THE AETIOLOGY OF GRAVITATIONAL ULCERS OF THE LEG

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The term "gravitational ulcer," first used by Dickson Wright (1931), refers to those chronic ulcers which occur on the lower half of the leg associated with one or more of the following: oedema, cyanosis, induration, sclerosis, pigmentation, loss of hair, eczema, and varicose veins of the affected limb. These are signs of chronic impairment of the venous drainage of the leg. The importance of gravity in the cause of this condition was stressed by Brodie (1846) and by Hilton (1863). Brodie called such ulcers "varicose," and they have long been thought to be due to varicose veins. Gay (1868) was probably the first to show, by clinical observation and careful dissection, that many were due to obstruction of trunk veins, deep and superficial, and that varicose veins often play no part. Gay's work seems to have been forgotten or has been neglected, and the view that varicose veins are the main or only cause has persisted (McPheeters, 1928). Dickson Wright (1931) and Homans (1939) held this opinion, though both believed that some gravitational ulcers were due to thrombosis of deep veins. However, in a series of 432 patients with leg ulcers Birger (1941) found that thrombosis was the chief factor. Nilzén (1945) thought that certainly 41% or possibly 56% of such ulcers were caused by previous thrombosis, Bauer (1946) that 80–90% and Birger (1947) that 40% were due to this cause.

The belief that varicose veins play a major part in the aetiology of these ulcers has affected treatment, which until the last few years has concentrated attention on such superficial varicose veins as might be present.

Allen, Barker, and Hines (1946) considered that chronic venous insufficiency or stasis of the venous blood flow was due to obstruction of one of the main veins of the limb, particularly the ilio-femoral, as the result of thrombophlebitis, neoplastic invasion, or external pressure; incompetency of valves of the ilio-femoral vein resulting from thrombophlebitis without permanent obstruction of the vein; or varicose veins of primary type (i.e., developing spontaneously), particularly those of long standing or considerable extent.

The chief manifestations of chronic venous insufficiency are in the skin and subcutaneous tissue, and are thought to result from venous stasis rather than from increased venous pressure. As a result of stasis the venous blood has a low content of oxygen and a high content of carbon dioxide and other products of metabolism (Dickson Wright, 1931). The nutrition of the tissues is impaired and oedema and necrosis may result. Ulceration of a limb with venous stasis may occur at the site of a local thrombosis of small superficial veins or it may follow trauma with broken skin. The healing power of the poorly nourished tissues is affected and trauma may not be followed by repair. Hence ulceration is a common complication of chronic venous insufficiency. Infection plays little or no part in ulceration (though it may cause thrombosis). There is no relation between the type of infection or the bacteria in the ulcerating area and the slowness or rapidity with which the ulcer heals. Those ulcers which heal most rapidly often contain the most bacteria (Löwenfeld, 1924).

The importance or otherwise of varicose veins in causing chronic venous insufficiency and ulceration is still a matter of dispute. Certain it is that many individuals with severe varices do not suffer from either. Furthermore, patients with chronic venous insufficiency and ulceration of the legs are seen not uncommonly with no varicose veins visible or palpable.

The venous circulation of the limbs can be investigated by clinical examination, including the patient's history, the condition of the limbs, certain special tests (the Brodie–Trendelenburg, Perthes's, etc.), phlebography, venous pressure estimations, examination of veins after surgical removal, and post-mortem dissection.

Present Investigation

This investigation was undertaken to try to determine the cause of ulceration in a series of 270 unselected patients examined and treated personally. The methods employed were clinical, with phlebography in a few patients.

The term "thrombosis" is used here to denote thrombosis of one of the deep veins of the lower limb, and is assumed to have taken place if there is a history of chronic oedema of the leg of sudden onset, with or without pain and tenderness in the calf and with other signs of persistent venous stasis. Symptoms of pulmonary embolism at the onset and the appearance of varicose veins soon after are taken to indicate that thrombosis occurred.

