flaps, of which the anterior is made by transfixion, and the posterior by cutting from within outward. With able assistance the operation can easily be performed in less than twenty seconds. At least three assistants are required in this, as in all amputations of the hip. One of these is entrusted with the control of the circulation in the limb, the second follows the knife to grasp the flap before the artery is divided (Fig. 193, Hueter) and then to retract it, and the third takes charge of the condemned limb.

The patient's body having been brought to the foot of the table, the nates are made to project over its edge, and the scrotum and sound thigh are held out of the way. While the condemned limb is slightly flexed, the operator, standing on the left side, enters the point of an amputating knife, the blade of which is at least a foot long, midway between the anterior superior spinous process of the ilium and the trochanter major. It is carried deeply into the limb in a direction parallel to Poupert's ligament, across the anterior surface of the joint, which is thus opened, and made to issue on the inner surface of the thigh close to the perineum and just in front of the tuberosity of the ischium. Transfixion accomplished, a broad rounded flap, five to seven inches in length, is made by carrying the knife downward in front of the bone and cutting outward. This flap is at once reflected and held out of the way. By a transverse incision on the head of the bone the capsule is then widely opened, while the limb is forcibly abducted and everted. Hyperextension then causes the head of the bone to start from its socket with a "popping" noise when the ligamentum teres is cut. The knife being then introduced behind the head of the femur, the posterior portion of the capsule is divided and a posterior flap four inches in length is cut from within outward (Liston). When the operation is made on the right side, the knife is entered from the inner side just above the ischial tuberosity. When the posterior flap is cut from within

* According to Ashhurst there are forty-five.

outward, the cutaneous margin of the wound is generally irregular and not well suited for close coaptation with the anterior flap. It is advisable, therefore, particularly in robust limbs, either to outline this flap by an incision through the skin, or to cut it altogether from without inward (Fig. 194, Esmarch) (Manec). Indeed, both flaps may advantageously be cut in this manner (Guthrie).

The great advantage of the operation just described is in the rapidity with which it can be executed. Its disadvantages are in the excessively large wound which it leaves, the tendency to the retention of pus in the intermuscular spaces, and the great probability of excessive hemorrhage from the posterior flap.

A wound better suited for drainage is that made by lateral flaps. In this form of operation a semicircular incision is made, beginning at the tuberosity of the ischium, and terminating on the outer side of the femoral vessels in the centre of the groin. The incision crosses the outer surface of the thigh four or five inches below the trochanter. The flap thus outlined is then reflected over the latter and the joint opened. The inner flap is then made by cutting from within outward.

Tegumentary Flap Method.—This is an admirable method to overcome the superfluity of muscular tissue in the wound and the consequent tendency to purulent infection, and it is therefore preferred by a number of operators, among whom are Agnew and Volkmann. The operation is described by Agnew as follows: "The surgeon makes a semilunar incision in front of the limb, with its convexity downward, and, commencing midway between the anterior superior spinous process and the trochanter on the outside, descending the thigh in a longitudinal direction for five inches, then passing across the front of the limb in an oval course, adding thereby an inch to the length of the flap, and, last, ascending the inner border of the thigh, and terminating one inch below the ramus of the pubes. The integument is now rapidly dissected up from the deep fascia and entrusted to the fingers of an assistant."

The next step is to isolate the femoral vessels above the origin of the profunda, and to apply separately to

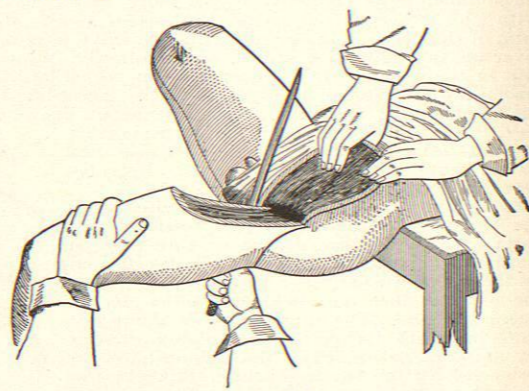


FIG. 194.

the artery and vein a strong ligature.* By displacing the pectineus muscle the obturator artery can be readily found and ligated below the obturator membrane.

