

SYMPATHECTOMY FOR ISCHEMIA FOLLOWING FEMORAL ARTERY LIGATION

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IN VIEW of the current interest and lack of agreement in the value of sympathectomy following ligation of the femoral artery, the following five cases are reported. The cases are similar in that all had the superficial femoral artery and vein ligated between the profunda femoris branch and Hunter's canal. The first case was observed for three months then sent to limited duty without sympathectomy. In three cases sympathectomy was performed after a two months observation period. The fifth case had a sympathectomy immediately following the ligation of the vessels.

Dr. I. A. Bigger, in a recent article,¹ points out the frequency of permanent reduction of blood supply to tissues, especially the muscles, following interruption of large arteries. He reports seven out of eight cases with interruption of the main artery of the lower extremity (iliac to popliteal) had definite symptoms of chronic circulatory deficiency distal to the obstruction on examination after a period of nine months to eight years. One case which did not have these symptoms had had an injection of the lumbar sympathetic ganglia with alcohol.

CASE REPORTS

Case 1.—A 24-year-old Ordnance Sergeant was wounded in action, March 16, 1944, at 0700 hours, at Anzio Beachhead in Italy, sustaining a penetrating wound of the left thigh from enemy shell fragments. The fragment divided the femoral artery and vein at the proximal end of Hunter's canal. He received 1 cc. of tetanus-toxoid and sedation at the Battalion Aid Station and was then sent to an Evacuation Hospital. At 1000 hours, March 16, 1944, three hours after injury, the wound was débrided and the femoral artery and vein ligated at the site of injury. A lumbar paravertebral sympathetic injection with novocaine was done on the 16th and 17th of March. Forty thousand units of gas gangrene antitoxin was given intramuscularly. A plaster hip spica encasement was applied for the immobilization of the soft-tissue wounds and the patient evacuated to a General Hospital March 23, 1944.

On March 24, the toes were fairly warm but no pulsations could be felt in the foot; the color was good, however, and there was no swelling. There were two large wounds, anterior medial and the lateral surface of the thigh with some induration of the exposed muscle. On March 24, 1944, a transfusion of 500 cc. of blood was given and the following day the plasma protein was 8.3 Gm.; hemoglobin 15 Gm., and hematocrit 44 per cent.

On March 27, 11 days after the débridement, the wounds were closed with end-on-mattress silk sutures after trimming the skin edges.

Progress Notes—April 5: "Sutures removed, the wounds are healing cleanly."

April 11: "Posterior tibial pulse cannot be felt. The dorsalis pedis is present but weak. The toes are normal color, there is no swelling, the left foot is slightly cooler than the right."

April 24: "There is a small area on the left heel which has purplish discoloration and a vesicle has formed, probably the result of pressure from the splint. He has been walking fairly well."

May 11: "The area on the left heel has almost covered over with epithelium now. The posterior tibial and dorsalis pedis pulses are present but weak. The left foot is cooler than the right on cool days and the color of the foot is normal."

June 1: "It is now three months since the injury and ligation of the vessels. The vessels of the involved foot can be felt but pulsate weakly. On cool days the pulsation cannot be felt and there is a difference in the temperature of the two feet. The color is normal and there is no swelling. He does not have excessive sweating of the feet. The calf cramps after walking 800 to 1,200 yards at a moderate rate of speed."

Disposition: Sent to limited duty in the Mediterranean Theater.

Case 2.—A 23-year-old Infantry Private was accidentally shot by another soldier, at 2030 hours, May 15, 1944, at Anzio Beachhead in Italy. He was given 1 cc. of tetanus toxoid and 250 cc. of plasma at the Battalion Aid Station, then was taken to a Field Hospital. At 0100 hours, May 16, 1944, 4.5 hours after injury, the wound was débrided and the left femoral artery and vein ligated in the mid thigh, distal to the profunda femoris branch. Lumbar sympathetic novocaine injections were done daily for three days. Sulfadiazine, 1 Gm. every four hours was given orally following the operative procedure. On May 23, the wounds were sutured under local novocaine anesthesia. He was evacuated to a General Hospital, May 26, where examination showed the wounds to be healing cleanly. The left foot was cooler than the right and both feet were sweaty. The pulsations could not be felt in the left foot vessels. There was no swelling of the foot and the color was good. The plasma protein was 6.6 Gm., hemoglobin 11.8 Gm.; hematocrit 34.5 per cent.

Progress Notes.—May 29: "Transfusion 1,000 cc. of whole blood."

June 20: "Cold day, both feet cold and moist, pulses in the left foot are not palpable, color slightly cyanotic."

July 8: "The posterior tibial pulse can now be felt. The dorsalis pedis is very weak. The feet are about the same temperature, both sweaty and cold. He can walk about 400 yards slowly without pain but gets cramp in the calf on climbing two flights of stairs at moderate speed."