There were 192 female and 78 male patients. Their ages at the onset of ulceration varied greatly. One woman who had suffered from osteomyelitis of the left leg when aged 3 first developed an ulcer in that leg after slight trauma at the age of 13, and another first developed an ulcer at 17 years while suffering from congenital haemolytic icterus. Ulceration occurred in one youth of 17 a year after a Trendelenburg operation. Most ulcers appeared during the fourth and fifth decades, but in one patient not until the eighth.

Family History.—Patients were questioned about the presence of varicose veins or ulceration of the legs in their parents, brothers, sisters, or children. Twelve patients were uncertain and 140 (54%) of the rest gave a positive family history.

Illustrative Cases.—Three sisters (unmarried) had gravitational ulcers. Their mother, one of their four brothers, and another sister (married, with five children) had ulcers. Four other sisters were unaffected.

A tram driver had gravitational ulcers. Both his parents had varicose veins and two maternal aunts had ulcers.

Heredity may play a part in the aetiology of ulceration of the legs associated with purpura haemorrhagica, sickle-cell anaemia, congenital haemolytic icterus, splenic anaemia, Gaucher's disease (Witts, 1942), or Cooley's anaemia (Estes, Farber, and Stickney, 1948); otherwise its importance in this condition is not well established. Weber, Rast, and Lutteroti (1930), however, described chronic ulceration of the legs following pneumonia in a man of 25 with thromboangiitis obliterans whose father had suffered from similar ulcers, and Carleton (1948) showed a striking family history in two sisters with varicose ulcers. Congenital absence of valves in the veins of the leg as described by Eger and Casper (1943) and Curtis and Helms (1947) may be important in relation to inheritance. Weber (1948) wrote that there certainly is a constitutional tendency to ulcus cruris in some families.

Occupation.—Table I shows the occupations followed at the time ulceration appeared. It will be noted that very

TABLE I.—*Occupation*

Men (Total 78)		Women (Total 192)	
Standing		*Standing*	
Fitter or driller	10	Housewife	132
Labourer	8	Shop assistant	14
Farmer	5	Weaver or spinner	11
Shop assistant	4	Office cleaner	5
Warehouseman	4	Canteen worker	5
Joiner	3	Cook or kitchen worker	5
Gardener	2	Hoffman presser	3
Boiler fireman	2	Tailoress (half sitting)	3
Painter	2	Barmaid	2
Boot repairer	2	Landworker	2
Tailor's cutter	2	Hairdresser, laundry hand, varnisher, 1 each	3
Tailor's presser	2		
Baker, bricklayer, circus hand, cleaner, compositor, cook, dentist, engineer, fur cutter, grinder, hairdresser, laboratory attendant, miner, motor mechanic, music-hall artist, optical instrument maker, paper maker, plate-layer, porter, roller coverer, scourer, shoeing smith, steward, tea blender, tram driver, tram conductor, washhouseman, watchman, 1 each	28		
Total	74	Total	185
Sitting		*Sitting*	
Unspecified	2	Unspecified	3
Clerk	2	Office worker	2
		Printer	1
		Mender	1
Total	4	Total	7

few patients had sedentary jobs, and that many worked standing with little activity as in fitting, drilling, shopkeeping, weaving, and spinning. Although many miners attend this hospital, only one was seen with a gravitational ulcer. Constant muscular effort while working, standing, kneeling, or lying may prevent venous stasis.

Child-bearing.—Of the 192 women, 37 (19%) were nulliparous. The remaining 155 had 1 to 15 children each (mean 4.1).

Weight.—Obesity has been thought to be of importance in relation to gravitational ulcers (Dickson Wright, 1931; Heller, 1943; Mahorner, 1949). The weight of patients in this series varied between 45 and 132 kg.: a distribution curve is shown in Fig. 1. Nine men and 29 women weighed more than 89 kg., and, of these, four men and twelve women weighed more than 100 kg. One woman weighed 132 kg. It would appear that in the majority of patients with ulcers obesity plays no part in the aetiology.

