

Compression sclerotherapy of varicose veins

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THIS study was originally stimulated by an article in the *Lancet* describing the "continuous compression technique of injecting varicose veins" (Fegan 1963). Through the generosity of the Upjohn Foundation I was able to visit Dublin in October, 1967 and study the work originated by Fegan being carried out on an extensive scale in the Sir Patrick Dun's Hospital and the Rotunda Hospital. Since that time the "Fegan technique" has been used on a number of my own patients, some of whom have been followed up for periods of over a year. The following is a review of the basis and technique of "continuous compression sclerotherapy" and some preliminary results of its application in general practice.

History

Traditionally there have been three methods of treating varicose veins, support, obliteration and removal. Support by means of bandages or elastic stockings is largely palliative and though it may relieve symptoms and reduce the rate of progression, it is in no sense curative. Surgery was first advocated by Galen, and various modifications of ligation, and widespread stripping have since been advocated and are still extensively practised.

Injection has also been combined with ligation by some surgeons. For some years intravenous injections of phenol, sodium salicylate, sodium morrhuate, quinine urethane and many other sclerosants became fashionable. But despite some initial success, the results were disappointing. The injections were often painful and disabling, complications frequent, and there was a high rate of recurrence within a few months, so that the treatment fell into disrepute. But the primary purpose of these earlier methods of injection was the obliteration of whole sections of veins and little regard was paid to the physiopathology of the condition. The primary lesion in the development of varicose veins is the loss of competence of the valves in the perforating veins. This then permits retrograde overflow of venous blood from the deep veins into the superficial veins, with consequent overdistension and the production of varices. Once one valve becomes incompetent, valves in adjacent perforating veins may become secondarily incompetent through over distension of the vein, and the condition becomes progressively worse.

"The object of sclerotherapy should be the production of a permanent fibrous occlusion of a vein at a point which will control abnormal retrograde pressure and flow patterns" (Fegan 1967).

Anatomy

The return of venous blood from the lower limb takes place through the deep veins of the leg, the *venae comites* of the arteries, the femoral, popliteal and peroneal veins, the anterior and posterior tibial veins and the intramuscular venous sinuses. These all lie deep to, and with the exception of the venous sinuses, receive strong support from, the deep fascia of the limb and rarely if ever become varicose.

On the other hand, the superficial system of veins which drain into the deep veins lies unsupported, superficial to the deep fascial layer. It is these veins which become

varicose. They consist of the long saphenous vein, the short saphenous vein and the anterior vein of the leg.

In addition to the communicating veins which form an extensive network between the major superficial vein trunks of the lower limb, there are a variable number of short perforating veins which pierce the deep fascia and connect the superficial and deep veins. These perforating veins are provided with valves which in a healthy vein only permit the flow of venous blood in one direction. Most of the perforating veins arise from the tributaries of the saphenous veins and the anterior veins of the leg, not from the main trunks.

Pathology

The deep venous system is not subject to varicosity probably because of the close association of many deep veins with the accompanying arteries and the strong support given by the deep fascia and the tissues in which they lie.

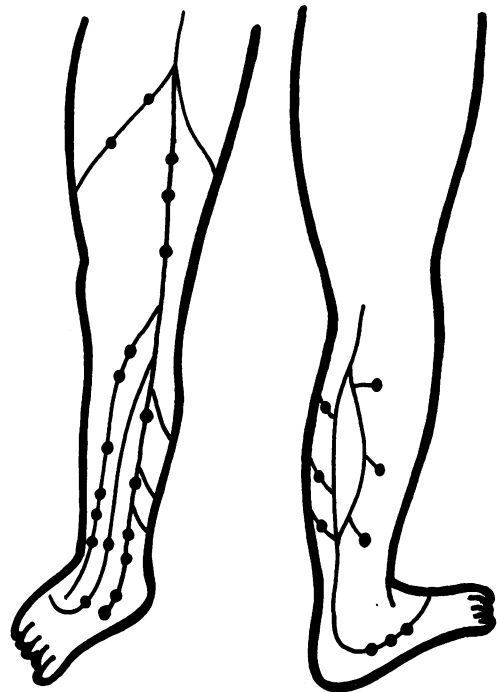
The superficial veins however are poorly supported, lie above the deep fascia and increased intravenous pressure may lead to varicosity. Such increased pressure is readily transmitted to the superficial system if the valves in the perforating veins become incompetent and allow retrograde flow from deep to superficial venous systems.

