

**Staff Meeting Bulletin  
Hospitals of the » » »  
University of Minnesota**

**Popliteal Aneurysm**

STAFF MEETING BULLETIN  
HOSPITALS OF THE . . .  
UNIVERSITY OF MINNESOTA

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during the school year, October to May, inclusive.

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William A. O'Brien

I. LAST WEEK

Date: April 8, 1938  
Place: Recreation Room  
 Nurses' Hall  
Time: 12:15 to 1:15  
Program: Movie: "A Night at the  
 Movies"

Announcements  
 Optic Neuropathies -  
 A Review.  
 Edward Burch

Discussion: Edward Burch  
 Royal Gray  
 A. B. Baker

Present: 122

Gertrude Gunn,  
 Record Librarian

II. MOVIE

Title: "California Giants"  
Released by: Paramount Film Corp.

III. AUTHORS1. CARL LIND

Was born in Minneapolis. Graduate of the University of Minnesota, B.A., B.S., M.B., M.D. 1934. Internship at Receiving Hospital, Detroit, Michigan. On camp service 1934-35. European travel 1935. Surgical intern at University of Minnesota Hospitals. Teaching assistant in the Department of Surgery, University of Minnesota Medical School, January 1937 to date.

2. JOHN RANDOLPH PAINE

Was born in Dallas, Texas. Attended Harvard. Degrees: A.B., 1927, M.D., 1931. University of Minnesota, M.S. in Surgery with a minor

in Physiology, 1933. At University of Minnesota since 1931. Surgical intern, surgical research assistant, houseman in medicine, Minneapolis General Hospital; Surgical fellow, University of Minnesota Medical School. Now instructor in Surgery.

IV. BACTERIOLOGISTMILAM VACLAV NOVAK

Was born in Cobb, Wisconsin. Attended Macalester College, degree B.A. 1929. Graduate of University of Minnesota, degrees B.S., M.B., M.D., M.S., and Ph.D. Former assistant professor of bacteriology, University of Tennessee. Research fellow in pharmacology in cooperative program with bacteriology 1933-1938. After completing requirements for M.D., was appointed instructor of bacteriology and assigned for service to the bacteriology laboratory of the University of Minnesota Hospitals.

Dr. Novak comes to us with an intimate knowledge of the problems of clinical bacteriology. For some time a working arrangement between the hospital laboratory and the department of bacteriology has been contemplated. The present laboratory service is a direct result of the genius of Rudolph Koucky. Dr. Novak carries on from March 15, 1938. He is anxious to know how the laboratory service may be improved. During the past month he has been acquainting himself with the service and now is ready to discuss any problem with you. Dr. Koucky remains on the staff as an associate in the general laboratory and the tissue laboratory.

V. NEXT WEEK

The meeting will be held Friday, April 29, 1938 at the usual time. We urge everyone to be present to hear the annual report of the department of obstetrics which will be presented by Drs. McLennan and Mitchell. It not only is an interesting report but it is also important as a demonstration of a technique for keeping daily and monthly records which can be assembled for review purposes.

## VI. POPLITEAL ANEURYSM

Carl Lind  
John R. Paine

### Introduction

The medical record of aneurysm extends back at least to early Christian days. Most of the modern knowledge of aneurysm, however, rests upon the studies of Rudolph Matas of New Orleans. His work in cardiovascular surgery in the early years of this century are still fundamental. His researches on aneurysm apply in particular to those of the popliteal artery, which are second in frequency only to those of the aorta. Matas defined aneurysm as a hollow tumor, space, or sac, filled with liquid or coagulated blood, directly connected to the lumen of an artery with which it is continuous and developed in whole or in part at the expense of arterial wall. In a true aneurysm one or all tunics of the arterial wall enter into the formation of the sac. In a false aneurysm, the sac is formed entirely by adventitious walls. The classical true aneurysm in which the sac has all three layers of the parent artery is extremely rare, since with continued enlargement the middle coat usually disappears.

