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VARICOSE VEINS OF THE LEG;
THEIR CAUSE AND TREATMENT.

BY
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A THESIS
Submitted to the Faculty of the Nebraska University
in Partial Fulfillment of the Requirements
for the Degree of Doctor of Medicine
in the School of Medicine

OMAHA, 1934.
HISTORY

The earliest mention I find of Varices is in the work of Hippocrates who thought they were due to an accumulation of melancholous humor, and treated them by multiple puncture.

The unflinching spirit of Caius Marius is evidenced in the record of his having submitted to complete removal of the varicose system on one of his legs without a murmur. The account goes on to state that he thought the disease preferrable to the cure and would not permit a similar operation upon his other leg.

Paulus of Argentia, perhaps a mythical character, treated varices by multiple ligation.

Celsus treated varices by cautery and excision, using the former method for straight varices and excision for the sinuous variety.

Galen, great anatomist among other things, excised the varicosed system for the cure of varicose veins.

For the early historical material I am largely indebted to the works of Francis Adams.
Rhazes, great Hebrew physician and surgeon, excised the varicosed portion of the vein.

Avenzoar, another of the great Jewish doctors of the middle ages, considered the complaint incurable, and did nothing in a therapeutic way.

Fabricius recognized the presence of varices and considered valvular insufficiency the principle cause. Remembering the fact that Fabricius was the first apparently to mention valves in veins, it is interesting that he, in spite of a somewhat perverted idea of the circulation, should have attributed to weakness of these valves the permitting of stagnation in the veins and thence distension, the etiology of varices.

Pare treated varices surgically. Briquet, also a Frenchman, early in the nineteenth century described the fact that varices were most common where the deep veins communicated with the superficial.

Sir Benjamin Brodie, in 1846, gave a
lucid description of the test bearing Trendelenberg's name.

With the invention of the syringe by Pravaz in 1851, came the period of injection treatment, which through the following years had varying degrees of recognition but which at present has largely displaced the operative treatment.

Trendelenberg, in 1890, described the test bearing his name and basing his judgement thereon, advocated high ligation of the saphenous vein as a therapeutic measure.

Early in the twentieth century came the major advances operatively, with Mayo's description of his stripping method in 1906, and Babcock's description, in 1907, of a method of removing the vein in a bunched up state on a wire.

Tavel of Berne, in 1904, used a combination of high ligation plus injection, which has recently been revived successfully by A. Dickson Wright of England and de Takats of this country.
ANATOMY

There are three great systems of veins in the legs: the deep system in which the veins accompany the arteries, superficial subcutaneous system, and the communicating system connecting the other two.

Deep system. The deep system needs but few words. As the name implies it lies deep in the leg. It consists of veins plaited about the deep arteries, usually two or more freely interconnected venae comites accompanying each artery. Thus practically all components lie between muscle groups and are intimately surrounded thereby. They are liberally supplied with valves, usually of the bicuspid variety with the free ends directed proximally. These valves lie distal to the tributary veins and anastomoses. They start with the plantar digital veins which, after communicating with the dorsal digital veins of the superficial system, run backward as the metatarsal veins and form the deep plantar arch. From this, as the medial and laterl plantar veins accompanying the corresponding arteries
they communicate with the saphenae interior and exterior near the ankle and unite to form the posterior tibial vein. The posterior tibial vein follows its artery to the lower border of the Poplitius muscle where it unites with the anterior tibial to form the popliteal. The anterior tibial vein represents the venae comites of the anterior tibial artery and starts in the foot as the dorsalis pedis. It joins the posterior tibial at the Poplitius muscle to form the popliteal vein. The popliteal receives tributaries corresponding to the popliteal artery and at the popliteal space, the small saphenous of the superficial system. It ascends to become the femoral at the aperture of the adductor magnus muscle. The femoral vein accompanying the femoral artery in the upper two thirds of the thigh after receiving the great saphenous in the femoral sheath at the fossa ovalis becomes, behind the inguinal ligament, the external iliac vein.

**Superficial system.** The superficial subcutaneous veins lie in the subcutaneous
connective tissue between the skin and the underlying muscles. About one tenth the importance of the deep system in the venous drainage of the leg (von Meisen) it is by far the more frequent site of varix formation. It consists of the saphena magna and parva and their branches.

Saphena magna. From the standpoint of varix formation the main roles are played by the inferior hemorrhoidal and the saphena magna. The anatomy of the latter vein was better appreciated by the surgeon when practically all varicose therapy was operative than at present when a different approach is offered.

The veins of the sole are characterized by two venous plexi: one in the ball of the foot, the plantar cutaneous arch; and another in the fat pad of the heel. The former by the intercapitular veins drains into the dorsal digital veins and also into the medial and lateral marginals. The latter drains into the deep system and into the marginal veins. The great saphenous (saphena magna, long or internal saphenous) begins in the medial marginal vein
draining the dorsum of the foot and a portion of the sole and ends in the femoral vein about three cm. below Poupart's ligament. In its course it begins distally and runs anteriorly over the internal malleolus. It rises almost vertically, crosses the medial surface of the tibia, ascends posterior to and almost parallel with the medial margin of the tibia, enters the hollow between the calf of the leg and the knee and passes immediately posterior to the medial condyle of the femur. In the thigh it ascends obliquely in a somewhat anterior and lateral direction and passing through the fossa ovalis terminates in the femoral vein. In the leg it receives many cutaneous branches and communicates freely with the anterior and posterior tibials as described later. In the thigh it communicates with the femoral and receives the superficial epigastric, the superficial iliac circumflex and the superficial external pudendal. The tributaries from the medial and posterior parts of the thigh frequently unite to form a large accessory saphenous which joins the main trunk of the saphenous
at varying levels. It may also receive the small saphenous. In the thigh it is paralleled by the medial cutaneous nerve (of interest because not infrequently in operations upon the saphenous vein it was cut, leaving a resultant zone of anesthesia--Deaver) in the leg by the saphenous nerve.

**Small Saphenous, (external saphenous).**

The small saphenous begins behind the lateral malleolus as a continuation of the lateral marginal. It ascends along the lateral margin of the tendon of Achilles, then crosses the tendon to reach the middle of the leg in its posterior portion. Running directly upward it perforates the deep fascia in the lower part of the popliteal fossa and ends in the popliteal vein between the heads of the gastrocnemius. It communicates with the deep veins on the dorsum of the foot and leg and receives numerous tributaries from the back of the leg. Not infrequently (1/3 of the cases dissected--Kosinski) it terminates in the great saphenous.
Communicating System. This is interesting in its own stead because it is one of the most constant venous systems of the body and because to it is delegated a large role in the development of varicose veins of the superficial system and their complications there of V. Meisen, Warwick, McPheeters, Twyman. The most constant perforating veins are as follows in relation to the great saphenous: 1. At the junction of the middle and superior thirds of the leg. Here a large important vein connects the internal saphenous system with the posterior tibials. Interestingly enough this is the most frequent site of early varix formation. 2. At the junction of the middle and distal thirds of the leg also connecting the saphenous to the posterior tibial. 3. A group around the ankle at the medial malleolus (the most frequent site of ulcer formation) In the thigh the branches are of less importance and constancy.—McPheeters, v. Meisen. Small saphenous. Here the communicating system is different in that communication between the deep and superficial system is not direct but via the agency of muscular veins.
Arterial supply of the lower extremity.

