more reproducible and better-defined conditions of treatment by infra-red rays. There remains, of course, the great and complex problem of the physiological action of heat radiation. Here again the position is much more difficult than in the case of *x* rays. Whereas *x* rays are more or less uniformly absorbed by the tissues, in which they produce chemical changes, the action of infra-red rays results mainly in an increase in temperature produced near the surface of the skin, which is counteracted by perspiration and by dissipation of the local increase in temperature by the circulation. While a certain amount of information as to the penetration of infra-red radiation exists, little is known about the specific action of heat radiation under clinical conditions. As has been pointed out before (Brown and Mendelssohn, 1944), the physiological action of a given type of heat radiation is likely to be quite different in local and in general administration. The greatest need is for clinical observations of the effects of infra-red radiation administered in known quantities and under well-defined conditions, and we hope that the considerations advanced in this paper will aid the clinician in establishing conditions of treatment which will provide a sound physical basis for the study of clinical observations.

Summary

The physical factors involved in the clinical application of radiant heat have been enumerated and discussed. Computation of dosage based on the consideration of the nature of the treatment source is liable to grave error and should be discouraged. Treatment should be based on the direct measurement of radiation flux—i.e., the amount of radiant energy received on the surface of the patient's skin. The methods by which such measurements may be made have been discussed, and one particular radiometer has been described and recommended for clinical use.

Dangerous overdosage may be caused by: (a) neglect of the fact that the radiation from almost all treatment sources increases during the time of application; (b) attempts to determine the flux received by the patient with unsuitable radiometers which yield results far below the true values.

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RADICAL OPERATION FOR VARICOSE VEINS

BY

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To call an operation for varicose veins radical is a substantial claim, especially when the ingenious and occasionally heroic procedures of the past are recalled—e.g., multiple ligatures and excisions, the Trendelenburg operation with and without excision of the prominent veins, the stripping operation, injection therapy, etc. Since 1930 the operation of simultaneous ligature and injection in various forms has been developed and reported (Dodd and Oldham, 1940; Dickson Wright, 1940). I started in 1932, and this article details the position after over 500 operations which a follow-up has shown to merit the term "radical." Since 1939 modified procedures have been described which give good immediate results, but, in my experience and that of others, recurrence takes place in three months to three years, and these easier methods are not advised (Russell, 1941).

The radical operation for varicose veins premisses several factors. First the veins must be varicose—that is, they must be distinguished from compensatory veins which have developed in response to thrombosis of the deep conduits. Then, having decided that the veins are varicose, the type must be diagnosed, so that the correct radical measure can be chosen. There are at least seven varieties of varicose veins which require operation to cure; most of the remainder will respond to efficient injections. The types of varicose veins are diagnosed as follows, depending on incompetence of the valves in or at:

- (1) the termination of the great saphenous vein; (2) the termination of the external saphenous vein; (3) the internal and the external saphenous veins coincidently; (4) the communicating veins between the deep and superficial venous systems of the leg (which normally allow blood to flow inwards); (5) the communicating veins between the deep and superficial venous systems, plus (1); (6) the communicating veins between the deep and superficial venous systems, plus (2); (7) the communicating veins, plus (3).

The radical operation consists in the permanent obliteration of the varicose veins. It is achieved by a combination of ligatures and division at the termination of the internal or external saphenous veins or of the communicating veins, and thrombosis and sclerosis of the varices by injection of an effective and adequate amount of sclerosing agent at the same time. These two factors—i.e., the agent and its volume—are determined by the grossness of the veins to be destroyed.

Radical Operation for Varicosity of Internal Saphenous Vein

This is the commonest presentation, and the plan to be detailed often suffices for the occasional associated incompetence of the communicating veins, particularly those in the thigh.

The Anaesthetic.—A local or general anaesthetic is admirable; a spinal gives pleasantly empty veins and the patient stops in bed for 24 hours. In my practice patients get up the night of the operation, and thereafter morning and evening for lengthening periods, the object being to avoid pulmonary embolism and to keep up muscle power.