July 31: "(Cool day) The left foot is cooler than the right, both are sweaty and he can walk only 200 to 300 yards at moderate speed before getting pain in the left calf (two and one-half months after injury)."

August 10: "Left lumbar sympathectomy performed under spinal anesthesia, through an anterior muscle-splitting extraperitoneal approach. The second and third lumbar ganglia and connecting sympathetic trunk were excised."

August 26: "The abdominal wound healed cleanly. He can walk ten times the distance he could prior to sympathectomy at the same rate of speed without cramping in the calf (16 days after operation)."

September 20: "He walked one and one-fourth miles today at a brisk pace without pain (one month and ten days postoperative)."

"The foot and leg are warm and dry, there is no swelling, and the left foot is warmer now than the right. The posterior tibial pulse is fairly strong."

Disposition.—Limited duty in the Mediterranean Theater four months after injury and one month and ten days after sympathectomy.

Case 3.—A 26-year-old Infantry Private sustained multiple penetrating wounds by enemy shell fragments, at 0800 hours, June 1, 1944, near Rome, Italy. He received 250 cc. of plasma and 1 cc. of tetanus toxoid at the Battalion Aid Station, and was then sent to a Field Hospital where, at 1320 hours, June 1 (five and one-half hours after injury) the wounds were débrided. There was extensive muscle destruction of both anterior thighs, especially the left, and the left femoral artery and vein had been severed distal to the profunda femoris branch. The vessels were ligated and plaster splints applied to both lower extremities for soft-tissue immobilization. He was evacuated to a General Hospital, June 6, 1944, where examination showed extensive wounds of both anterior thighs with some necrotic tissue in the wounds. The pulses of the left foot

could not be felt, the color was pale, there was no swelling and the left foot was slightly cooler than the right.

Progress Notes.—June 7: "Plasma protein 6.6 Gm.; hemoglobin 9.2 Gm.; hematocrit 27 per cent.

June 8: "Transfusion 1,000 cc. of whole blood."

June 9: "Transfusion 1,000 cc. of whole blood. Wounds closed after excising the necrotic tissue from the thigh wounds and mobilizing skin flaps by undercutting. Drain left in right thigh wound. Penicillin 25,000 cc. every three hours, given from June 8 until June 13."

June 11: "Plasma protein 7.3 Gm.; hemoglobin 13.7 Gm.; hematocrit 40.5 per cent."

June 20: "Sutures removed, moderate purulent reaction about sutures and small deep pocket of pus at upper angle of left thigh wound. Hot dressings applied."

June 27: "Wounds healing satisfactorily."

July 12: "Patient walking about and getting physiotherapy. He has marked weakness of muscles of both thighs but the left is more marked than the right."

August 1: "(Two months after ligation of artery.) The left foot is cooler than the right and the left foot pulses are weak. He has cramping pain in the left calf after walking up two flights of stairs at a moderate speed."

August 10: "(Two and one-half months after injury.) Left lumbar sympathectomy performed through an anterior muscle-splitting abdominal incision using the extra-peritoneal approach. The second and third lumbar ganglia and connecting trunk were excised. (Spinal anesthesia.) Some enlarged lymph nodes were encountered in reflecting the peritoneum over the sympathetic chain."

August 13: "Temperature elevated to 102-103° F. Pain and tenderness deep in left flank. The wound was explored under pentothal anesthesia. Moderately large collection of thin, bloody purulent exudate in retroperitoneal space evacuated. Two drains (cigarette) inserted. Culture of fluid showed *beta hemolytic Streptococci*. Penicillin 25,000 units every three hours and sulfadiazine 3 Gm. followed by 1 Gm. every four hours started."

August 17: "Temperature and pulse have gradually declined. The left foot has been dry and warmer than the right since the sympathectomy, color of foot is normal. Posterior tibial pulse fairly good volume, no swelling."

September 3: "Temperature elevated again, and some pain in the left flank. Digital exploration, under pentothal anesthesia, revealed small pocket beneath fascia with inadequate drainage."

September 16: "Patient afebrile, wound healing, drain removed."

October 7: "Sympathectomy wound almost healed now, the patient is taking daily walks with gradual improvement. He has considerable general weakness from sepsis and long hospitalization, plus local weakness of the thigh muscles from muscle destruction by the fragments."

October 11: "The posterior tibial and dorsalis pedis pulses are palpable and strong on left. The left foot is dry and warmer than the right. There is no swelling and the color is normal. He can walk 1,200 yards at a moderate speed. General weakness and local weakness in thigh prevent further walking now. No pain experienced in the left foot after walking this distance, also no pain after walking up stairs."