I shall make but brief reference to this. It has been found (Bellocq, quoted by v. Meisen) that the medial surface of the leg, most frequent locus of varicose ulcer, is not as plentifully supplied with subcutaneous arterial branches as is the corresponding lateral surface. In addition on the medial surface the subcutaneous arteries branch less and have fewer anastomoses, the subcutaneous net has wider meshes and in the skin itself the branches are fewer and communicate less than in a corresponding position laterally.

Valves.

Valves were first described apparently by Fabricius although it is rather difficult to conceive their having escaped the attention of earlier anatomists. His description of their function is quite apropos in a discussion of varicose veins as we shall see later. "Nature has formed them to delay the blood to some extent and to prevent the whole mass of it flooding into the feet or hands and fingers and collecting there."

The valves, the majority of which are
bicuspid, are composed of an endothelial covering and thin bundles of connective tissue lying within. They are almost always distal to a tributary opening. (Bardeleben)

**Valves of the deep system.** As a whole the deep system is usually adequately valved. The most constant valves (Kosinski, Kampmeier, Warwick, Nicholson, Hesse and Schaak) are: 1. Femoral valve, above opening of saphena magna and deep femoral, often the first valve between the abdominal column of blood and that of the leg. 2. Parietal valve just below the entrance of the deep femoral and still above the saphena magna. 3. A terminal valve at the mouth of the external saphenous and at the popliteal immediately distal to the external saphenous' entrance into the popliteal. 4. Just above the entrance of anterior and posterior tibials and throughout the vena comites following the rule mentioned above. Warwick finds some of these inadequately valved and terms them congenitally varicose main deep veins.

**Great saphenous.** The number of valves in the saphena magna is variable, running from four to twenty with ten a fair average. (Gray, Cunningham, Kosinski, Hesse, Schaak, Kampmeier, Bardeleben).
Their situation is variable but in general tends to follow Bardeleben's rule. Probably the most constant valve (Hesse, Schaak and Nicholson) is stationed at the mouth of the great saphenous or a few centimeters below that point. Warwick found this valve to be frequently quite weak but found the next to be of much greater strength. This fact is to be borne in mind. Kampmeier found no correlation of the number of valves with the age of the individual.

**Small Saphenous.** These vary in number from four to twenty three (Kosinski) and also tend to follow Bardeleben's rule.

**Perforating system.** Investigation of twenty eight "normal" cadavers demonstrated that the valves of the perforating system were so disposed that in twenty five cases they directed the flow from the superficial to the deep systems. (Warwick).
HISTOLOGY OF VEINS.

Three coats may be distinguished in veins.

An intima consisting of a single layer of endothelial cells polygonal in form, simple squamous in type. A subendothelial layer consisting of connective tissue and fibroblasts and in the femoral and popliteal (Stöhr) developed in the form of distinct fibrous lamellae. The intima also contains smooth muscle fibers, longitudinally or obliquely arranged. The media exhibits considerable variation. It is composed of connective tissue, a relatively great proportion compared to arteries, elastic tissue and smooth muscle longitudinally, obliquely and circularly disposed, varying with the vein and the portion examined. The adventitia, quite thick, contains connective tissue in considerable quantity, elastic tissue and longitudinal muscle fibers. The adventitia contains a rather rich supply of lymphatic vessels.

The walls of veins are supplied by vasa vasorum, which more superficially anastomose with those of the surface. (v. Meisen).
PHYSIOLOGY OF VENOUS CIRCULATION

The flow in the deep veins is active and centripetal in direction. The forces concerned in its maintenance are: 1. Visatergo of arterial circulation. That this is a very important factor is demonstrated in curarized dogs with the thorax laid open (Magnus, quoted by v. Meisen) and clinically under deep anesthesia when complete muscular relaxation is obtained. 2. Pumping action of the muscles surrounding the veins. When the muscles of the leg which as we have already seen intimately surround the veins are thrown into a state of contraction we have a great increase of venous pressure. The valves are so disposed normally that this is transmitted only proximally and so promotes the flow of blood. With relaxation venous pressure decreases, the veins are permitted to dilate and the next contraction sends the blood heartward. We have thus a muscular venous heart dependent upon the muscles of the leg and the integrity of the valves of the deep and communicating systems. 3. Effect of respiration. It is generally agreed that respiration is of some
assistance to the circulation. It is probably one of the minor facts in normal respiration. Hydrostatic pressure offers the major opposition to upward flow.

The circulation of the superficial veins is not as well agreed upon. Whether it is active centripetally as was originally supposed, whether the principle flow is by way of the communicating veins or through the fossa ovalis—the factors concerned in its maintenance—all these are problems of fundamental interest and value in a proper concept of the background of varix formation yet still require considerable work for clarification. If the hydrostatic pressure of the column of blood in the superficial veins is greater than the pressure of the vis a tergo, (Recklinghausen, quoted by v. Meisen) if they are not subjected to the massaging pumping action of the muscles what factors would tend to produce active centripetal flow? The work of Kilbourne on normal individuals would tend to corroborate the conclusions to be reached from the above facts "In the normal person in the standing position there is very little upward flow in the
superficial veins and there is a definite down-
ward flow below the great valve in the saphenous
just below the knee. During exercise the circul-
ation possibly upward may be increased." Pomeranz
and Tunkel on the other hand found the circulation
to be active using the same technique and same
radio opaque solution—skiodan. If we accept
their work as being free from error we must reach
the conclusion that there may be normally either
active participation of the superficial system in
the venous drainage of the leg or that the super-
ficial system may act principally as a reservoir
for the deep system, that with successive decrease
and increase of pressure in the deep veins
during muscular relaxation and contraction there
is in the first phase an aspiratory effect upon
the superficial veins tending to empty the vessels
and in the second time for the veins to be partially
filled by the vis a tergo of the arterial
circulation and the aspiratory effect of respiration,
the ebb and flow taking place through the com-
municating vessels. Either of these explanations
include the flow from the superficial to the deep
system which has been seriously questioned clinically
by Thiel and Twyman.
ETIOLOGY.