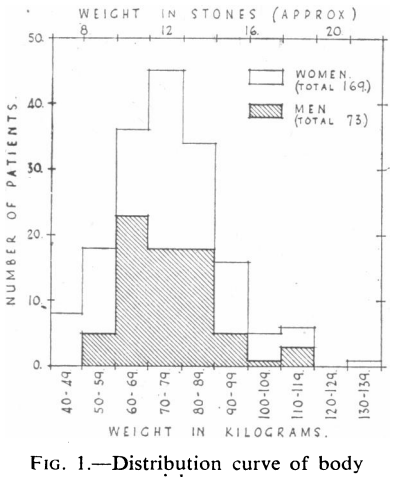

FIG. 1.—Distribution curve of body weight.

Blood Pressure.—The blood pressure of 69 men and 172 women was determined. The readings of the women were classified in age groups. The number with systolic pressures above 140 mm. and diastolic pressures above 90 mm. is shown in Table II, with the total in each age group, in order to compare the results with the figures given by Robinson and Brucer (1939) based on a group of 3,405 American urban women taken at random. The proportion of ulcer patients with hypertension is significantly higher than in the control group. The men with ulcers formed a group too small for conclusions to be drawn from their blood-pressure readings.

TABLE II.—*Proportion of Women with Hypertension (172 Patients)*

Age Group:	25–9	30–4	35–9	40–4	45–9	50–4	55–9	60–4	65–9	70–4
Total in group	3	4	13	17	20	30	28	32	12	13
Systolic hypertension:										
No. in group	0	1	2	9	9	17	19	28	10	11
Percentage of group	—	—	15·3 (5·4)	52·9 (12·3)	45·0 (20·9)	56·6 (21·4)	67·8 (37·6)	87·5 (46·5)	83·3 (57·2)	84·6 (71·4)
Diastolic hypertension:										
No. in group	0	1	2	5	5	11	14	21	10	9
Percentage of group	—	—	15·3 (5·1)	29·4 (9·1)	25·0 (11·5)	36·6 (10·9)	50·0 (19·9)	65·6 (22·5)	83·2 (26·0)	69·2 (12·5)

The figures in parentheses are those of Robinson and Brucer, 1939.

Concurrent Disease.—The following diseases were present in addition to ulceration: pernicious anaemia in one patient, severe anaemia secondary to menorrhagia in one, congenital haemolytic icterus in one, diabetes mellitus in four, hyperthyroidism in one, hypothyroidism in one, thrombophlebitis migrans in one, Paget's disease (osteitis deformans) in two, and syphilis in two. The ulceration of the legs of the last two patients had none of the characters of syphilitic ulceration, and antisyphilitic treatment did not cure the ulcers. The Wassermann reaction was also determined in 68 other patients, and was negative. Some of the aetiological factors as disclosed by the history in the present series are shown in Table III.

TABLE III.—*Aetiological Factors in Patients with Gravitational Ulcers*

	Men	Women	Total
Thrombosis of deep veins:			
1. Post-partum thrombosis	—	69	69
2. Ante-partum thrombosis	—	15	15
3. Conditions affecting the leg:			
Injury without fracture	26	34	60
Injury with fracture	6	5	11
Operation on a leg	2	4	6
Infection of the leg	7	8	15
Treatment of varicose veins	8	7	15
4. Unknown causes	8	11	19
5. Recumbency or inactivity:			
Medical illness	5	7	12
Operation (not on leg)	5	7	12
6. Miscellaneous causes	5	3	8
7. "Silent" thrombosis (proved)	0	1	1
Total	72	171	243 (86·6%)
Venous stasis with no history of thrombosis:			
1. Varicose veins as only cause found	5	24	29
2. Miscellaneous causes	1	1	2
Total	6	25	31 (11·4%)
Grand total	78	196	274

Note.—Four women are entered in more than one group.