Disposition.—Evacuation to Zone of Interior (four and one-half months after injury, two months after sympathectomy).

Case 4.—A 28-year-old Infantry Sergeant was wounded in action by enemy bullet, at 2400 hours, August 19, 1944, in Southern France, sustaining penetrating wounds in the hip, left thigh, and right heel with laceration of the right femoral artery and vein. He received 1 cc. of tetanus toxoid and 750 cc. of plasma at the Battalion Aid Station at 0120 hours. The patient was then sent to a Field Hospital where the wounds were débrided and the femoral vessels divided and ligated at the site of injury below the

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profunda femoris branch. The exact time was not stated, but was probably within a few hours after the injury, on August 20, 1944.

Lumbar sympathetic injections of novocaine were done daily for three days. Penicillin 15,000 cc. every three hours was given intramuscularly. He was evacuated to a General Hospital in Italy, on August 25, at which time he was quite pale; plasma protein was 6.7 Gm.; hemoglobin 8.2 Gm., and hematocrit 24.1 per cent. The pulses could not be felt in the right foot, the foot was pale and slightly cyanotic and cooler than the left foot. There was no swelling.

Progress Notes.—August 25: "Transfusion 1,000 cc. of whole blood."

August 26: "Transfusion started, after receiving about 100 cc. he had a severe reaction, with back pain, numbness, and tingling of extremities, dyspnea, cyanosis, but symptoms were relieved by adrenalin. Cross-match rechecked and found compatible. Reason for the reaction not determined."

August 27: "Wounds closed (seventh day after débridement). Transfusion 1,000 cc. of whole blood during operation."

September 3: "Sutures removed, wounds healing cleanly."

October 2: "(Two months after injury) patient has cramping pain in right calf after walking 500 to 600 yards at moderate speed. The pulses remain weak, and the foot becomes quite cold and pale on cold days."

October 28: "Right lumbar sympathectomy. Spinal anesthesia, extraperitoneal, muscle-splitting, anterior abdominal incision. The second and third ganglia and connecting trunk were excised."

November 6: "The right foot has been dry and warmer than the left since sympathectomy. Pulses in foot fairly good volume. Suture removed. Wound healing clearly."

November 13: "Taking daily walks. No cramping in calf."

November 25: "(Three months after injury, one month after sympathectomy.) Patient can now walk two miles at a moderate speed without pain in the calf. The right foot remains dry and warmer than the left. There is no swelling. The color is good and the pulses of good volume."

Disposition.—Limited duty in Mediterranean Theater.

Case 5.—A Sergeant in a Tank Battalion was wounded by accidental explosion of a rifle grenade on a practice range in Northern Italy, at 1530 hours, February 14, 1945, sustaining a penetrating wound of the left anterior thigh. There was considerable bleeding from the wound, necessitating the application of a tourniquet. Treatment during evacuation consisted of the application of a dressing and the injection of one-quarter grain of morphine. He was given 1 cc. of tetanus toxoid and penicillin started. The left foot was cold and pulseless.

Operation.—February 14, 1945, 2000 hours: Under gas-oxygen-ether anesthesia, the wound was débrided, the femoral artery was found divided about three centimeters below the profunda femoris branch. The vessel was ligated and the concomitant vein divided and ligated at the same level. The metallic fragment was removed. The wound was left open. A dry fine-mesh gauze dressing was applied.

At the end of the above procedure the left foot was cold, pulseless and a cyanotic-purplish color. The general condition of the patient was good. A left lumbar sympathectomy was then done through an anterior muscle-splitting extraperitoneal approach. Lumbar ganglia II and III with connecting trunk were removed. The wound was closed in layers with fine cotton. Following the sympathectomy the left foot was almost as warm as the right. The veins were full and showed good venous flow. The color was slightly cyanotic but gradually became normal within a few hours. A 1,000 cc. blood transfusion was given during the operation.

Progress Notes.—February 15: "The left foot is hot and dry, veins full good color. Feet about equal warmth. No pulse is felt in the left foot. Plasma protein 6.2 Gm.; hemoglobin 11.2 Gm.; hematocrit 38 per cent."

February 16: "Transfusion 500 cc. of blood given. Patient has moderate tenderness and some pain on motion in left medial calf muscles."

February 20: "Patient is afebrile for two days now. Wound of left anterior thigh closed with end-on-mattress silk sutures, under pentothal anesthesia."

February 24: "Penicillin discontinued. He has been afebrile since February 21."

February 28: "Abdominal and thigh wounds are healing cleanly. All sutures have been removed."

March 14: "Plasma protein 6.5 Gm.; hemoglobin 15 Gm.; hematocrit 44 per cent."