Incidence. There seems to be a paucity of figures on the incidence of varicose veins in the populace at large. Ochsner in Dean Lewis Loose Leaf Surgery, Holman in Nelson Loose Leaf Surgery and in his text, Babcock’s Surgery text, Graham’s Surgical Diagnosis, Warbasse Surgery give nothing on the incidence of varices. Da Costa finds “20% of adults exhibit it in some degree in one region or another.” Meisen found an incidence of 15% in 200 “normal” adults summoned before the conscription board in Scandanavia, only 2% of these were marked to any degree. According to a report from the Danish Army Medical Corps in 1920-23 an average of 455 men were rejected for military service on account of varicose veins which corresponds with 1.5% of the total number of men examined.

Sex. These figures are subject to a big source of error. Women frequently see their Doctor for cosmetic reasons only. Men are not as conscious of nor as conscientious regarding their appearance and therefore not as likely to see their Doctor as early as women, nor as likely to see their physician for treatment in the absence of symptoms. Meisen
found 1910 females to 590 males. Bernsten's series demonstrated even higher proportion of females between the age of 20 and 30 and 40 to 50--4 to one, a little less between 30 and 40--3 to one, and male and female patients equal in number up to 20 years. Nicholson found nearly an equal number of males and females.

**Heredity.** Statistics must be viewed in the light of comparatively little knowledge of the existance in the patient's family of varices unless they happened to be quite marked. The author will have to confess that he does not have positive knowledge as to the existance of varices other than in his parents and believes that in a large percentage of patients not even this can be relied upon. Were he questioned as to the existance of a family history of varices he would probably answer that there is none. However, as stated previously, he does not know. Viewed in that light the large percentage giving a positive family history is remarkable. Nicholson's series gave a positive family history in 55%, the remainder was negative or did not know. Babcock says a majority of cases but gives no figures.
Meisen found an incidence of a positive history in 70%, de Takats, positive in 65%. Warwick on the basis of anatomical dissection and the finding of incompetent valves in the communicating system of normal young adults was led to suspect a positive family history which was present in 2/3 of the cases corresponding interestingly enough to other figures on the role of heredity. Using Mendelian characteristics and working out the checkerboards using the tendency toward varicosity as a dominant:

\[
\begin{array}{cccc}
X & X & X & x \\
x & Xx & Xx & x \times xx \\
x & Xx & Xx & x \times xx \\
4 \text{ varicose tendency.} & 2 \text{ v. tend.} & 4 \text{ normal}
\end{array}
\]

\[
\begin{array}{cccc}
x & X & x & X & x \\
x & Xx & Xx & x \times xx \\
x & Xx & Xx & x \times xx \\
x & Xx & Xx & X x \\
x & Xx & Xx & X x \\
4 \text{ varicose tendency.} & 4 \text{ varicose tendency.} & 4 \text{ varicose tendency.}
\end{array}
\]

\[
\begin{array}{cccc}
x & x & X & x \\
x & Xx & Xx & x \times xx \\
x & Xx & Xx & x \times xx \\
2 \text{ varicose} & 3 \text{ varicose} & 4 \text{ varicose}.
\end{array}
\]

Totalling 27 varicose tendency and 9 normal.
We should expect a positive family history in 75% of the cases using all possible combinations of characteristics. Considering the facts mentioned earlier in the paragraph the percentage figures found are quite close to the predicted. Curtius in his masterly work also comes to the conclusion, "Nachweis des monohybriden, einfach dominanten Erbgangen der Beinvarikosis."

If there is a hereditary tendency towards varix formation as the above facts might seem to indicate, although it must be confessed the figures are too meager to carry a great deal of weight, if the outstanding workers in the field both in this country and abroad, v. Meisen of Norway, Curtius of Germany, Warwick of England, and Nicholson in this country subscribe to the existence of a hereditary tendency, what forms may it take?

v. Meisen believes that as Leonard Hill has demonstrated in rabbits some of which may be held upright without syncope others of which may not, that there is a sthenic tendency with lowered general tone effecting the vein wall and its external support. This view is supported by an
editorial in the J.A. M.A and by Curtius.

Warwick finds a more obvious explanation of this hereditary tendency. On the basis of injection and dissection experiments he finds:

1. Incompetence of the valves of the muscular veins. 2. Incompetence of the valves of the deep veins. 3. Incompetence of the valves of the communicating veins in "normal" young adults. In the family history of these "normals" he finds a high incidence of varices and because it is not anatomically unsound argues that that may be the hereditary congenital weakness spoken of by other men in less definite terms.

Klotz believes that there is a tendency for atrophy of the valves with increasing age although dissections by Kampmeier and Kosinski lend no support to this view.

Curtius says, "Der frühe Manifestation termin der subkutanen einfachen und varikösen Beinphlebitalasier ist (abgesehen von jener höchst seltenen rein paratypischen Fallen) fast ausnahmslos der Ausdruck einer tief greifenden, genotypischhen Alteration des Bindegewebes."

It does not seem to me that v. Meisen
or Curtius have considered the possibilities suggested by Warwick and vice versa. The suggestions of Curtius and v. Meisen finding the weakness in the vein wall and the connective tissues seem the more universally applicable although Warwick's work merits serious consideration.

Given then a hereditary predisposition, what factors are required to produce varicose veins? These fall into two headings, hemodynamic and anatomico-pathologic. Under the former would come anything tending to increase venous pressure in the superficial system. Valvular insufficiency the most obvious cause of increase is considered by many the primary cause of varices—Delbet, Klotz, Magnus, Trendelenberg. Hemodynamic factors would include standing for a long time without movement of the legs which would contribute by furthering stasis and dilatation in the superficial system and in the presence of incompetent communicating valves as Warwick suggests would further increase pressure in the superficial system. Clinically the importance of this factor is well recognized. Continued straining, as with
constipation, stricture of the urethra, hypertrophied prostate, by increasing intra-abdominal pressure and causing venous dilatation and stasis. (This can be demonstrated easily by sitting with the leg extended and straining. Even in normal individuals the veins may be seen to expand and at once decrease in size when the pressure is released) Combine incompetent valves in the communicating system with this picture and it is easy to understand how venous dilatation would be produced and how in the presence of a hereditary weakness this would be exaggerated. Continued violent exertion might operating to increase intra-abdominal pressure play a role. Obstruction to the venous return as a pelvic tumor could conceivably be an exciting factor. Heart lesions lessening the vis-a-tergo and tending to favor stasis might play a part. Accidental causes such as arteriovenous aneurism in which there is a much greater increase in venous pressure than would arise otherwise may cause varices of the superficial system. The interesting thing in this connection is that in only 50% of the arteriovenous aneurisms
collected by Pemberton and involving the femoral vein and artery was there varix formation lending support to the theorem of hereditary predisposition being one of the conditions necessary for the development of phlebectiasis.