The identification of incompetent perforating veins

The first step in successfully treating varicose veins must be the identification of incompetent perforators. The number and position of perforating veins varies in different subjects so it is not possible to identify them by surface anatomy. A few are said to be relatively constant in position but in practice we have not often found it possible to locate them. Careful, patient and sometimes prolonged examination of the veins is necessary to find them and it is essential to carry out this examination methodically.

1. With the patient standing in a good light, all the visible veins are outlined with a skin pencil (blue).

2. The patient now sits on a couch with the legs hanging over the end. The examiner stands at the end of the couch and raises the limb to be examined, resting the foot of the fully extended leg against his shoulder. The veins are now palpated with the fingers of both hands slightly flexed, moving the hands up and down the leg fairly quickly. After some experience it is possible to detect orifices in the deep fascia through which the perforating veins pass. The orifices are felt as soft indentations in the tissues and sometimes as definite sharp-edged openings admitting a finger tip. All such orifices are ringed with a skin pencil (red).



Common sites of perforating veins

3. The most likely sites of retrograde filling can then be selected by relating the orifices detected to the complex of veins outlined. With the patient again lying flat and the leg raised to empty overfilled veins, as many as possible of the likely sites of retrograde

filling are compressed by the finger tips of the examiner, using both hands if necessary. With the occluding fingers still in position, the patient now stands and the veins are observed to see if they fill. If they do, the test is repeated with pressure applied to different orifices. When filling of the veins is controlled by pressure of the finger tips in a few sites, the fingers are released one at a time starting with the most distal finger and the veins watched. When a vein fills, the orifice just released is the site of retrograde filling and is suitably marked as a site for injection (red arrow). "There is often more than one point of retrograde filling in a limb, but seldom more than three" (Fegan 1967).

4. Where there is difficulty in identifying deep fascial orifices an alternative method can be used. The patient lies down and the leg is raised to empty the veins. Venous tourniquets are then applied at different levels, for example, mid-calf, below knee, above knee and mid-thigh. The patient then stands and if the veins do not fill, the tourniquets are released in turn starting with the most distal and the veins observed for filling. When filling occurs the site of the tourniquet just released approximately identifies the level of retrograde filling. More accurate identification of the level can be made by suitable adjustments of the tourniquet. A half-inch wide strip of car tyre inner tube lightly compressing the limb, secured by a pair of Spencer Wells forceps forms a suitable venous tourniquet.

5. Minor confirmatory signs of the presence of an incompetent perforating vein are:

- (a) The site of the perforator may be tender and warmer than the surrounding skin.
- (b) There may be pigmentation of the overlying skin.
- (c) Varicose lesions such as an ulcer or patch of eczema are usually intimately related to an adjacent incompetent perforator. (According to Fegan (1963) "a varicose ulcer above the medial malleolus is almost diagnostic of incompetence of a lower posterior tibial perforating vein.")

The technique of injection

With the old random method of injection of varicose veins, recanalization was almost inevitable, since no firm fibrous union was established between the opposing walls of the vein injected. The sclerosant simply produced a thrombus in the vein, which soon shrunk and slit-like sinuses developed both between the thrombus and the vein wall and in the clot itself. These sinuses enlarge and unite under the venous pressure exerted on them from above and below through the perforating veins and eventually the whole clot is obliterated and the vein is recanalized.

To avoid this Fegan elaborated an injection technique for localizing the sclerosant to a limited section of vein from which the blood was excluded as far as possible. In this way the intima of the vein is exposed to continuing contact with concentrated sclerosant. The intima is damaged and a mild inflammatory reaction is set up in the vein wall. Furthermore by applying continuous pressure over the site of injection, the opposing damaged surfaces of the vein are kept in apposition and fibrous union follows, provided adequate pressure is maintained for a sufficiently long period. It was found by serial histological examinations that several weeks were required to complete the process of organization and firm fibrous union (Fegan 1967) though after three weeks the process is well established.

To achieve this result the technique of the injection is extremely important. Using an all-glass 2 ml syringe and a fine bore needle (25 by $\frac{3}{8}$), 1 to 2 ml of sclerosant solution (STD) is drawn into the syringe and the plunger tested to ensure that it moves freely and easily. With the patient lying down the needle is inserted into the vein at the selected site. In those patients where the veins are not well filled in the horizontal position, it may be necessary to insert the needle when the patient is sitting with the legs horizontal, and after insertion the patient gently lies down with the needle and syringe held firmly

in position by the operator. A small amount of blood is withdrawn into the syringe to ensure that the needle is in the lumen and 0.1 ml. of sclerosant immediately injected to clear the needle.