The operation necessitates incisions in the groin and at the internal malleolus at the ankle. The grossest veins require a third ligature, injection, and division above the knee. The veins are exposed, tied, and divided, and 20 to 40 c.cm. of 30% saline is injected downwards at the groin and upwards at the ankle. The result is a firm sclerosis of the internal saphenous system, and in some cases of varicose veins in the external saphenous area as well. The thrombosis is palpable before the patient leaves the operating-table, so that the adequacy of the operation is apparent.

Technique of the Operation

The Landmark of the Incision.—The incision runs 1/4 in. below and parallel to the natural fold of the groin. It is 2 to 3 in. long, according to the obesity of the patient. Its centre lies where a line dropped from the pubic spine at right angles to the fold of the groin intersects the incision. The location of the internal saphenous vein is somewhat variable, but this exposure leads immediately to it. The centre of each lip of the wound is seized and forcibly elevated and retracted. This stretches the subcutaneous tissue and makes it possible to cut steadily through the two layers of subcutaneous fascia to expose the vein. The internal saphenous vein—recognized by its large size—is dissected "nude" with the scalpel until its three upper and occasionally one or two downward branches are revealed and also until the inward turn of the main trunk to join the deep femoral vein is defined.

Saphena varices are notoriously friable and are handled fondly like old china. The branches are tied and divided between ligatures. The common femoral vein is exposed sufficiently to ensure that the lower part is patent; the operation is abandoned if it isn't, for then the internal saphenous vein must be compensatory. The end of the saphena magna at its union with the femoral vein is tied with stout thread; to tie it distal to this point leaves a cul-de-sac of vein in which a thrombus can form and pass into the main venous system, with undesirable pulmonary embolism.

An Abnormality.—Occasionally what appears to be the internal saphenous vein is small; this stimulates the search for a duplicate vessel which may lie underneath separated by a layer of fat or occasionally parallel in the same plane of fascia. The common femoral vein, which may be mistaken for it, is recognized by its size, its straightness, the depth at which it lies, and the pulsation of the femoral artery adjoining it. I have once tied and injected the femoral vein, and on two other occasions have had the ligature around it, discovering the mistake only just in time. A good exposure is the best preventive.

The great saphenous vein collapses on ligature, as its content is mainly a regurgitation from the femoral vein.

The Injection.—The distal portion of the vein is injected with 20 c.cm. of 30% saline, making sure that the fluid does go into the lumen and that it is not put into the deep tissues, which results in gross sloughing and delayed healing. A less effective alternative is 5 to 10 c.cm. of ethamolol. When injecting some veins they dilate and the sclerosing fluid sprays out alongside of the needle, indicating that the terminal valve in the collapsed vein has become competent. In this event the technique is as follows:

The lower end of the exposed vein is clipped with a haemostat. Another ligature is passed loosely round the centre of the exposed vessel. The varix is half divided by a scalpel between the two ligatures, and an olive-headed needle or ureteric catheter is threaded into the vessel. When the head is beyond the lower ligature, this is pulled tight to avoid bleeding, and the forceps is removed. The long needle or catheter is introduced gently down the internal saphenous vein. These instruments hitch occasionally on the valves, but manipulation disengages them and allows 10 to 18 in. of the vein to be traversed. Handling should be dainty, to avoid poking the instrument through the venous wall, when gross sloughing occurs. The concentrated saline (30%) is injected through the olive-headed needle (it fits a Record syringe) or ureteric catheter, slowly withdrawing it while doing so and avoiding leakage of the sclerosing agent from the vein. If the anaesthetic is local infiltration a painful spasm follows. The needle or catheter is now removed and the lower ligature tied.

Transfixion Stitch.—When the internal saphenous vein is divided there is no valve between it and the right side of the heart, so that a torrential haemorrhage follows if the proximal ligature slips. When this happened once, seven pints of blood were required to restore the loss. This danger is minimized by a second tie, transfixing the stump with fine thread in the same way that a hernial sac is secured. The wound is cleaned, especially when it has been soiled with the injection; the dead space is obliterated; and the skin is closed accurately and a pressure dressing applied.