Under the heading of anatomico-pathological factors would be included anything tending to weaken the vein or the supporting tissue around it or tending to lower their tone. Included in this caption we should have thrombophlebitis of the deep and of the superficial systems. This has called attention to the fact that the thrombus in the deep veins in this condition is a relatively transient thing and is seldom followed by permanent obliteration. Van Gorder ligating the femoral vein for thrombangitis obliterans did not produce varices. Putting the two observations together the suggestion that the varices are due not to the disturbed circulation but to effect upon the venous wall does not seem amiss. Similar weakening might explain the association of pathological findings of phlebitis in phlebectiasis not infrequently and the various infections such as rheumatism,
scarlet fever, pneumonia, influenza, etc. (Zezas quoted by McPheeters.) Inflammatory changes are held by Noble to be responsible for the condition through destruction of the valves and loss of elastic and muscle tissues permitting valvular insufficiency. Endocrine deficiency believed by Sicard, Delater and Forestier to be the underlying cause has no little evidence in its favor. The frequent association of varices with pregnancy (100% according to DeLee) and the fact that varices in women are worse during or around the time of menstruation (v. Meisen) lend support to the hypothesis that varices may be part of the picture of endocrine dysfunction. Somewhat hesitantly and qualifying his statements by the fact that he does not wish to be quoted, Kilbourne suggests that venous dilatation may be a reflection of the tendency of the hollow tube systems of the body, the Müllerian duct, the Wolffian duct, the gastrointestinal tract and the circulatory system to lose tone or dilate in the absence of effective pituitrin during pregnancy.

In the author's opinion none of the factors mentioned can be neglected but he has during the discussion indicated what he believes to be the
principle ones responsible for the condition of varicosities of the leg.

MORBID ANATOMY

Gross anatomy. Bermstein, quoted by McPheeters, classified the varicose veins according to the pathological formations present or the types of varices:

1. The isolated or saccular varix. It is usually present on the main trunk of the saphenous magna of the thigh.

2. The serpentine or sinuous varix. These two forms are encountered at the same time on the principal trunk of the saphenous and the collaterals. In the initial stage they often appear as a combination of type one and three.

3. The varix of uniform dilatation. One may call it the normal vein a interposed between two varicose parts of the vein yet where the wall is hypertrophied on account of the abnormal pressure due to the true varices on both sides. This is seen on all parts of the thigh and lower leg.

4. Fine cutaneous dilatations often forming stars or brushes. These are most commonly seen on the inner thigh of fleshy individuals.
Microscopic. The above gives a good gross pathological picture of the findings present in varicosities of the lower extremity. The microscopic picture is a panorama and dependent upon the stage examined will be the picture found. Early there is a hypertrophy and hyperplasia of the muscle elements. Later this tissue undergoes atrophy and shows round cell infiltration with collagenous degeneration and replacement. This is an inelastic tissue and is stretched to produce the varix.—McPheeters, Kashimura quoted by v. Meisen.

Symptoms and Findings.
Varices rarely except in special cases have an acute onset; their development is gradual and progressive. The symptoms are not always proportional to the physical findings. In Nicholson's series 42% of his patients had no symptoms, 28% complained of fatigue and a sense of heaviness, 25% of burning, 9% of aching, 7% of cramps and 4% of pruritus. These are about as given by Homans. Pain of any consequence is ordinarily absent except in the presence of ulcer (properly speaking a complication) in which case it may be very severe and cause untold suffering.
Varices of pregnancy frequently have an acute onset--within 6 to 8 weeks of conception and may develop quite rapidly but have a similar symptomatology.

Varices of women are usually more troublesome and have accentuation of pain during menstruation. (v. Meisen)

The physical findings are variable. The patient should always be erect during the examination. We may find the tortuous distended veins described in the section on morbid anatomy and find a leg relatively normal otherwise. We may find the varicosed veins associated with a cyanotic eczematous extremity, with an abundance of brownish pigmentation and numerous greasy scales which may readily be removed. We may find a swollen brawny indurated extremity in which the swollen veins are not visible but may be palpable or may not even be palpable until the edema is reduced. We may find thin walled sacculated veins or thick sclerotic cords.

Ulcers most frequently found in the lower third of the leg over the internal malleolus and anteriorly over the shin bone may be present. They will be described under complications. Briefly the picture
is not a constant one and depends upon the type of leg and the state of development of the varix and the state of circulation and nutrition of the leg.

**DIAGNOSIS**

Given grossly varicose veins the diagnosis is easy and should give no trouble for there is nothing else that gives the swollen tortuous cords of varicose veins. Given a fleshy individual with the symptoms described above, the diagnosis may not be so easy as the adipose tissue may hide the veins. Frequently the veins may be palpated when they cannot be seen. The presence of varicose veins may not be sufficient to explain the symptoms which may be due to arterial disease. Pulsation of the dorsalis pedis artery should always be searched for and this artery is a good guide to the status of arterial circulation. Given the findings of arteriosclerosis one should proceed more cautiously with the treatment. The symptoms of intermittent claudication should lead to a careful search for Buerger's disease. The use of histamine or other of the vasodilators and a skin thermometer are of aid in the examination of arterial circulation and a differential diagnosis.
Given the brawny indurated leg sometimes due to thrombophlebitis of the deep vessels and sometimes due to varicose veins the history of onset is of great aid.

It should again be repeated that the findings of varices does not rule out arthritis, myalgia, or neuritis, and these should be searched for as a cause of the presenting symptomatology, although as McPheeters suggests they frequently clear up after treatment of the varices.

**PROGNOSIS.**

Varicose veins tend to progress unless treated. The disease is not one of the self limited variety. Prognosis as to mortality is excellent. Very few deaths are reported in the literature which are due to varices per se. U. S. Mortality Statistics list the death rate from diseases of the veins including phlebitis, hemorrhoids and varices as .6 per 100,000 as an average for the years 1900-1904 and the same for the years 1927-29 inclusive. This exceedingly low rate would lead one to believe varices are not a pressing problem but if only one sixth of the deaths due to diseases
of the veins are due to varices that per se would mean over one hundred deaths annually. I have seen no figures as to morbidity other than those of v. Meisen who found 1.5% of adults examined for army service incapacitated for service because of varices and their complications. Varices may gradually develop until the patients exitus puts an end to the process, they may undergo phlebitis and not infrequently spontaneous cure in this fashion or they may be complicated as discussed later in this paper.

**PROPHYLAXIS.**

In the section on Etiology we reviewed some of the principle causes of varices. The best prophylactic measure in the prevention of varices would be proper selection of one's ancestors. Burdened by the hereditary predisposition toward varix formation prophylaxis would mean avoidance as far as possible of the specific exciting factors mentioned under Etiology.
PATHOLOGICAL PHYSIOLOGY

Normally circulation is centripetal, both in the superficial and deep systems. In the former it may be active—Tunick and Pomeranz—or sluggish—Kilbourne. In the latter it is active due to the vis a tergo and muscular contraction forcing it up. Normally blood flows from the superficial to the deep system via the communicating vessels and not in the opposite direction.