### Incidence

Of all diagnosed aneurysms those of the popliteal artery have been estimated by various writers to compose 15 to 25%. Matas states that 55 to 60% of all peripheral aneurysms are found in the popliteal artery.

Age: Most instances occur during active middle life (40 to 50 years). It is uncommon in early youth.

Sex: 75 to 80% of cases occur in males, although after the age of 50 both sexes appear to be equally affected.

Race: Various authors have stated that popliteal aneurysm is found only in civilized man. At least no cases are reported as occurring in uncivilized people. The relative incidence is stated to be greater among negroes than among

whites, but not as great as that of similar lesions located in the aorta.

### Classification

#### 1. Degenerative:

Includes all those cases classified as arteriosclerotic, idiopathic, spontaneous, or pathologic.

#### 2. Embolic:

Includes those cases usually caused by emboli originating from a septic endocarditis (mycotic aneurysms), but sometimes due to non-infectious particles such as from an atheroma.

#### 3. Traumatic:

Such cases usually but not necessarily occur in arteries already diseased.

### Pathogenesis

Sir William Osler once said that Venus, Bacchus, and Hercules are to be recognized as the etiologic trinity in the causation of aneurysm. This statement as regards popliteal aneurysm may not be strictly true, but the fundamental factors of inflammation, degeneration and trauma are still present. A modifying factor, however, is the peculiar anatomical relationship of the popliteal artery which renders it more liable to a physiological type of trauma. Its proximal end is fixed in the fibrous adductor canal. Its distal end is fixed by the tendinous insertions of the soleus muscle. Anteriorly it lies adjacent to the lower end of the femur and capsule of the knee joint. Posteriorly it is confined by the popliteal fascia. Thus, muscular exertion when the knee is markedly flexed subjects the artery to an unusual amount of strain. Matas observed that when a history of onset is given, violent muscle strain or effort which increases arterial tension precedes the initial symptoms. Similarly, Delbet noted that forceful flexion of the leg obstructs the popliteal artery and sudden violent contraction of the muscles in the lower leg raises the blood pressure in the collapsed artery. The fact that most of

these arterial changes occur in men of the laboring class is further evidence of the importance of muscular exertion and strain in their production.

### Pathological Anatomy

Popliteal aneurysms exhibit all gradations from the fusiform to the saccular type. The form in general depends upon the resistance of surrounding structures and the direction of the pulsatile force of the blood. These factors may produce a rotation of the aneurysmal sac and alterations in the relationship of the sac to the parent artery.

The location of the sac in the artery itself is significant. Lesions of the proximal portion of the popliteal artery have many less collateral branches than those of the distal portion. Therefore the danger of gangrene following excision or obliteration is enhanced in aneurysms of the distal portion. Also, venous stasis and nerve pressure occur earlier because the available space for enlargement is smaller.

The content of the sac, at first entirely liquid, later forms laminated white thrombi which occlude the sac to a variable degree and produce the variations found in the clinical picture.

### Signs and Symptoms

The symptoms are primarily those of arterial obstruction of varying degree. With small aneurysms the symptoms are often slight. Those aneurysms which appear suddenly, however, are accompanied by severe pain which may persist. If venous obstruction occurs edema and cyanosis usually follow, peripheral to the aneurysm. Flexion of the knee is restricted.

The physical findings are typically those of a tumor over the popliteal artery that pulsates and expands with the pulse. Tenderness to pressure is minimal. Lateral movement of the tumor is possible in a restricted sense but movement in the direction of the long axis of the artery is absent. Compres-

sion of the artery proximal to the aneurysm causes cessation of pulsation and a decrease in size, as is pathognomonic in all aneurysms. Aneurysmal bruit, usually harsh and synchronous with the pulse, may be present. Thrill is sometimes present.

This is of the opinion that oscillomographs can confirm the diagnosis. Arteriography is the most reliable diagnostic aid, although both arterial puncture and the use of thorotrast are condemned by some writers.

The diagnosis may be obvious, or it may be extremely difficult.

