VENOUS PRESSURE IN THE LOWER LIMBS

By R. Nambiar, F.R.C.S.E.

(Unit of The Senior Surgeon, General Hospital, Singapore)

In 1895 Perthes who is well remembered for his test for detecting incompetency of varicose veins, made an important observation that has become the basis of venous pressure studies. He noted that the pressure in the veins of the leg decreased on ambulation and that this did not occur in extremities with varicose veins unless these veins were occluded above with a rubber band. However, it was not until 1936 that venous pressure could be actually measured. Smirk in 1936 reported the use of direct method using a cannula in the vein and connecting it to a manometer. Beecher, Field and Krongh in the same year used indirect method for their studies. This consisted of determining the external pressure necessary to produce collapse of the vein. Venous pressure can now be recorded photographically by means of a strain gauge and amplifier on a pen writer system. Since 1950 various workers have found venous pressure studies an important addition to phlebography in the investigation of venous disorders of the lower limb.

This paper describes the studies of venous pressure in the lower limb done mostly on patients seen and treated during the last one year in the varicose vein clinic attached to the Unit of the Senior Surgeon, General Hospital, Singapore.

MATERIAL AND METHODS

All subjects studied were males and were divided into five groups as follows:—

1. *Normal:* Six patients with an average height of 5 feet 5 inches and weighing 125 lbs., whose venous system was clinically normal.
2. *Mild Varicose Veins* (Stage I): Eight patients all of whom had either subcutaneous or cutaneous varicose veins but without incompetency of saphenous system.
3. *Gross Varicose Veins* (Stage II): Twenty-five patients with varicose veins and incompetency saphenous veins.
4. *Gross Varicose Veins* (Stage III): Five patients who had incompetency of superficial veins and perforators and with oedema and skin changes.
5. *Miscellaneous Group:* This consists of seven patients—three of whom were clinically suspected of having deep vein thrombosis, two cases with oedema and ulcerations in whom deep vein thrombosis or incompetence had to be excluded and two cases with severe ankle oedema of unknown origin.

Venous pressures were measured:—

(a) with the subject erect and relaxed (R.V.P.)

(b) with the subject carrying out tiptoe exercises for two minutes (E.V.P.)

(c) with the subject performing the exercises with a venous tourniquet in the lower thigh (E.V.Pt.)

TECHNIQUE

The technique used in this series is the direct method originally described by Walker and Longland in 1950. The apparatus is simple to use and consists of an ordinary sphygmomanometer, a three way cock attachment, sterile air pressure bottle containing heparinised saline, sterile glass tube and rubber tube connections and a long polythene cannula (Fig. 1).

The apparatus is set up by connecting one end of the polythene cannula to a glass tube which passes through a tight cork and immerses well into the saline in the bottle. The bottle is connected by way of a three way cock to the sphygmomanometer and its airpump. The sphygmomanometer is placed at the same level as the foot.

The polythene tube is filled with saline by raising the pressure in the bottle using the airpump. Under local anaesthesia the internal saphenous vein at the ankle is cut down and the cannula introduced into the vein and tied around it. When the pressure in the reservoir is lowered after the patient is made to stand quietly on his

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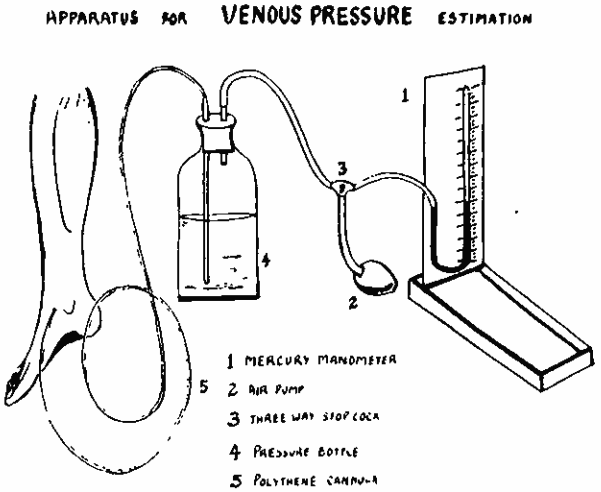

Fig. 1.

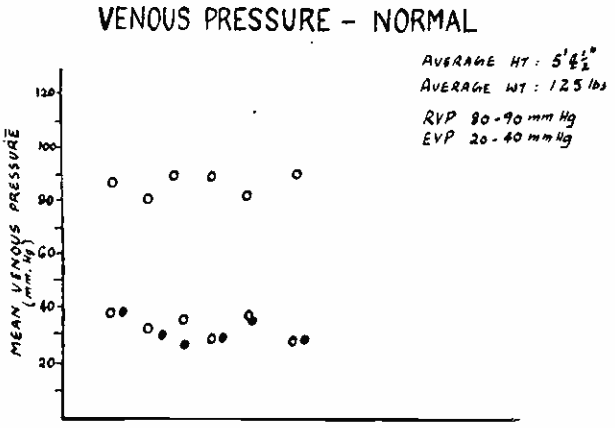

Fig. 2.