The limb being now raised, the surgeon proceeds to cut a semilunar tegumentary flap from the back of the thigh, one inch shorter than the anterior. With an amputating knife the muscles are then severed circularly in front of the joint, "when after liberation of the head of the bone, as in other methods, the operation is completed by dividing through the soft parts posteriorly."

* Volkmann divides the vessels between two ligatures.

According to Agnew, this operation can be completed in forty seconds.

Circular Amputation.—In order to make a smaller wound, and to divide the vessels where they are smaller, a circular amputation of the thigh at the lower part of the upper third is made. This may be accomplished by a single incision in thin subjects, while in robust extremities it is preferable to resort to a double incision. When the amputation in this part is effected, all the blood-vessels that can be recognized must be ligated. An incision is then made along the outer side of the stump from a point two inches above the trochanter to the circular wound, and dividing everything down to the bone (Dieffenbach). The operator then seizes the stump of the femur with a lion-jawed forceps, and while the edges of the vertical incision are separated by an assistant, the soft parts, including the periosteum, are stripped from the bone, and the capsule is opened and disarticulation effected as in other procedures. Fig. 191, from Wyeth, shows the circular amputation wound with pins *in situ* and before the head of the bone has been removed. In 1880, Mr. Furneaux Jordan, of Birmingham, published a method of amputating at the hip which does not differ essentially from the method just described. In his operation the outer incision is first made, disarticulation is effected, and the circular incision forms the last step of the operation.

Finally, mention must be made of the methods of Verneuil and Ed. Rose, and more recently of Senn,* who, in amputating at the hip, treat the lower extremity as they would a neoplasm that is to be removed, cutting from without inward, and tying each vessel as it is encountered. A shorter internal and longer external incision is made through the skin when the femoral artery and vein are to be divided between two ligatures. The incisions are then gradually carried through the muscles in front and on the outer side until the articulation is reached, when, after disarticulation has been effected, the adducted muscles are divided last of all.

Amputations at the hip of necessity present a deplorable mortality. Of 633 cases tabulated by Dr. F. C. Sheppard for Ashhurst, 393 terminated fatally, and in 20 the result was undetermined. The general mortality of the operation is, therefore, 64 per cent. The most unfavorable results obtained are those from military practice. Of 249 cases of this character in which the result was ascertained, including 66 operations performed during the War of the Rebellion, only 27 patients recovered, the mortality being 89.1 per cent.; 25 of the 66 cases referred to were primary amputations, of which 3 recovered; 23 of the operations were secondary, and all terminated fatally. Of 9 secondary operations, 2 survived, and of 9 reamputations, 6 recovered. Of 71 cases of hip-joint amputation for injury in civil practice, 47 died, the mortality being 66.1 per cent. Of 276 cases of hip-joint amputation for disease, of which 15 were undetermined, 105 terminated fatally, the mortality being 40.2 per cent.

Owing to the improved methods of preventing hemorrhage, and particularly through the use of Wyeth's method, the mortality of amputations at the hip has been very greatly reduced. Two years ago Wyeth† collected 69 cases with only 11 deaths. Of the fatal cases, 5 had severe injuries. I have collected 138 cases of amputations at the hip, published between 1889 and 1900, including the 69 cases collected by Wyeth. The total mortality of the 139 cases was 27 fatal, with a mortality of a little over 19 per cent. Of the amputations there were 121 for disease, with 21 deaths—in this estimate I include 3 cases of my own, 1 of which was fatal—or a mortality of 17 per cent. I find that 6 amputations were done for injury, with only 1 recovery—the cases reported by McBurney. In 15 cases the cause for the amputations was not stated; of these 1 died.

Joseph Ransohoff.

* Chicago Clin. Rev., 1892, p. 343.
† Annals of Surgery, vol. xxv., p. 129.