"It is now one month following injury and operation. He has been taking daily walks and thigh exercises. Today he walked two and one-half miles on a one-quarter mile measured track at a moderate gait without experiencing cramping in the leg. He does have cramp in the calf after walking one-quarter mile at a very fast pace. The foot remains dry and warm. The posterior tibial pulse can be felt on the left. The dorsalis pedis is not palpable."

Disposition.—Evacuated to a General Hospital, and from there was sent to duty in the Mediterranean Theater.

DISCUSSION.—The inaccessibility of a medical library prevents review of the literature on this subject. White and Smithwick² make the following statement about sympathectomy upon patients with arteriosclerosis and thrombo-angiitis obliterans who have associated vasospasm: "Besides improvement in the circulation to the skin and subcutaneous tissue, muscular circulation may also occasionally benefit, as judged by improvement in or disappearance of intermittent claudication."

The common stimuli which cause vasoconstriction are cold, pain, fear, anger, asphyxia, hemorrhage and dehydration. In any but the warmest climate, and under the most ideal circumstances, one is apt to experience many of these stimuli during peacetime as well as in a War Theater. In three cases the effect of cold stimulus could be seen repeatedly before sympathectomy.

The number of cases presented is too small to attempt to draw any broad conclusions from them. The results do, however, indicate that the recovery can be hastened and is probably more complete, with less disability resulting in those cases having sympathectomy performed following the division of the femoral artery.

SUMMARY

Five cases are presented, all of which had ligation of the femoral artery and vein between the profunda femoris branch and Hunter's canal. All cases were between the ages of 20 and 30 years. All cases had intermittent claudication in the calf of the involved extremity after walking a short distance at a moderate speed. The greatest distance any patient could walk at this speed was 800 to 1,200 yards prior to sympathectomy. The average distance of the four observed two months or more following ligation of the vessels was 500 to 600 yards. One case having sympathectomy immediately after ligation of the vessels walked two and one-half miles, over a measured course at a moderate rate of speed, one month following the operative procedures.

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TABLE I
SUMMARY OF DATA ON 5 PATIENTS UPON WHOM SYMPATHECTOMY WAS PERFORMED FOR ISCHEMIA

Case No.	Date of Injury	Age	Time-Interval between Injury and Ligation of Vessels	Immediate Postoperative	General Supportive Measures—Oxygen, Blood, Position, etc.	Hematocrit	Distance Walked at Moderate Speed before Cramping in Calf Occurred	Time-Interval between Ligation of Vessels and Sympathectomy	Distance Walked Following Sympathectomy at Moderate Speed	Disposition
1.	16 March, 1944	24	3 hours	Yes, for 2 days	None immediately. Postoperative transfusion 500 cc. blood, 24 March, 1944	44.5%, 24 March, 1944	800-1,200 yards, 3 months after injury	Sympathectomy done	Limited duty 3 months after injury	
2.	15 May, 1944	23	4.5 hours	Yes, daily for 3 days	None immediately. Postoperative 1,000 cc. blood transfusion, 29 May, 1944	34.5%, 28 May, 1944	200-300 yards, 2.5 months after injury	2.5 months	Walked 1.25 miles without cramping, 1 month and 10 days after sympathectomy	Limited duty 4 months after injury
3.	1 June, 1944	26	5.5 hours	None recorded	Plasma 500 cc. prior to operation. 2,000 cc. blood transfusion, 8 June, 1944	27%, 7 June, 40%, 11 June	After walking up 2 flights of stairs, 2 months after injury	2.5 months	1,200 yards without cramping. Muscle loss in thigh prevented further walking (See case report)	Evacuated to Z.I.
4.	19 August, 1944	28	Time not stated. (Less than 24 hours)	Yes, daily for 3 days	750 cc. of plasma at Bn. Aid Sta. Transfusion 1,000 cc. blood, 25 August, 1944. Transfusion 1,000 cc. blood 27 August	24.1%, 25 August, 1944	500-600 yards, 2 months after injury	2 months	2 miles at moderate speed without pain, 1 month following sympathectomy	Limited duty 3 months after injury
5.	14 February, 1945	28	4.5 hours	Sympathectomy immediately following ligation of artery	1000 cc. blood transfusion during operation. 500 cc. blood transfusion, 16 February, 1945	38%, 15 February, 1945	Patient walked 2.5 miles after injury, with no cramping in the extremity	1 month	1 month following sympathectomy	Limited duty 6 weeks after injury

All cases having sympathectomy showed a decided improvement in the blood supply of the involved extremity.

REFERENCES

- ¹ Bigger, I. A.: Treatment of Traumatic Aneurysms and Arteriovenous Fistulas. Arch. of Surg., 49, 170-178, September, 1944.
- ² White, J. C., and Smithwick, Reginald: The Autonomic Nervous System. Second Edition. The MacMillan Company, N. Y., page 210.