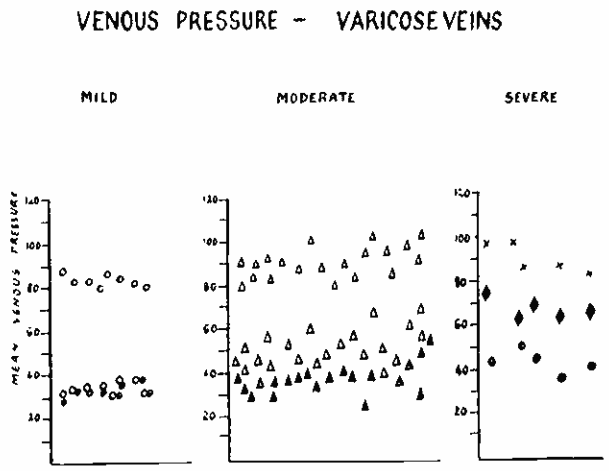

Fig. 3.

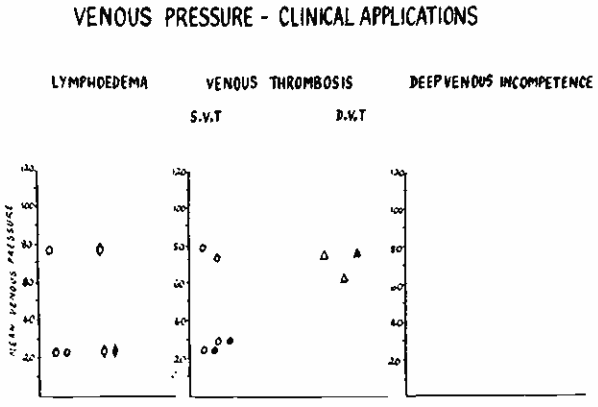

Fig. 4.

feet for some time, blood will be seen to flow out into the polythene tube. The pressure is so adjusted that the blood saline junction remains satisfactory. The manometer reading is recorded and repeated several times and the mean value noted (R.V.P.). The readings are repeated for exercise (E.V.P.) and exercise with tourniquet (E.V.Pt.).

DISADVANTAGES

1. Accuracy: The venous pressures obtained by this method are not highly accurate and the variations range from 5-10 mm. Hg. (Walker and Longland, 1950), but this degree of accuracy is sufficient for investigating the gross changes in venous pressure. The scatter of reading may be reduced by using the largest cannula possible and taking the mean of a number of readings.
2. Thrombosis and spasm: This may render the introduction of a large size cannula difficult and the veins may be empty of blood. The test was unsuccessful due to this on two occasions.
3. Delayed healing and even ulcer formation was the sequelae in two cases of gross varicose veins with severe oedema and dermatitis in whom the long saphenous vein was cut down over the ankle. In the later series since one of the veins on the dorsum of the foot was selected, this complication has become much less.

FINDINGS

1. *Normal:* The venous pressure at the foot on quiet standing should equal to the pressure exerted by a column of blood extending vertically from the level of the heart. In Asians with an average height of 5 feet 5 inches, the R.V.P. was between 80 - 90 mm. Hg. During exercise, the calf muscles pump the blood back to the heart and so the venous pressure at the foot falls. The E.V.P. was 20 - 40 mm. Hg. on an average in the normal cases. When a tourniquet was applied over the thigh and exercise pressure repeated, there was no significant fall of pressure (Fig. 2).
2. *Mild Varicose Veins* (Stage I): The results of pressure studies were the same as in the normal.
3. *Gross Varicose Veins* (Stage II): In these cases the E.V.P. was higher than the normal although E.V.Pt. was within normal limits.
4. *Gross Varicose Veins with Complications* (Stage III): The findings were similar as above. The rate of fall of E.V.P. was even less. The E.V.Pt. was above the upper limit of normal (Fig. 3).
5. *Miscellaneous:* In the case of lymphoedema in an 18 year old girl, venous insufficiency had to be excluded, the pressures were well within normal limits. In three cases of clinically suspected deep vein thrombosis two of whom were already on anticoagulants, the pattern of pressure was normal in two cases. Venous pressure in a young man referred from the Medical Unit showed high exercise pressure and no fall with a tourniquet and exercise. In two cases of post thrombotic syndrome with gross oedema and ulcerations, the test failed because the veins were found empty and the walls fibrosed making cannulation difficult. In another two cases of unilateral oedema of unknown origin venous insufficiency was excluded after pressure studies were normal (Fig. 4).

CONCLUSION

It may be assumed from the above studies that the extent of fall of venous pressure at the foot during exercise gives an evaluation of the overall efficiency of leg veins.

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