The four Trendelenberg states are given as indicating the flow of blood in the varix state as indicated by the condition of the valves. The Trendelenberg positive was first described by Sir Benjamin Brodie (1846). His description is worth repeating: "If I put on a bandage and squeezed the blood out of the veins below and then put my thumb on the vena saphena above so as to stop the circulation through it I found on taking off the bandage the patient being in the erect posture that the cluster of veins below filled very slowly, and only from capillary vessels. But if the patient being in the erect posture I removed the pressure from the vein, the valves being of no use the blood rushed downward by its own weight,
contrary to the course of the circulation and filled the varicose cluster below almost instantly."

Schmier finds by using radio opaque media that the flow may actually be upward in spite of the weight of the column of blood. Kilbourne, McPheeters, Pomeranz and Tunick find the flow to be in the opposite direction using the same technique.

In the Trendelenberg negative after the leg was elevated and the veins emptied, compression made on the saphena magna, and the erect position assumed the veins would fill rapidly from below indicating insufficiency of the communicating veins.

In the double phase Trendelenberg indicating insufficiency of both the saphenous and communicating systems there would be immediate filling from below and further dilatation when pressure upon the saphenous was released due to the reflux from above.

--Schmeier's investigation of this state using iodized oil having a specific gravity approximate to that of blood revealed three possible conditions:
1. The blood may ascend. 2. It may remain stationary. 3. It may descend. Kilbourne's work and that of Magnus, McPheeters, Pomeranz and Tunick using opaque media confirms the more conventional idea that the blood descends. McPheeters test of the
mechanics as demonstrated by blood pressure readings shows that the pressure decreases from the midcalf region to the internal knee region to the upper thigh but increases almost invariably at the great saphenous stem indicating that in this region at least the flow could not be upward. Schmeier's statement summarized the principles governing the direction of flow: "It appears logical to me therefore that the important factor that not only determines the direction of flow but also the rate of flow, is the difference between the pressures produced by the driving force through the capillaries below and by the weight of the column of blood above."

The Trendelenberg nil is the normal condition. The consequences of the abnormal direction of flow will be taken up in connection with complications.

The patency of the deep circulation may be tested by v. Perthe's test in which a tourniquet is bound around the upper thigh and the patient walks. If the veins are empty it is supposed to denote adequacy of the deep circulation. Another test described by Ferguson and emphasized by
Dr. H. H. Davis as more certain is wrapping the leg and thigh tightly so as to obliterate all varices and interrupt the superficial circulation. The patient is then instructed to take a long walk and return. If the patient is as comfortable or more so the deep system is adequate and the superficial system may safely be removed; if the deep system is inadequate great discomfort will be produced by the walk.

**TREATMENT**

If varices carry such a low mortality rate as the Census figures would seem to indicate and little if more than half the cases have symptoms why worry about treatment at all? In view of the facts mentioned under Prognosis and the fact that no type of therapy is absolutely free from danger this is not an unreasonable question. Treatment is not primarily instituted as a life saving measure for it cannot be regarded in that light. It is rather in the nature of a therapeutic procedure prophylactic in nature. Our aim is to prevent further development of the varix, to relieve whatever symptoms may be
present, to improve cosmetic appearance, and to prevent the onset and cure or ameliorate the complications present. Treatment of the varix itself falls into three divisions: conservative, operative, and injection.

Conservative treatment of a palliative nature. The usual type of palliative treatment is the wearing of an elastic bandage (in this section of the country usually of the Ace type) or the wearing of woven or elastic stockings. The purpose of these is to lend support to the vein wall and to keep the venous circulation as far as possible in the deeper channels. Perhaps in some cases this type of therapy may tide the person over the critical period. This is true especially of the varices of pregnancy which frequently almost entirely recede early in the puerperium.—McPheeters. This type of therapy may also be employed in individuals in whom the danger of the other types of therapy is too grave. Otherwise it is at best but splinting a broken leg without attempting to reduce or set the fracture except that not infrequently nature unites the fractured fragments and cures the condition. Varices are rarely cured.
The bandage possesses the advantages that it is cheaper, that if properly applied it fits every leg and that new bandages do not have to be purchased as frequently as new stockings. The big disadvantage lies in the offense to the esthetic senses and particularly in women. McPheeters advocates wrapping from the knee downward, believing that by this means the bandage can be more easily and evenly applied. The bandages should be applied as tightly as can comfortably be borne. They may be left on 24 hours of the day, or as they are more commonly used, applied in the morning upon arising and removed upon retiring, the theory being that hydrostatic pressure is sufficiently decreased in the reclining position to prevent venous dilation without the aid of the bandage.

Elastic stockings are of two kinds, ready made and tailored to fit. The former which theoretically fit everybody actually fit nobody. The latter are far more expensive, but are more satisfactory. Stockings lose their elasticity in a comparatively short time and are expensive to replace.

Operative treatment. Matas has outlined the principles governing operations and their effectiveness as follows: (a) to arrest the hemodynamic
reflux of the column of venous blood in the superficial vein when the valves of these veins are incompetent and the varicosities accompany or depend upon progressive intravenous tension. 

(b) To force the more superficial venous circulation from the less supported subcutaneous veins into the deeper more supported muscular trunks when these latter trunks are not involved in previous disease. (c) To entirely and permanently remove incompetent or diseased venous trunks. (d) To make impossible the entrance into incompetent superficial veins of blood from deeper intramuscular veins by obliterating enlarged parts of the communicating branches while in the act of excising the superficial trunks. To these I would add: (e) The arterial skin supply and nerve supply should be interfered with as little as possible. 

(f) The operation should not be disfiguring. 

(g) The lymphatic circulation should not be destroyed. 

(h) It should be attended by low mortality and morbidity.

The same principles might be said to govern injection therapy. 

In the light of these requirements let us review some of the operative procedures formerly in vogue.
Early operators with little appreciation of the normal or pathological physiology and etiology of varices fulfilled the requirements given under (c) to entirely and permanently remove incompetent and diseased trunks, and paid no attention to any of the others. Trendelenberg, who believed varices due primarily to a reflux of blood, strongly advocated the principle (a) to arrest the hemodynamic reflux—this he did by ligating a section of the saphenous vein.

Schede made circular incisions below the knee about the lower leg. These however never entirely encircled the limb and were made down through the superficial fascia to the deep fascia of the lower leg covering the muscle. All veins encountered were cut and carefully ligated. This operation was founded on the same principle as that of Trendelenberg and while it may prevent reflux from the superficial system completely disregards the other points.