AMYGDALIN.—The source, occurrence, and general nature of amygdalin have already been stated in discussing hydrocyanic acid. It is not official and is scarcely used in its own form, although occurring in commerce. Boiling alcohol is used to extract it from almond oil cake, after which it is precipitated by ether. It occurs in crystals or scales which are soluble in twelve parts of water. It is odorless, but very bitter. If entirely free from emulsin, it does not yield prussic acid and is not poisonous. H. H. Rusby.

AMYGDOPHENIN.—Phenyl-glycolyl-phenetidin, $C_8H_7OC_2H_5NH_2OC_6H_4OHC_6H_5$. This is a substance formed by the introduction of amygdalic acid and carboxyethyl into paraamidophenol. It is a grayish-white, light, crystalline powder, dissolving but slightly in water. Stüve finds it to be analgesic, but not antipyretic, and recommends it in neuralgia, rheumatism, and the pains of locomotor ataxia. The dose is gr. xv., given from one to six times a day in powder, tablet, or capsule. W. A. Bastedo.

AMYL IODIDE.—Iodamyl, $C_5H_{11}I$, is an oily liquid obtained by distilling together iodine, isoamyl alcohol, and red phosphorus. It is purified by washing with water and redistilling. This liquid is about as heavy as chloroform, boils at $148^\circ C$, is freely soluble in alcohol, and insoluble in water. It is used to replace amyl nitrite as sedative and antispasmodic in asthma, angina pectoris, etc. Dose, \mathfrak{m} ii.-v. by inhalation. W. A. Bastedo.

AMYL VALERIANATE.—Apple oil, apple essence, $C_8H_{11}C_5H_9O_2$, is obtained by the action of valerianic acid on isoamyl alcohol, in the presence of sulphuric acid. It is a clear, colorless liquid, lighter than water, having an odor like that of apples and a sharp ethereal taste. It is insoluble in water, soluble in alcohol and ether, and it boils at $188^\circ-190^\circ C$.

Amyl valerianate is used in place of valerian in functional nervous disorders, and also as a liver stimulant. As it is a solvent for cholesterol, it was thought to have the power to diminish the size of gall stones, but it is hardly probable that this solvent action could take place in the system. In fact, alcohol and other cholesterol solvents taken in large quantities have no effect whatever on the size of the stone. Amyl valerianate is administered in dose of \mathfrak{m} ii.-v. in capsules, or in five-per-cent. alcoholic solution with an equivalent quantity of the amyl acetate. W. A. Bastedo.

AMYLENE.—Valerine, C_8H_{10} . Amylene is a volatile and inflammable ethereal fluid of an unpleasant odor, resembling that of cabbage. It was experimented with by Snow in 1856, as an anæsthetic, and proved itself powerful, after the manner of chloroform; but proving itself also capable of killing, it never came into accepted service. Edward Curtis.

AMYLENE CHLORAL.—Dormiol-chloral-dimethyl-ethyl-carbinol, $C(CH_3)_2C_2H_5OH.CCl_2COH$, is made by fusing together molecular quantities of amylen hydrate and chloral. It is a colorless, oily-looking liquid, with a camphoraceous odor and a pungent, followed by cooling, taste. It is insoluble in water, and is freely miscible with alcohol, ether, acetone, and volatile and fixed oils. It goes under the trade name of dormiol, and is claimed by Meltzer and by Fuchs and Koch to be a certain hypnotic without depressing effect on the heart or respiration. Its dose is gr. viii.-xl., given in syrup, or in emulsion with a small amount of olive or almond oil, and flavored with lemon or cinnamon. W. A. Bastedo.

AMYLENE HYDRATE.—Tertiary Amyl Alcohol, Dimethyl-ethyl-carbinol. This is a clear, colorless, thin, neutral liquid, with a burning taste and an aromatic odor somewhat resembling camphor. It is soluble in eight parts of water and in alcohol, ether, glycerin, and oils; specific gravity, 0.812 at $53.6^\circ F$. It was recommended