With the syringe still *in situ*, an assistant raises the leg to 45° to empty the veins as much as possible. The operator then places the index and ring fingers of the unengaged hand over the vein at the site of puncture. The fingers exert firm pressure on the vein and are gently separated 1 to 1½ inches thus isolating a small section of vein and the pressure is maintained. In this way the vein is almost emptied of blood and 0.5 to 1.5 ml. of sclerosant is injected. The needle is withdrawn but digital pressure is maintained for at least 30 seconds before applying a strong crepe bandage. One turn of the bandage is made below the site of injection and one above and finally a pressure pad of bevelled sorbo rubber (3 in. to 4 in. by 1½ in. to 2 in.) is incorporated in the bandaging directly over the section of vein injected. Injection of sclerosant outside the vein is avoided by the feel of the injection, for if the needle is not in the lumen, the plunger does not move freely as the injection is given. Moreover, the middle finger lightly applied over the site of the injection will feel nothing if the injection is intravenous, but swelling is felt if the sclerosant is extra-vascular. Finally the patient is asked to complain immediately if there is any pain, which only happens if the sclerosant is going into the tissues.

Continuous compression

To obtain good fibrous union and permanent occlusion of the incompetent perforators, it is essential to establish and maintain adequate compression at the site of the injection. This is the third important innovation in the continuous compression technique.

Where two or more incompetent perforators have been detected, they are dealt with in ascending order, commencing with the most distal. When the injections have been completed and the local pressure pads secured, the whole limb is bandaged from the roots of the toes to well above the most proximal injection. The bandaging must be done evenly and firmly to ensure equitable pressure throughout the limb and to prevent the bandage from slipping. A square pad of sorbo rubber is inserted behind the knee and a strip of four to five inches is incorporated with one to two inches extending beyond the top of the bandage. Finally an elastic stocking is drawn over the bandage and pads and left *in situ* day and night for three weeks. The patient is instructed to walk for half an hour immediately following the injection and especially warned not to go home by car as this would involve sitting and a static condition of the circulation. This early exercise clears the deep veins of any sclerosant that may have spilled over into them. The patient is asked to walk at least three miles daily and to avoid standing. If any pain occurs a simple analgesic (paracetamol or codein) and a brisk walk is advised.

This insistence on exercise is an important part of the treatment which should be clearly explained to the patient before treatment is commenced, since co-operation from the patient is essential if the treatment is to be successful.

After care

In addition to explaining the necessity for exercise, the patient is given a card explaining the treatment and containing precise instructions. (See appendix I).

The patient is asked to report in three weeks when the stockings and bandages are removed and the legs examined. The ideal result is a small section of sclerosed vein at the site of injection, with absence of filling of the related complex of veins. The patient is also examined in the standing position and any incompetent perforators missed at the first session are now injected, padded and bandaged as previously described. If the site of the original injection is tender on examination, the pressure pads are replaced for a further two to three weeks, but if the site is not tender the bandages and elastic stocking

are adequate support for the next three to four weeks. It is advisable for the patient to continue the wearing of elastic stockings for at least three months after completion of the injections.

Further follow up is essential at three to four week intervals for six months, and indeed Fegan advises follow up for five years, though at six or even 12 month intervals as the patient's condition demands.

Selection of patients for treatment

There are very few contra indications for treatment of varicose veins by this method, but the following conditions preclude successful treatment:

1. Overweight patients. Such subjects are difficult to treat because it is almost impossible to maintain adequate compression, and in addition obese patients are usually poor walkers. An initial course of strict dieting should be instituted, and the veins only dealt with when the patient is within half a stone of normal weight.
2. Those patients who are unable to walk should not be treated at all by this method.
3. It is inadvisable to undertake treatment purely for cosmetic reasons, since even when treatment obliterates the unsightly vein, the pigmentation often present is not eliminated.
4. Treatment should not be undertaken if acute cellulitis is present, but once the cellulitis is cured injection may safely be carried out.
5. Veins above the level of mid-thigh are unsuitable for compression sclerotherapy since it is quite impossible to apply continuous pressure in this position.
6. A small proportion of patients are allergic to sodium tetradecyl sulphate and are therefore unsuitable. We have not encountered such patients, but other sclerosants such as ethamolin (five per cent ethanolamine oleate) could then be tried.