### Differential Diagnosis

This is sometimes very difficult. Many great surgeons have erred in attempting to incise and drain an undiagnosed inflamed popliteal aneurysm. In general, other forms of peripheral vascular disease must be ruled out. The most important is arteriovenous fistula, which generally shows striking venous circulatory disturbance, with a venous pulse, and a loud purring murmur and thrill variably transmitted from the tumor along the proximal and distal veins. The systemic effects of such fistulae are not duplicated by popliteal aneurysm. One must also rule out tumors over the popliteal arteries, which may be very vascular and exhibit bruit. Cysts and abscesses must also be considered.

### Progress

An untreated popliteal aneurysm threatens the life of its bearer, for its natural course is that of progressive enlargement. So-called spontaneous cure from thrombosis within the sac is exceptional and rarely permanent. Enlargement causes pressure symptoms. The prognosis in unoperated cases is poor. Gangrene or rupture usually occur.

### Supportive Treatment

All such treatment is directed toward improvement of the collateral circulation.

In general the methods used are those recommended for arterial occlusion. The extremity must be protected from trauma. Heat is provided by a light cradle, diathermy machine or infra red lamp. A slightly dependent position is recommended. Vasodilators such as acetylcholine, papaverine and sodium nitrite may be of benefit. Alternate positive and negative pressure such as is furnished by the pavex boot is valuable as is intermittent venous hyperemia. Intermittent proximal arterial obliteration by pressure may increase the collateral blood flow.

### Operative Treatment

This is the only method of cure. Ordinarily it should be deferred until collateral circulation is adequate.

#### 1. Indirect methods

Attempt to produce intra-aneurysmal clotting by indirect pressure, by filipuncture, by galvanic currents. These methods are no longer employed in the treatment of popliteal aneurysm.

#### 2. Ligation

These procedures have been superseded generally by the radical operations.

Anel's operation (1710) - artery ligated immediately proximal to the sac.

Hunterian operation (John Hunter, 1785) - ligation at a distance proximal to the sac.

Brasdor's operation (1798) - distal ligation close to the sac.

Wardrop's operation (1825) - Ligation distal to the first distal branch of the artery.

Pasquin's operation - ligation immediately above and below the sac.

Porta's operation - gradual occlusion of artery. Halsted's metal bands or strips of fascia lata have been used of late for this.

#### 3. Radical operations

These attack the aneurysm

directly.

Aneurysmotomy (Antyllian operation - dates to third century A.D.). The popliteal artery is ligated immediately above and below the aneurysm, after which the sac is opened, packed and allowed to granulate in.

Aneurysmectomy (Philagrin's or Purmann's operation). In this the aneurysm is excised after ligation of all blood supply.

Endoaneurysmorrhaphy (Matas' operation, 1888). Using a tourniquet, the sac is entered:

- a. Obliterative type - intrasaccular ligation of all arterial apertures. After this the remaining sac is obliterated.
- b. Restorative type - when only a small aperture connects the sac to the artery, the hole is sutured, thus restoring the arterial continuity. The sac is then obliterated.
- c. Reconstructive type - The artery is reconstructed by suturing sac over a catheter which is then removed. The remaining sac is obliterated.

#### 4. Recent or Experimental Operations

Aneurysmectomy has been performed with plastic procedures to the artery, with transplantation of artery or vein and with tubes to restore the arterial lumen.

Simultaneous popliteal vein ligation has been recommended as tending temporarily to increase the collateral flow.

Arterectomy at the site of the aneurysm is strongly urged by some, who think this will relieve arterial spasm and thus aid collateral circula-

tion.

Lumbar sympathectomy pre- or postoperatively is advised by others for the same reason.

Muscle transplant with pedicled grafts into the aneurysmal sac to occlude collateral bleeding is a recent valuable suggestion. Damage to collateral arteries is thus avoided.

#### 5. Amputation

Done now only for gangrene.

### Results of Operations

This varies with the choice of operation, which in turn depends upon the condition of the aneurysm, its surrounding structures, and the circulation in the limb.