The Mayo stripping operation described in 1906 was a step forward. The technique is somewhat as follows: an incision is made over the great saphenous about 8 inches above the knee. The saphenous is ligated and cut at this point. The stripper comparable to the end of a fishing rod
is passed over the distal end of the vein and pushed downward stripping the main vein from its branches as far as convenient. The stripped is left in place and an incision is made over its lower end. The saphenous is ligated, the upper fragment removed, and the process repeated usually to a point somewhere about 4 inches below the knee. Bleeding was controlled by tightly bandaging the leg, otherwise the communicating branches were disregarded. This operation lessened the reflux from above in the main superficial branch and had more respect for the arterial, nerve and lymph supply than did the Schede operation and was more thorough than the Trendelenberg operation, yet left most of the requisites laid down by Matas unfulfilled.

The Babcock method in which a probe was passed down the vein, the vein tied around the lower end and withdrawn through the upper incision represents no essential advance over the Mayo method.

The only operation which would fulfill the dicta of Matas would have to be radical excision of the entire saphenous trunk and its branches and this would disregard the great danger of infection in such a radical operation in addition to not ful-
filling the other requirements we laid down as to mortality and morbidity, for such an extensive operation would carry a much higher morbidity certainly, and mortality probably than the more conservative Mayo and Babcock operations.

On the basis of purely theoretical considerations the operative method of approach leaves much to be desired—what were the results?

Recurrences:

Goerlick (quoted by Mayo) collected the largest number of cases subjected to the Trendelenberg operation which I have seen. Of 1425 cases he obtained 65 to 85% cures. However the length of time elapsing between the operation and the report was not given. Trendelenberg in a followup of 51 cases using his technique found 84% satisfactory results in 1 to 11 years postoperative.

Probably the largest series collected was in response to a questionnaire sent out by McPheeters to the leading surgeons of this country and abroad. The table of results follows:
<table>
<thead>
<tr>
<th>Description</th>
<th>Total</th>
<th>Percentage</th>
<th>Replies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of varicose vein cases operated.</td>
<td>6771</td>
<td></td>
<td>119</td>
</tr>
<tr>
<td>Number of deaths from embolus following operation</td>
<td>35</td>
<td>0.53</td>
<td>119</td>
</tr>
<tr>
<td>Number of deaths following operation due to other causes than post-operative embolus</td>
<td>28</td>
<td>0.41</td>
<td>119</td>
</tr>
<tr>
<td>Total no. post-operative deaths</td>
<td>63</td>
<td>0.94</td>
<td>119</td>
</tr>
<tr>
<td>No. Cases non-fatal emboli</td>
<td>37</td>
<td>0.54</td>
<td>119</td>
</tr>
<tr>
<td>Average No. of days in hospital following operation</td>
<td>15.1</td>
<td></td>
<td>111</td>
</tr>
<tr>
<td>Average No. of days, date of operation to date of resuming work</td>
<td>34.8</td>
<td></td>
<td>90</td>
</tr>
<tr>
<td>Percentage of recurrences 1 year</td>
<td>5</td>
<td></td>
<td>29</td>
</tr>
<tr>
<td>Percentage of recurrences 5 years</td>
<td>19.2</td>
<td></td>
<td>22</td>
</tr>
</tbody>
</table>

Kilbourne in a collection of about fifteen hundred cases representing the work of Homans, the Cook County Hospital, Bernstein, Jeannel, found the rate of failure to be about 30%. In a questionnaire to 34 hospitals representing 4607 cases the mortality rate was 0.4%.

Briefly then recurrences range from 15 to 66%. Deaths range from 0.4 to 0.94%.

**Injection treatment.**

The criteria and principles of operative treatment might also be applied to injection treatment. The big difference would be the method of removing diseased veins which in the injection treatment would be removal by substituting a
fibrotic cord for a venous duct. Let us evaluate the injection treatment by the same criteria.

a. To arrest the hemodynamic reflux of the column of venous blood in the superficial vein. The thrombus produced serves this function for unless absorption or recanalization occurs the reflux is prevented.

b. To force the more superficial venous circulation from the less supported subcutaneous veins into the deeper more supported muscular trunks. By means of the injection the entire superficial venous system may be obliterated.

c. To entirely and permanently remove incompetent or diseased venous trunks. In the injection treatment removal is not by excision but as I said earlier by substituting a fibrotic cord for a patent venous channel. That this can be done with far less trauma than by excision is evident. The question of permanent removal will bear investigation.

d. To make impossible the entrance into incompetent superficial veins of blood from deeper intramuscular veins by obliterating enlarged parts of the communicating branches while in the act of excising the superficial trunks. It is evident that operative obliteration would mean very
extensive surgery. The fluid injected would much more easily find the communicating vessels.

e. The arterial and nerve supply of the skin should be interfered with as little as possible. There is no interference unless \textit{maximally} perivenous injection, which is a matter of imperfect technique, takes place.

f. The operation should not be disfiguring. There are no cutaneous scars following injection therapy.

g. The lymphatic circulation must be preserved. There is little damage to the subcutaneous lymph channels. Only in the immediate region of the vein is there any damage. Later it will be shown this is slight.

h. There should be a low percentage of recurrences. Figures establishing this fact will be quoted later.

i. It should be attended by low mortality and morbidity for varices untreated have a low mortality.

The theory upon which the injection treatment of varices is based is the formation of obliterating thrombi at the site of injection. The thrombi upon organization represent veins
removed from active circulation because they are non-patent.

The pathologic processes involved have received no little attention and practically all the men who have done basic work in connection with the subject have their contributions to offer. The following description is largely a compendium.

Patey using the internal jugular vein of rabbits and a variety of solutions including dextrose 60% and sodium salicylate 20-40%, has best worked out the early changes. Grossly within 15 minutes (when a thrombus was formed) the circulation had ceased and intravascular clotting had taken place. Microscopically he found in addition to the intravascular clotting, slight wrinkling of the endothelial walls and deposition of blood pigments in the endothelium. Later the endothelium tended to degenerate and disappear, the vein wall stained poorly, occasionally became fragmented and by 24 hours was almost completely destroyed. Perivenous inflammatory change accompanied the process. His work as to the cause of the clotting is instructive. Using the injection of normal saline as a control in the other vein he determined that trauma was not the primary etiological factor. Using an intra
vitro experiment he found his solutions did not have direct coagulating effect upon the blood. That the responsible agent was not inflammation he reasoned from the facts that the clot was present before any evidence of inflammatory change had taken place and from the fact that the appearance of inflammatory change in the vessel wall was not concomitant with the presence of clot. That it is not primarily a matter of hypertonia as v. Meisen believes he deduced from the fact that the solution was in contact with the vein wall but a very short time and that the most strongly hypertonic solution used (60% Dextrose) was not as reliable as the other solutions. From all this data he comes to the conclusion that the primary action is a chemical one and that the chemical injury to the vein wall results in the liberation of tissue juice and that it is this tissue juice which institutes clotting.