Stasis due to Thrombosis of Deep Veins

1. Post-partum "White Leg"

Sixty-nine (36%) women gave a history of post-partum "white leg" (phlegmasia alba dolens)—28 after the first confinement. In the remainder the "white leg" occurred after confinements varying from the second to the thirteenth. Most of the women were multiparae (mean 3.9 confinements), and in six "white leg" occurred after two confinements; in one patient it occurred three times. The mean age at which thrombosis took place was 30.2 years (variation 19 to 46 years). In 27 patients the thrombosis was bilateral and in the others it occurred slightly more commonly on the left side. Only 13 women developed "white leg" after a normal confinement, and one of these got up on the third day, "white leg" developing soon after. Intervention with forceps took place in 18 patients, severe post-partum haemorrhage in 12, a long labour in five, twins in three, abortion at seven months in two, toxaemia of

pregnancy in two, malposition in two, retained placenta in two, ante-partum haemorrhage in one, and triplets in one. Details of other abnormal confinements were not obtained. Matthew (1947) mentioned the raised incidence of "white leg" with high forceps deliveries and stressed the role of infection in some cases. The first ulcers in the present series occurred three months to 27 years after the "white leg" (mean 8.9 years).

Illustrative Case.—This patient was delivered of her only child at the age of 25. Details are not available, but she says that it was a difficult labour and forceps were used. A few days later she had "white leg" and "pneumonia" (probably pulmonary embolism). The swelling of the legs persisted, and ten years later, following slight trauma, the first ulcer developed. There was no family history of varicose veins or ulcers of the legs. Her weight was 85 kg. No varicose veins were found on examination, but the legs were oedematous, indurated, and pigmented over the lower halves.

2. Ante-partum Thrombosis

Fifteen patients gave a history of pain and swelling of one or both legs of sudden onset during pregnancy. Oedema of the affected legs persisted and some of the patients developed varicose veins for the first time. It is assumed that thrombosis of the deep veins of the leg had occurred, and in seven patients ulceration of the leg followed within a few weeks. Ante-partum thrombosis is well recognized as a complication of pregnancy, but, as Matthew (1947) pointed out, it is less frequent than post-partum "white leg."

Illustrative Case.—A spinner had bilateral varicose veins from the age of 18. Her mother also had varicose veins. At the age of 44, at about the sixth month of her eighth pregnancy, she developed "white leg" (left). She spent the remainder of the pregnancy in bed. An ulcer of the left leg appeared a few months later. She weighed 97 kg. and her blood pressure was 240/110 mm. when she was examined at the age of 52.

3. Conditions Affecting the Leg

Injury to Leg without Fracture.—Sixty patients had suffered such an injury to one or both legs. The severity varied from that of a kick to that of a fall from a height, as from a roof or down stairs or through a floor which collapsed (three patients). Other injuries were due to a fall from a tram-car, a superficial gunshot wound of the leg, or wrenching an ankle; many were caused by mild blows such as walking against some firm solid object. In many the skin had not been broken. With most ulcers of the leg the precipitating cause is mild injury with abrasion of the skin. In the group under consideration, patients with a previous history of thrombosis of the leg in whom mild injury produced ulceration are not included. Only those with legs previously normal or with varicose veins with no evidence of chronic venous insufficiency are considered. Of these, 23 gave a history of swelling of the leg after the injury, probably due to thrombosis caused by the injury, and 10 developed varicose veins after the injury, possibly from the same cause. At the time of examination, when ulcers were present, 52 had varicose veins, which in several patients were in the injured leg alone. Slight or moderate injury to the leg with laceration, soft-tissue wounds, or simple haematoma may result in thrombosis. Vance (1934) investigated thrombosis of the veins of the lower extremity and pulmonary embolism as a complication of trauma. He found that even minor injury to the leg may result in thrombosis. Homans (1934), Bauer (1944), Birger (1947), and Mahorner (1949) are in agreement with this view. In Bauer's patients the presence of thrombosis was confirmed by phlebographic examination.

Illustrative Case.—A grinder in good health was injured at the age of 32 by a severe blow from an iron girder which fell against his right leg. There was no fracture and the skin was not broken. Swelling of the leg followed. Varicose veins appeared for the first time, and a year later there was ulceration of the affected leg. At the age of 34 the varicose veins were ligated, but the ulceration was not improved. The Wassermann reaction was negative. His father had suffered from ulcers of the leg.