Matas' obliterative endoaneurysmorrhaphy is practised but his plastic operations are considered somewhat uncertain in result by some modern operators. Extirpation is frequently done if there is adequate collateral circulation.

Recurrence and gangrene are the most common complications. There are no dependable recent statistics on results but the impression gained from figures compiled from many sources are as follows:

	<u>Ligation</u>	<u>Extirpation</u>	<u>Endoaneurysmorrhaphy</u> ( <u>Matas</u> )
Failure	5%	0	4%
Gangrene	8%	0-5%	2-4%
Death	8%	5-8%	4%

### Summary

1. Popliteal aneurysm is second in frequency only to aortic aneurysm.

2. It is most frequently found in late middle life, in males, in negroes.

3. Trauma is the main factor in its origin, due to the anatomical relationships of the popliteal artery, but degeneration and inflammation also play a part.

4. Its shape varies from fusiform to saccular, and its structure and form are determined by blood flow and surroundings.

5. Symptoms are primarily those of varying degrees of arterial obstruction. Physical findings are those of a pulsating expansile tumor over the popliteal artery. Oscillomographs and arteriographs are of diagnostic value.

6. The differential diagnosis is from other tumors and other forms of peripheral disease, particularly arteriovenous fistula.

7. The untreated aneurysm progresses to gangrene or rupture.

8. Supportive treatment is aimed at improvement of the collateral circulation.

9. Past and present operative treatment is outlined.

10. Results of recent operations of all types are nowhere adequately analyzed.

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After a week's time, during which the patient applied hot applications to the knee and lower leg all the symptoms subsided. No further trouble was experienced for 15 months, but at the end of that time it was noted that the left leg was swollen from the level of the knee down and pained after a day's work.

These symptoms gradually increased in severity up to January 10, 1938 when the patient presented himself at the hospital for treatment.

#### Physical Examination

The physical examination was essentially negative except for the left leg. A swelling 8x6 cms. in size was noted in the left popliteal space. This could be slightly decreased in size by firm continued pressure. An expansile pulsation synchronous with the pulse was noted. A definite systolic bruit was heard with the stethoscope. No thrill was noticed. Compression of the femoral artery at the groin caused the pulsation and bruit to disappear, and at the same time there was no change in pulse or blood pressure. No pulsation was felt in the dorsalis pedis or posterior tibial artery. No venous engorgement or disturbance in sensation was present. Reflexes were normal.

#### Blood Pressure

Right arm: 150/85  
Right leg: 168/108  
Left leg: Could not be measured.

## VII. CASE SUMMARIES

### Case 1

Patient 69 years old,  
Admitted 1/12/38, discharged 1/30/38.

#### History

A farmer, suffered an injury to his left leg in January 1934 when a sleigh in which he was riding turned over and pinned him to the ground. At the time of the injury excruciating pain was felt in the popliteal space which persisted for 10 minutes and then subsided. The left leg and foot became swollen and painful.

#### Oscillometric determinations:

These measurements demonstrated a definitely increased pulsation at the popliteal space.

#### Arteriogram:

A soft tissue mass was seen in the left popliteal space within which was noted a lobulated space connected to the lumen of the popliteal artery.

Wassermann: Negative;

Kline: Negative.

Clinical Diagnosis

Aneurysm of the left popliteal artery.

Treatment:

January 18, 1938 - excision of a large popliteal aneurysm with ligation of the main artery and all collateral branches close to the sac.

Postoperative Course and Treatment

The postoperative course was uneventful. 3/4 of a grain of papaverine was given intravenously in the operating room when the aneurysm was removed and 1/2 grain doses were given by mouth four times a day for two days after operation.

The knee was kept slightly flexed with the lower leg elevated on a pillow under a light cradle for a week. The patient was then allowed to be up in a wheel chair and was discharged from the hospital on crutches 13 days after operation.

Immediately following operation the left leg became moderately swollen and slightly cyanotic. The cyanosis gradually disappeared during the next two or three days, but a moderate amount of pitting edema was still present when the patient left the hospital.