McPheeters and Lufkin describe the process somewhat as follows, "Oclusion of the injected varicose vein begins with the injury of the intima by the injected substance. Upon the injured area platelets are deposited and a deposition thrombus develops. As soon as the thrombus fills the lumen its growth ceases. At the junction of
the thrombus and the now stagnant uncoagulated blood there will be present coagulating substances which will at once precipitate fibrin. This will cause an extension of the clot by the liberation of thrombin as fibrinogen is changed to fibrin. The extent of this clot or coagulation thrombus will be determined by the number and size of the tributaries and the rapidity of circulation through them. If the tributary veins are numerous and their circulation active, only a short segment of the vessel will be occluded. If the opposite conditions exist occlusion may be very extensive."

Because of the dilution of the clotting substance a clot will probably never extend into the deep veins of the leg or beyond the saphenofemoral junction as long as the circulation in these vessels is competent.

"The more completely the intima is destroyed the more certain will the primary thrombus permanently obliterate the vessel. The type of thrombus formation is determined by the activity of the circulation" (Theis)

Results of thrombosis: 1. If the thrombus is infected, if there is a phlebitis present or latent so that leucocytic infiltration with proteolysis takes place there may be complete ABSORPTION and removal with restoration of the
circulation, or the thrombus may become an EMBOLUS and lead to pulmonary infarction and even death, this condition fortunately is relatively rare.

2. Connective tissue buds carrying capillary buds and fibroblasts soon grow into the thrombus and by lending endothelium cells to the sinuses produced by retraction (not a settled question for by some the source is regarded as endothelial cells remaining of the original endothelium) may lead to CANALIZATION with restoration in whole or in part of the circulation.

3. There may be ORGANIZATION—the end sought. In this first there is a solution and progressive removal of the thrombotic material and this is followed by the laying down of fibroblasts and new connective tissue. The thrombus thus eventually becomes represented by a shrunken mass of dense connective tissue. (Adami and McCrae)

INDICATIONS AND CONTRAINDICATIONS

Indications for injection treatment vary with the conservatism of the surgeon and his success with the treatment. It would be easier to first treat of the contraindications.
Absolute contraindications to injection treatment: 1. Buergers disease. 2. Active acute phlebitis. 3. Non patency of the deep channels as indicated by Perthe's and Ferguson test. 4. Acute pharyngitis or upper respiratory infection, subacute pelvic infection--Kilbourne.

Relative contraindications. History of deep thrombophlebitis considered a contraindication by most authors and notably those of the French school Gaugier and Sicard but not considered a contraindication per se by Meisen or McPheeters, their criteria being patency of the deep circulation and present activity of the infection. I think the latter more reasonable in view of the remarks under Etiology.


3. Pregnancy. De Lee does not mention injection treatment believing little can be done for the condition but advocates palliative treatment.
The same is true of Williams.

McPheeters does not regard pregnancy as a contraindication if the veins are causing suffering. Neither does Kilbourne. Dawkins and Kern on the other hand consider pregnancy an absolute contraindication. I see no reason for denying the woman the relief given even if the varices would clear up spontaneously after pregnancy.


5. Advanced cardiac pulmonary or renal disease--absolute Dawkins, McPheeters--depends upon case.

In all these instances I believe the case at hand and not rules governing all cases should be employed. A careful test of the patency of the deep circulation is certainly indicated. The activity of arterial circulation and the presence or absence of latent infection as determined by histamine and by simple puncture of the vein wall, the general condition of the patient, the suffering entailed by the presence of the varices--all these
are factors that determine whether or not treatment is indicated and in every case it should be a judgement based upon these conditions rather than any dogmatic rules that determine whether treatment is indicated or not. The importance of mature judgement and experience is shown by the extremely low mortality of the larger clinics.

Evolution of the Injection Treatment.

The earliest solutions used were coagulants. Perchloride of iron, 1853, Chassaignac. Iodotannic solution, 1855, Vallet. In 1884 English used a caustic solution 5% alcohol to produce internal injury. In 1904 Tavel combined high ligation with phenol injection. Schiassi in 1908 followed using ligation and Lugols. Only in 1911 with Sicard's use of sodium salicylate, 1921 Genevrier's hydrobichloride of quinine and urethane. Sodium chloride in 1923 by E. Linser, and more recently sodium morrhuate have been introduced and widely used.

Requisites of a good solution: Clinical:
1. Non toxic. 2 Production of a firm thrombus rather than a clot. 3. Freedom from slough, pain and cramp. Pharmacologic: 1. Stability. 2. Ease of preparation. 3. Small expense. 4. Bacteriocidal power. Also under clinical requisites should be included pain upon perivenous injection, ease of administration, and effectiveness in small quantities.
The more commonly used solutions are sodium salicylate, introduced by Sicard and used in 20% and 40% solution, the "Meisen mixture" sodium salicylate 25%, sodium chloride 10% (Meisen uses a variety of solutions dependent upon the refractoriness of the varix to treatment.) Quinine hydrochloride and urethane, calorose, sodium morrhuate, sodium chloride, Work by Patey, Lewis, Kilbourne experimentally and the large amount of clinical material and the success of the European workers indicate that sodium salicylate which is non toxic in therapeutic quantities and which gives the greatest percentage of good firm thrombi (Lewis and Patey) is probably the safest. The other qualities are but secondary to these. Kilbourne regards bacteriocidal power as important as the majority of deaths reported have been the result of thrombophlebitis and embolus subsequent thereto. For that reason he regards quinine and urethane as superior for it is more highly bacteriocidal. It also produces good firm thrombi and gives a lesser percentage of sloughs. It may be toxic to individuals who have an idiocyncracy toward the drug. As to pain and slough production quinine and urethane is again superior to sodium salicylate which by producing spasm of the musculature of
the vessel produces pain which may last over several days. Calorose does not produce as high a percentage of good thrombi is not bacteriocidal and also produces cramps. Kern combining dextrose and sodium chloride obtained results superior to the use of either.

Sodium morrhuate is the newest of the solutions used. Insufficient work and insufficient follow up of cases do not permit proper evaluation of this newest reagent. It is said (Cooper) to possess all the advantages of sodium salicylate without the pain or slough. Pharmacologically it is very much inferior to the other solutions as it is not stable, it is not a pure substance being a mixture of sodium salts of the fatty acids found in cod liver oil, it is somewhat expensive and has weak bacteriocidal power.

Of the solutions mentioned sodium salicylate and quinine hydrochloride and urethane, are the solutions of preference.