Injury to the Leg with Fracture.—This had occurred in 11 patients—affecting the tibia and fibula in six, the femur in two, the patella in one, and the ankle (fracture-dislocation) in two. Both direct injury to a vein and immobilization of the limb may have been factors in causing the thrombosis which followed. Ulceration occurred in a period varying from one month to 26 years (mean 4.8 years) after the fracture.

Illustrative Case.—A married woman sustained a fracture-dislocation of the right ankle at the age of 37. The leg was immobilized in plaster-of-Paris for three months, after which it was found to be oedematous and discoloured. These signs persisted, and one month after removal of the plaster ulceration of the leg occurred. There was no family history of ulcers or varicose veins.

Operation on a Leg.—Six patients had undergone operation for knock-knee, for hammer-toe, for deformity of the tibia in Paget's disease, for tuberculosis of bone, for osteoarthritis of the hip, and for an unknown cause. In each patient thrombosis of the affected leg had followed the operation, ulceration occurring later.

Infection of the Leg.—Fifteen patients had infection of the leg in various forms causing thrombosis: osteomyelitis (2—one of the tibia and one of the patella), septic wounds of the leg (12), and abscess of the ankle drained with tubes (1). One of these patients was a diabetic. Ulceration followed the infection in a period varying from a few weeks to 11 years (mean 4.1 years).

Illustrative Case.—A motor mechanic aged 57 caught his left ankle against a sharp piece of metal, an abrasion resulting. This healed, but two weeks later an abscess formed at the site of injury and burst, discharging pus. At the same time the whole leg became swollen, with deep tenderness in the calf. He attended the clinic five months later with an ulcer at the site of the abscess and with oedema and discoloration of the leg. The other leg was normal except for varicose veins, which were prominent in both legs.

Treatment of Varicose Veins.—This appeared to be the cause of ulceration in 15 patients, including two in whom the injection of varicose veins was carried out during pregnancy. In two others thrombosis of the leg had occurred previously, in one after a fracture of the patella and in another after a fracture of the humerus which required rest in bed. Injection of varicose veins seemed to intensify the chronic venous insufficiency already present in these patients and to produce it in the remainder. Ulceration of the legs concerned resulted within a few months. The risk of thrombosis of deep veins after the injection of sclerosing fluids into superficial varicose veins, especially above the knee, was stressed by Boyd and Robertson (1947). In three of the patients in the present series varicose veins had been injected at the same time as the internal saphenous vein was ligated, ulceration following within a few weeks. In none had phlebography been carried out to determine the state of the deep venous circulation of the legs before injection of the varicose veins.

Illustrative Case.—A married woman suffered from "white leg" (left) after her first confinement at the age of 28, when forceps were used. Varicose veins followed, and these were

injected eleven years later. The left leg became even more oedematous, and ulceration occurred shortly after. Her mother had suffered from varicose veins and ulcers of the leg.

4. Thrombosis of Unknown Cause

Thrombosis in the legs from no apparent cause occurred in 19 patients. In several the condition had started in superficial veins, but all gave a history of marked oedema of the affected leg, with pain in the calf in some, which suggests that the deep veins were involved. Thirteen patients had a family history of varicose veins or ulcers of the legs. Phlebography confirmed the presence of thrombosis (of the femoral vein) in one patient.

Illustrative Case.—A nulliparous woman weighing 76 kg. and living an active life suffered from phlebitis of a superficial vein of the left calf for no apparent reason at the age of 36. Within a few days the leg became greatly swollen and pulmonary embolism occurred. Shortly after this the right leg also became swollen. When she was able to walk the oedema increased and ulceration near the left ankle followed. Her mother had suffered from varicose veins and ulcers of the leg.