Case 2

Patient, 62 years old,  
Admitted to University of  
Minnesota Hospitals 4/11/37,  
Discharged 5/1/37.

History

A laborer, first noted a dull ache in his right foot accompanied by intermittent claudication in the right lower leg during the summer of 1933. This pain was continuous and gradually came to involve the entire right leg from the level of the knee down. In 1935 the patient was forced to stop working and in February 1937 the right ankle and right foot became swollen and cyanotic. A few days later an ulcerated area on the dorsum of the foot was noted which persisted up to the time the patient came to the hospital for

treatment on March 5, 1937.

Physical Examination

The physical examination was essentially negative except for the right foot and leg. The foot and ankle were markedly swollen and cyanotic. When the foot was elevated to the horizontal blanching occurred. No pulsation was noted in the popliteal, dorsalis pedis or posterior tibial artery. An ulcer with ragged edges and dirty base was present on the dorsum of the foot. The temperature of the foot was increased. The area immediately surrounding the ulcer was exquisitely tender to touch.

Wassermann: Negative.

Kline: Positive.

Urine Analysis: No glucose present.

Clinical Diagnosis:

Circulatory insufficiency of the right leg probably due to arteriosclerosis.

Treatment

March 6 to March 24, 1937 - treated with intermittent venous occlusion for 4 hours a day. Cuff was placed above the knee. Positive pressure - 80 mm. of mercury. The patient's pain persisted and required relatively large amounts of codeine or dilaudid for relief.

April 6, 1937 - the sural and peroneal nerves were injected with alcohol for relief of pain. This was unsuccessful. Pain persisted.

April 12, 1937 - lower thigh amputation performed to relieve pain. Wound healed without infection.

Pathological Examination

Examination of the leg after amputation revealed extensive arteriosclerosis with large atheromatous plaques. In the lower portion of the popliteal artery a fusiform aneurysm was found 3 cms. long and 1½ cms. wide. Adjacent to this was an irregular calcified mass 1 x 2 cm. in size. The aneurysm itself was filled with an old organized

thrombus which practically entirely occluded the lumen.

### Case 3

Patient, white male, 59 years old, Admitted to University of Minnesota Hospitals 11/8/37. Discharged 11/24/37.

### History

A ditch digger and tile layer. No history of trauma to leg. About Oct. 1, 1937 noted pains and cramps in left calf which were worse on resting or sleeping, and were relieved by work. About Oct. 25, 1937 the pain became severe and he ceased work. From Nov. 1, 1937 until admission the left leg and foot became increasingly swollen. The leg became red over the calf, which was also the site of burning pain during the night. Aspiration revealed blood, but no pus. Developed septic type of fever, but no chills. Remaining history negative as recorded.

### Physical examination

Temperature 102.4°. Pulse 118. Respiration 20. Blood pressure 130/78. Moderate peripheral arteriosclerosis was noted. Remaining examination essentially negative except for left leg. The left calf was tender, swollen and tense with a pale, ischemic area about ten cms. in diameter in its middle, surrounded by erythematous skin. Moderate pitting edema was present in the foot and ankle. The left popliteal and dorsalis pedis were not palpable. These arteries were pulsatile on the right.

Urinalysis was negative. White blood count was 34,600 with 97% neutrophils. Wassermann: negative. Kline: negative.

### Clinical Diagnosis

Thrombophlebitis and cellulitis of left leg with arterial occlusion.

### Treatment

The patient was treated by elevating the leg to 80°, and applying hot moist heat.

On Nov. 10, 1937 the left foot and lower leg suddenly became blanched, cold and completely paralyzed. 10,000 units of gas gangrene antitoxin was given and 2 hours later the left leg was amputated through the lower thigh.

Postoperative course uneventful.

### Pathological Examination

Examination of the leg after amputation revealed a ruptured aneurysm of the posterior tibial artery just below the popliteal space. A diffuse saccular dilatation of the artery with a large irregular opening was seen. The walls of the aneurysm were composed of rough calcified plaques.