Material used in treatment

1. Three per cent sodium tetradecyl sulphate solution.
2. Several 2 cc. all-glass syringes with Luer needles (25 gauge, $\frac{3}{8}$ length).
3. Sorbo rubber pads. Prepared from commercial lengths of sorbo rubber, cut into suitably sized pads (4 in. by $1\frac{1}{2}$ in. to 2 in.) bevelled on each side.
4. Uni-crepe or elasto-crepe bandages (4 in.).
5. Thigh length elastic stockings, two-way stretch, standard yarn.

Results

The details of treatment of the first 30 patients is shown in table I. They comprised 29 females and one male, ranging from 26 to 63 years of age. Four patients were pregnant at the time of treatment, four had had previous operative treatment for varicose veins (ligation above the knee), and two had previous injection treatment by the orthodox method.

The severity of their varicose veins was estimated before treatment commenced, 11 being classified as severe, 13 moderately bad, and six slight, though all complained of symptoms ranging from pain in the veins, aching legs and cramp to oedema of the feet and excessive tiredness of the legs. The affected veins were in both legs in 17 patients, in one leg only in 13.

The number of injections given varied from two to nine for any one patient and all 30 patients have been observed since completion of treatment for periods varying from three to 15 months. Twelve of these have been observed for over nine months, 18 for over six months.

Each patient was asked to express an opinion about her (or his) treatment. One said she was no better, six thought their veins were very much better and 23 thought the treatment entirely successful. Symptoms were entirely relieved except in two cases; case 10, the patient who was no better, and case 4, who still complained of pain on standing, though she felt her veins were much better. (On examination the veins

TABLE I

No.	Name	Age	Severity	Bilat	No. of injections	Time since comp.	Patient's assessment		Doctor's ass't				Major/minor recurrence	Comment
							Symptoms	Comment	A	B	C	D		
1	Mrs J.H.	27	Mod.	x	6	15/12	Alleviated	Improved v. mnch				x	Major L. leg	Rt. leg v. good. L. leg veins missed
2	Mrs M.J.	43	Sev.	x	6	15	Ent. relieved	Very successful	x					Very good result
3	Mrs K.R.	57	Sev.	x	8	15	"	"	x					Op. ligation. V. ulcer healed after first injection
4	Mrs D.T.	31	Mod.	x	3	14	Still pain	Very much improved		x			Minor L. leg	Eczema gone, pregnant. Still has pain
5	Mrs H.	40	Sev.	x	6	14	Alleviated	Improved				x	Major	Recurrence L. leg. Rt. leg good result
6	Mrs D.C.	—	Sev.	x	5	13	Ent. relieved	Very good	x					V. small vein missed
7	Mrs J.L.	30	Mod.		4	13	"	" "	x					Had ulcer from leakage, healed three weeks
8	Mrs M.W.	49	Sev.	x	6	13	"	V. much improved		x			Major	Pregnant. Prev. op. ligation. L. leg very good. Veins missed in R. leg
9	Mrs P.	33	Mod.	x	4	11	"	Successful	x					
10	Mrs I.S.	63	Mod.		2	10	No change					x		Had previous injections. Not satisfactory at time of injection. Since injected by Mr White
11	Mrs I.P.	36	Slight		2	9	Gone	Very successful	x					
12	Miss M.E.L.	34	Mod.		3	9	"	"	x					
13	Mrs P.M.G.	26	Mod.		2	8	Ent. relieved	"	x					Pigmentation persists along line of collapsed vein
14	Mr C.H.S.	30	Sev.	x	5	8	"	"		x			Major R. leg	Had phlebitis in thigh. Two weeks off work. Left leg very good
15	Mrs C.A.	33	Sev.	x	9	7	"	"	x					Emigrated Australia April 1969
16	Miss M.B.	41	Sev.	x	7	7	"	"	x					Had two courses of injections. Will have more later
17	Mrs P.R.	50	Sev.	x	5	6	"	"	x					Too fat
18	Mrs L.R.	27	Slight		3	6	"	"	x					Pregnant
19	Mrs S.R.	28	Slight		2	6	"	"	x					Pigmentation still noticed
20	Mrs J.C.	46	Mod.	x	7	5	Ent. relieved	Very successful	x					Prev. op. ligation
21	Mrs M.O.	41	Mod.		3	5	"	"	x					
22	Mrs J.S.	44	Slight		3	5	"	"	x					Vein in post. thigh not treated
23	Mrs P.	46	Sev.		2	5	"	"	x					Op. ligation 14 years ago
24	Mrs M.T.	28	Mod.	x	6	5	"	"	x					
25	Mrs J.C.T.	55	Sev.	x	6	4	"	"	x					
26	Mrs S.M.C.	26	Slight	x	3	4	"	"	x					Pigment present
27	Mrs M.C.W.	50	Mod.		2	4	"	"	x					Had previous injections
28	Mrs L.A.R.	45	Mod.		4	4	Alleviated	Improved	x					Three weeks off. Above knee phlebitis
29	Mrs D.R.S.	29	Mod.	x	3	4	Better	Better	x					Non-co-operation. Removed bandages after two weeks. Pregnant
30	Mrs I.A.	34	Slight		2	3	Gone	Very good	x					Two areas of 1 in. sclerosis