Ligature of Internal Saphenous Vein at the Ankle

The internal saphenous vein at the ankle lies in a groove at the anterior border of the internal malleolus intimately bound to the deep fascia; it is important to find the great saphenous vein and not a large superficial radicle. An incision 1 in. long is made over the front edge of the internal malleolus, and the lips of the wound are opened and elevated. In some females fat overlies the vein, but usually it is visible through the deep fascia and is picked up, cleaned, and tied at its lower end. A loose ligature is passed round the upper end. The vein is half cut through transversely and the olive-headed needle or ureteric catheter is inserted upwards very gently. Sometimes the ureteric catheter will pass when the needle won't, and vice versa. They frequently hitch where a large communicating vein joins. The delicate introduction is essential, otherwise the needle or catheter may be thrust through the wall of the inelastic vein and the sclerosing fluid be inserted into the subcutaneous tissue, causing a huge slough of the skin, fat, and deep fascia that requires months to heal. The catheter or needle is withdrawn during the introduction of 20 to 30 c.cm. of 30% saline. Soiling of the wound must be avoided. The upper ligature is tied and the vessel divided. The skin is sutured accurately; it unites slowly in this area, especially if pigmented or eczematous or ulcerated.

The Dressing.—A pressure dressing is put on both wounds. Skill is required, and sepsis must be good, for suppuration and dermatitis will incapacitate otherwise fit men and women for weeks or even months.

Ligature above the Knee

When saline 30% is used the varices are palpably thrombosed at the end of the operation. Should those about the knee not be solid, a third ligature of the internal saphenous vein above the knee is required. The vessel is exposed on the antero-internal aspect a hand's breadth above the joint line, and a ligature is applied. If the upper section is solid nothing further is necessary, but if it is fluid 5 c.cm. of saline 30% will make sclerosis certain. Below the tie 5 to 15 c.cm. of the hypertonic saline is put in it either through a hypodermic needle or through the olive-headed needle or catheter, managed

as before. Then the vessel is again ligatured and divided. The wound is closed.

Ligature of External Saphenous Vein

The Anatomy.—The external or short saphenous vein perforates the deep fascia about the lower part of the popliteal space and runs under it until it reaches approximately the bend of the knee-joint, where it turns in deeply and joins the popliteal vein, usually 1/2 to 1 in. higher. *Gray's Anatomy* points out that "the mode of ending of the short saphenous vein is subject to considerable variations. It may join the long saphenous vein in the upper one-third of the thigh or may divide into two branches, one of which joins the long saphenous vein, the other the popliteal vein or the deep posterior veins of the thigh. Occasionally it ends below the level of the knee-joint, in the long saphenous vein or in the deep muscular veins of the calf."

Technique of Operation.—The patient lies on the face. Originally the incision was longitudinally over the line of the vein and was extended up or down as required, but this often heals indifferently, sometimes with a thickened and sensitive scar. The incision made in the central transverse crease behind the knee is better. A sandbag under the foot produces a slight laxity of the otherwise tight gastrocnemius muscles. The incision is deepened through the deep fascia. The external saphenous vein lies surrounded by fat in the groove between the inner and outer heads of the gastrocnemius. It may be duplicated or triplicated, and the sural branches of the internal popliteal nerve may be closely associated. A deep dissection is required, and the successful complete exposure, ligature, injection, and division can be a major surgical exercise. The union with the popliteal vein must be exposed, and the associated branches divided between ligatures. The vessel is ligatured and injected similarly to the internal saphenous vein in the groin, giving meticulous attention to technique. No further ligature or injection is needed for the external saphenous drainage area.