I believe that three solutions are to be used, the quinine hydrochloride and urethane in the smaller varices and sodium salicylate in 20 and 40% solution in the larger and more stubborn varices.

Technique:--

The purposes to be accomplished have been
reviewed. These should always be kept in mind. Remembering the pathogenesis of thrombus formation the things to be borne in mind are to secure destruction of the intima of the vessel involved and the fact that the injection is to be intravenous and not perivenous.

As aseptic precautions are to be observed as in all intravenous work. The subsequent details are a matter of individual choice and will probably be varied until an ideal procedure which should then be religiously adhered to is found. The vein should be entered with the leg dependent and the veins distended. This makes the vein easier to enter and obviates a portion of the danger of perivenous injection. The leg is then elevated to empty the veins. After this is done tourniquets may be employed above and below the segment to be injected or the Theis ring may be used to retain the solution within a limited portion of the venous system. The leg is then lowered, for circulation is retarded with the leg in this position and after aspirating the syringe to insure its presence in the lumen of the vein the injection is made slowly. If there is any pain at the site of injection (not present with quinine and urethane) the needle should
be withdrawn and the area injected with normal saline, 5-10cc. If not the needle should be left in place a few minutes after injection is completed, then withdrawn rapidly and firm pressure applied to the area injected and maintained by a gauze sponge and adhesive straps. In view of the evidence presented indicating a retrograde flow of blood it is believed that the initial injections are to be made high in the saphenous system and not in the more distal portions. The pressure serves to maintain the two walls of the vein in apposition and thus reduces the size of the thrombus and danger of embolus and canalization. Until organization is well under way probably at least a month, elastic bandages tightly applied are of aid in preventing canalization and recurrence.

Number of injections: 7% of the weight of the body is blood. In the average adult this would amount to between 4 and 5 liters (Macleod) Sodium salicylate is used in doses of as much as a grain per pound of body weight over long periods with little signs of toxicity. The effect upon the veins throughout the body would be minimized due to the degree of dilution; the general toxic effects would be a matter of tolerance to the drug. Sicard's 3 grams
of sodium salicylate as the upper limit seems a little conservative. The case at hand and the individual tolerance to the drug should determine the quantity used. The same type of reasoning is applicable to the use of quinine and urethane. Four cc. as recommended by McPheeters as the upper limit is certainly safe.

The author believes that the entire saphenous system is to be obliterated from the more proximal to the more distal segments and that if in a month or so there are signs of recanalization or of new varices that these should be injected with the next stronger solution. He does not believe a course of treatment is complete and that freedom from recurrence can be expected if only the varicosed segment is injected! Thoroughness is the keynote of successful treatment.

Combined ligation and injection are more recently being advocated by de Takate, Wright and Howard, Jackson and Mahon. The results appear to be good but as the operation of ligation carries with it a certain mortality it should be reserved for cases in which the response to injection has not been satisfactory.

Results following injection treatment:--

To operate upon varicose veins requires some technical skill and experience and some
courage. The injection treatment appears much more simple, technically far less difficult and may be done in the office. For those reasons and for the reason that Pharmaceutical houses are interested in the promotion of this method there are many more men using this form of therapy than ever used the operative form. Yet in spite of this few deaths have been reported in the literature. This in my mind is stronger argument for the safety of the procedure than is the large number of cases reported by experts such as Meisen, Sicard and Laisser with no deaths. In the large collection of cases gathered by McPheeters and Rice, 1928, there were only 7 deaths in 53,000.

Recurrences:

Figures show the utmost variation—from 1-4% in a personal communication from Gangier to Kilbourne in 15,000 cases to 98% of 49 cases given by Howard, Jackson and Mahon. The latter were followed a year. Laisser followed 15,000 cases for three years and found no improvement in 5-7% of cases. Meisen thinks 25-30% more representative and I agree. In view of the facts given under Etiology it seems to the author that the superficial venous system would have to be obliterated
in toto to secure such results as Gamgier reports and if this were done he can understand the small percentage of recurrences.

Complications:--

The complication which most frequently brings the patient to the doctor and which most frequently takes the patient from the doctor because of its slow progress is ulcer cruris.

These are found in the lower third of the leg and its medial surface. Most frequent sites correspond to the site of communication between the deep and superficial systems and the region of poorer arterial circulation. They are very painful. The majority of cases have a history of years duration.

The points of differential diagnosis are serology, location and state of arterial circulation. The etiology lies in impaired circulation in the capillary bed causing transudation of fluid into the tissues and impairing nutrition and impairing lymphatic drainage, as predisposing causes with trauma, embolism or local infection the exciting cause. Treatment of the underlying varix with no other treatment produced a cure in 84 of 94 ulcers.(Lewis.) If this is not successful the use
of the McPheeters "Venous Heart" should be resorted to. His directions follow:

1. Cleanse the skin and ulcer area with gauze wet with benzene.
2. Apply 10% AgNO₃ to the ulcer.
3. Apply some mild ointment to the ulcer area that will remain soft.
4. Apply several layers of fluffed gauze.
5. Cover this with 4 layers of sheet wadding.
6. Select a good grade rubber bath sponge (firmest possible) one inch larger than the ulcerating area.
7. Bandage this all in place with a 3 inch plain gauze bandage.
8. Apply a 4 inch Ace bandage from just below the knee to the toes over the sponge and dressing bandage firmly. The more cellulitis and the worse the ulceration the tighter the bandage must be applied.
9. Sell the patient completely as to the point that the more he walks the quicker will the ulcer heal.
10. Never apply the sponge and bandage described to a bed patient.
11. Change the dressings often enough to keep them from becoming saturated.
The group in which scar tissue prevents the healing of the ulcer thus making it truly a trophic ulcer are best treated by excision and a full thickness graft after circulation has been improved by obliteration of varices and the use of the McPheeters heart.

Those associated with gross edema to a marked degree present a more grave prognosis. Cases not responding to other therapeutic measures may require the disfiguring Kondoleon operation to restore lymphatic drainage. (Homans, McPheeters)

Phlebitis. This is another of the complications of varices. The orthodox method of treatment is elevation of the extremity rest in bed and hot packs. High ligation of the saphenous as advocated by de Takats plus limitation of the period of bed rest are valuable adjuvants and prophylaxis against extension and embolism.

Flat feet. Not properly speaking a complication of varices but rather a manifestation of laxness of connective tissue supports of the body.
CONCLUSIONS:

It is believed that the underlying cause of varicose veins is a congenital diathesis manifested in the veins of the leg. It is believed that to successfully cure varices and prevent their recurrence the superficial venous system must be removed from the circulation and the blood made to go through the deep channels. The best means of doing this available at the present time, carrying the lowest mortality and freedom from recurrence is the injection treatment.
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