originally injected had disappeared but there was a small varicosity which had either been missed or had recurred and it was in this vein that the pain was felt).

An objective assessment was also made using the following criteria:

- A—*Good*. Veins effectively obliterated without residual or recurrent varicosities.
- B—*Satisfactory*. Treated veins effectively obliterated but with minor residual varicosities causing no concern.
- C—*Fair*. Treated veins effectively obliterated, but with varicose veins either missed at first treatment or newly developed which require further injection.
- D—*Poor*. Treated veins unchanged, major recurrence of new varicose veins, or recanalization of the injected veins.

Table II shows the results of this objective assessment:

TABLE II

				<i>Percent</i>
A	Good result	19	79.92	
B	Satisfactory	5		
C	Fair (requiring further treatment)	3	9.99	
D	Poor	3	9.99	

Discussion

Assessment of the results of any form of treatment of varicose veins is difficult since the assessment standards vary so much with different observers and there are no entirely satisfactory criteria. Furthermore, results must be considered in relation to the time interval since completion of treatment, for varicosity of veins is liable to recur and it could well be appropriate to speak of a five-year-cure rate as we do in assessing cancer treatment. Fegan (1967), in a survey in 1963 of 1,171 patients treated at his clinics in Dublin between 1956 and 1961, found that 81.8 per cent of the patients showed satisfactory results and considered themselves cured.

This paper can only be regarded as a preliminary report, since 11 of these patients have only been observed for less than six months since the completion of treatment. The most that one can claim is that the immediate effect of treatment has been satisfactory, in 80 per cent of the patients treated. It seems inevitable that some of these patients will relapse, and some will require further treatment. Of the eight patients observed for 13 to 15 months after completion of treatment, four remain satisfactory, two are greatly improved but require further treatment and in two the result is poor, but these were the first patients treated by an inexperienced operator using a new technique for the first time and, to some extent, this may be reflected in the results.

Cases 1 and 5 are classified as poor results, though initially the results seemed to be good and both patients agree that their symptoms are improved. When seen recently, in each case the veins were satisfactory in one leg, but there had been major recurrence in the other leg or it is possible that veins were missed at the first treatment which have since become much worse. In case 10, which was a complete failure, the injections were known to be unsatisfactory at the time they were given, there being difficulty in localizing the incompetent perforators, and considerable difficulty in giving the injections, since the small veins seemed to collapse as soon as they were touched by the needle, and one was hesitant about injecting sclerosant unless the needle was known to be in the lumen of the vein.

With two exceptions, the treatment of these 30 patients caused no pain or major inconvenience and 28 patients were able to continue work or their normal occupations. In two patients (cases 14 and 28) painful, hard sclerosed veins developed above the knee extending for some four inches up the thigh, though no injections had been given above the knee. These slowly subsided and the end result was satisfactory in case 28, good in one leg in case 14, though in the other leg major veins had not been dealt with, and further injections are required. These two patients had respectively two and three weeks off work. It is thought that in both these cases, the complication was due to faulty technique, since in both patients we failed to incorporate a piece of sponge rubber in the top of the bandage, and the tight bandage immediately above the knee caused stasis and clotting of the blood in the veins above.

The only other complication noted was that in one patient a small painless, punched-out ulcer, the size of a shilling, developed at the site of an injection (case 7). This was thought to be due to injection of sclerosant outside the vein. It was treated by continuous compression with sponge rubber and healed with minimum scarring in three weeks.