Incompetent Communicating Veins

Occasionally the communicating veins between the superficial and deep systems are so gross as to require deliberate exposure and division of the connexion and repair of the considerable defect in the deep fascia. These points usually lie at the lower inner third of the thigh and at the leg on the inner surface. They are located by palpation with the help of the finger, when the elastic varix and the hole in the deep fascia are felt, or, after emptying the veins, by moving two tourniquets closer together on the limbs and watching the vessels fill up.

In the average case of incompetent communicating veins ligature and injection at the groin and ankle or of the external popliteal vein behind the knee suffice to obliterate them. In the lower third of the leg the inefficient communicating vein may be so large and the pressure in it so great that direct attack is required. In fact, the already-described procedure, by obliterating a large part of the superficial venous systems, has the effect of increasing the content of the deep veins and thereby the pressure in the communicating veins. The clinical result in large communicating veins is more swelling and pain in the lower third of the leg than before the operation, which may raise the suspicion of obliterated deep veins. It is usually this which explains the recurrences after the operation. A hint of a marked communicating vein of the leg is given by pigmented skin, oedema, or ulcer in the lower inner third of the leg.

The Remedy.—The treatment of the communicating veins consists in finding them, dividing them between ligatures, and closing the hole in the deep fascia. They are located in one of two places on the inner surface of the leg—either 2 to 3 in. above the tip of the internal malleolus or at the junction of the middle and lower thirds of the leg. Their position is determined by palpating systematically over the skin, when elastic sensation and a defect feeling like a button-hole in the deep fascia are found. One or two demonstrations soon give the peculiar experience. The incision is made vertically over the area. There are usually a few overlying small varices, and bleeding is copious. The deep fascia is exposed and the penetrating vein will be located coming off at an unexpected

angle. It is divided between ligatures, and the slit in the deep fascia is closed. The skin in these conditions heals poorly; it is often eczematous, or there may be adjoining ulceration. One stitch and a firm pressure dressing only are required, and patients stop in bed until healed, getting up morning and evening for lengthening periods. The results are excellent.

The communicating veins in the lower third of the thigh seldom call for direct attack, and are settled either by incision, ligature, and injection of the groin or by a similar procedure to the internal saphenous vein, 3 to 4 in. above the knee on its antero-internal surface.

Subsequent Injections.—In the majority of cases no further treatment is required, but occasionally small areas of veins remain patent, and these respond to immediate injection by ethamolin or quinine and urethane, 2 to 5 c.cm. of each. Sodium chloride 30% is not used for ordinary injection because gross sloughing follows if a few drops leak outside the vein.

Conclusion

The radical operation for varicose veins depends on the pathology and diagnosis of the varicosities. There are two types of varicosities: those due to loss of elasticity of the internal and external saphenous venous system with incompetence of the valve guarding their terminations, putting the superficial veins in direct communication with the right side of the heart, and those due to enlargement of the communicating veins between the deep and superficial venous systems—these are mainly at the lower third of the thigh and leg.

There are seven main diagnoses made up of combinations of these.

Up to five small but essential operations are required to cure the varicose veins in a limb.

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SULPHONAMIDE ALLERGY THE PERSISTENCE OF DESENSITIZATION

BY

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There are two types of allergic sensitivity which can arise during sulphonamide therapy—according to whether the drug is taken internally or is applied to the skin. The internal type may take many different clinical forms, of which fever, morbilliform erythema, and leucocytosis are the commonest features. In the cutaneous type the reaction is an eczematous dermatitis. In either case violent reactions are apt to follow administration by mouth, and one question which comes up is, Can these people be desensitized as a safeguard for the future?

The answer is that they can. Schlesinger and Mitchell (1938) reported that cases of sulphanilamide fever and rash cleared up in three or four days even though the drug was continued, and that one such case was followed up two months later and found to be insensitive. In 1942 Erskine stated that allergic cases could be desensitized either by keeping on with full doses at the time of the reaction or by giving ascending doses at a later date. In a previous report (Park, 1944) on a patient who developed sulphapyridine neutropenia and was still sensitive after three months, details of a successful desensitization were given.

In the eczematous type desensitization was introduced by Tate in 1943 (personal communication), either at the expense of a severe reaction by full doses over about four days or by smaller doses for about three weeks, causing milder reactions.