In addition to the cases reported above, a further 15 patients have been treated or are under treatment. The experience gained in treating 45 patients by the Fegan method justifies some comment on the actual technique of treatment. First, we must admit to some difficulty in identifying incompetent perforators, especially in the earlier cases, though even now cases are encountered where the deep fascial orifices described by Fegan are not found. Our experience suggests that in such cases, the most reliable method is to occlude the suspected sites with the fingers when the veins are empty (patient lying down), then maintaining pressure whilst the patient stands and releasing the digital pressure from below upwards and watching for refilling of the varicosities. (See para. 3—identification of incompetent perforating veins). Reid and Rothnie (1968) also recognize this difficulty in their report on the treatment of 1,317 legs by compression sclerotherapy. They suggest that "the number and significance of perforator leaks have been overstressed", and that the success of Fegan's treatment lies in the immediate and continuous compression of the injected varicose vein. They have therefore modified their technique by using multiple injections placed at intervals along the varicose veins (with continuous compression), so producing a diffuse sclerosis. We should have thought that diffuse sclerosis would be unsightly, but Reid and Rothnie claim that nine out of ten of their patients were satisfied with the result and objectively successful. They do not give the length of time since treatment was completed, and if Fegan is correct in his beliefs, there may be danger of the veins re-canalizing. On the other hand, our successful patients show a small area of sclerosis, often one inch or less, with complete disappearance of the vein below this area.

We found that where the incompetent perforators were widely separated it was usually possible to give three or four injections at one session, and often to complete the treatment required for that case. But where the perforators were close together, injection of the lowest often led to collapse of the vein above which precluded further injections, since there was then no method of ensuring the needle was in the vein.

Some difficulty was experienced in maintaining the bandages in place, especially with veins in the lower part of the thigh. Our patients were instructed to report to the practice nurse if they had any difficulty, so that she could reapply them without interruption of the continuous pressure. We also found it helpful to secure the pressure pads in position by a small piece of adhesive tape, and where the treatment extended into the thigh to use elastoplast over the top of the crepe bandages to secure the upper turns of bandage.

As a general rule, we found the larger, severe cases easier to treat than the smaller, not so severe varicosities. One patient, who had a small resistant varicose ulcer which had been present for over a year, reported that the ulcer healed within two weeks of the

first injection (case 3). No change was noted in the appearance of the skin in those patients who had marked pigmentation along the line of the varicose vein.

It is our impression that we have been too conservative in the number of injections given, especially in the patients first treated. Some veins were certainly missed in the early patients and it seems important to try and deal completely with all the veins showing varicosity. Finally it is essential to continue follow up, for almost inevitably small veins may be missed at early sessions and these tend to develop into larger varicosities unless the associated perforator is dealt with. Fegan recommends follow up for five years. We are now asking our patients who have completed their treatment to report in six months.

The advantages of this method of treatment are considerable. The patient can be treated in the surgery by any general practitioner willing to study the technique. It requires no special equipment other than a few all-glass syringes, disposable needles, and a sheet of sorbo rubber; the sclerosant, stockings and bandages are all prescribable on an EC 10. For the patient there is no interference with normal routine, and the treatment is virtually painless. Compared with the surgical method of treatment, the saving in consultants' time and hospital beds is considerable. The patient is saved a long period without treatment whilst waiting for a hospital bed. Reid and Rothnie calculated the cost of this method of treatment in the outpatient department as being one fifth the cost of one week's inpatient surgical treatment.

The results obtained by both Fegan (who has now treated over 10,000 patients) and Reid and Rothnie are over 80 per cent successful. This compares favourably with the best results of radical surgery, and the mortality is nil. It is unquestionably better than the results obtained by the older methods of injection. No one would claim that the method described is the complete answer to the treatment of varicose veins but it is a significant advance in the treatment of this common condition and our own preliminary results have convinced us of the value of continuous compression sclerotherapy.

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The first outbreak of influenza due to the Hong Kong variant of the A2 virus in a general practice in Cirencester lasted 13 weeks but attacked only four per cent of the practice population. Successive cases in households always occurred within ten days of the preceding case.

The reason for the relative smallness of the epidemic is unknown. Positive isolation of HK virus was obtained in about two thirds of all cases of 'febrile respiratory disease' occurring during the peak three weeks of the epidemic.