Methods Used

My experience over the last 18 months has been that desensitization has been consistently successful in these allergic

states. The drug has been given in all cases by mouth, in four or five divided doses per day—enough to keep up a fairly constant level in the blood stream. Beginning with an amount too small to cause a reaction, the dose is doubled each day until a mild reaction appears. It is then kept the same until all symptoms have subsided, when it is again increased.

The two forms of allergy differ sharply in their response to desensitization. In the internal type, in which the first sign of a reaction is a rise in temperature, it is usually possible to start with 0.1 g. at each dose, doubling up daily to reach 1 g. in four or five days. More sensitive cases, such as the one reported below, take longer; the most sensitive one yet encountered had to start with 0.005 g., and took nine weeks to work up to 1 g. In the eczemas this high degree of sensitivity is the rule. The average case takes about six weeks to desensitize if the dosage is kept below reaction level.

The next question which springs to the mind is, How long does this benefit last? Does the allergic state return in the way that it does each season after hay-fever desensitization, or is it permanent? This question has not been answered up till now, and it is only from its answer that we can learn whether this desensitization to sulphonamides is really worth while. The following case is reported as a single pointer to the possible solution of this problem.

Case Report

Sapper X., aged 40, began treatment for chancroid with sulphanilamide on July 21, 1943, taking 1 g. four times a day. On the sixth day his temperature rose to 103° F. and he developed a general morbilliform erythema, showing no tendency to photosensitivity. It was slightly irritable. He complained of pains in the knees and other joints, but there were no objective findings. The drug was stopped at once. He gave a history of having received sulphapyridine for pneumonia six months previously without any reaction. On successive days his temperature reached peaks of 103°, 101.6°, and 100° F. A leucocyte count showed a total of 10,000. From July 30 onwards he was afebrile. On Aug. 8 he was put on divided doses of 1 g. of sulphapyridine. A few hours after the first dose he developed a temperature of 101° F. and further joint pains, but no rash. The fever lasted 48 hours.

Desensitization with sulphanilamide was started on Aug. 8 with four doses per day of 0.125 g. After two doses, however, he again reacted with a fever up to 102° F., a recurrence of the rash, and further joint pains. The drug was stopped and his symptoms subsided. Sulphanilamide was continued as follows:

Date	Doses per Day	Amount (g.)	Result
Aug. 11	4	0.02	No reaction
12	4	0.04	" "
13	4	0.08	" "
14	4	0.125	Fever of 99.6°
15	3	0.125	" 101.6°
16	Nil		Still febrile
17	"		Almost afebrile
18	"		Afebrile
19	"		" "
20-22	4	0.02	No reaction
23-24	4	0.04	" "
25-26	4	0.08	Mild reaction
27-28	4	0.04	No reaction
29-30	4	0.06	" "
Aug. 31-Sept. 2	4	0.08	" "
Sept. 3-5	4	0.125	" "
6-11	4	0.15	" "
12-14	4	0.19	" "
15-16	4	0.4	" "
17	4	0.5	" "
18	4	0.6	" "
19	4	0.75	" "
20	4	0.9	" "
21	4	1.0	" "

He was discharged from hospital and nothing more was seen of him until Sept. 1, 1944, when he reported at the V.D. Dept. to have a routine injection for syphilis, which he had contracted in the meantime. He gave the story that in June, 1944, he developed a sore on his penis. At this time he was given sulphanilamide in seven doses of 1 g. over two days. This caused a febrile reaction accompanied by a recurrence of his previous symptoms, subsiding in two or three days. A diagnosis of syphilis was then made, and from that time he had been receiving weekly N.A.B. and bismuth.

He was brought in for further investigation and given the following drugs:

Sept. 3,	sulphathiazole,	1 dose of 1 g.
" 4,	"	4 doses of 1 g.
" 6,	sulphapyridine,	1 dose of 1 g.
" 7,	"	4 doses of 1 g.