5. Thrombosis due to Recumbency or Inactivity

Medical Illness.—Some illness, the disease itself or the rest in bed necessitated by it, had caused thrombosis of the legs in 12 patients. In three it was said to have been influenza, in two bronchitis (one with pleurisy), and in two lobar pneumonia. Rheumatoid arthritis with many months in bed, pyaemia following a carbuncle, tonsillitis, scarlet fever, and pyrexia of unknown origin were each responsible in the other patients.

Illustrative Case.—A baker whose mother had varicose veins developed scarlet fever at the age of 17. Three weeks after the onset, while in bed, thrombosis of the left leg occurred. There were no other complications of scarlet fever. An ulcer of the same leg appeared a few weeks later when he got up. The Wassermann reaction was negative.

Operations not on the Leg.—Twelve patients gave a history of "white leg" appearing shortly after an operation. Of these, nine had undergone an abdominal operation—two for appendicectomy (one with drainage), two for removal of ovarian cysts, one for cholecystectomy, one for hysterectomy, one for pelvic abscess, one for abdominal hernia, and one for an operation following an injury, the details of which are not known. Two patients had undergone left inguinal herniotomy and one a perineal operation of unknown type on the bladder for retention of urine. Allen, Barker, and Hines (1946) showed that post-operative thrombosis is more common after pelvic operations than after any other procedure, and more common in the left leg than in the right.

Illustrative Case.—A railway plate-layer underwent an operation for left inguinal hernia at the age of 37. Five days later he suffered from pulmonary embolism and shortly afterwards his left leg became swollen. Ulceration of the leg occurred a few weeks after he got up.

6. Thrombosis due to Miscellaneous Causes

Thrombosis of the leg occurred in a woman aged 29 during intravenous therapy with glucose-saline for hyperemesis gravidarum. An ulcer of the ankle followed at the site of injection. The risk of this complication of intravenous therapy when given at the ankle is now recognized.

A woman weighing 117 kg. had varicose veins for years, for which several injections with sclerosing fluids had been given. Thrombosis and ulceration followed a second-degree burn of the right leg. In another woman, aged 59, these followed a scald of the leg.

A miner aged 39, in bed on account of a slight injury to his back, had a thrombosis of the right leg, and ulceration occurred when he got up. He had injured his right groin when 27 years old and some swelling of the leg had followed.

A joiner aged 57 fractured his pelvis. Thrombosis and ulceration of the right leg followed. His mother had varicose veins and his brother an ulcer of the leg.

A farmer, when aged 22, had both legs severely bruised by a riding accident and varicose veins appeared. A year later Trendelenburg's operation was carried out bilaterally, marked swelling of the right leg occurring afterwards. At the age of 24 the varicose veins, which had reappeared, were injected with sclerosing fluid. Ten years later he fractured his right femur, the limb being immobilized for ten months with a plaster spica. Shortly after the plaster was removed the first ulcer appeared. The Wassermann reaction was negative. There was no family history of varicose veins or ulcers.

A labourer aged 58 had no family history of varicose veins or ulcers. When aged 27, while wearing puttees in the infantry, thrombosis occurred in the right leg with much swelling and aching. Varicose veins appeared for the first time, with ulceration, after a few months.

A Czech fur-cutter, a cigarette smoker, had suffered from thrombophlebitis migrans since the age of 21, with recurrent idiopathic thrombophlebitis of the superficial veins of the legs and right arm. No signs of arterial disease were present. There was marked venous stasis of the legs, with varicose veins. Ulceration first occurred when he was aged 31. His Wassermann reaction was negative and his weight 74 kg. His father and sister had ulcers of the legs.

7. Silent Thrombosis

When a patient has venous stasis, with no history of thrombosis, a silent thrombosis may be suspected if there has been pulmonary embolism; otherwise it may be indicated by phlebography, by surgical exploration, or by post-mortem examination. In this series, in those patients with no history of thrombosis, phlebography was carried out in only one, and of the others some may have had a silent thrombosis.

Illustrative Case.—The mother of 13 children, weighing 82 kg., had bilateral varicose veins for many years, and these were injected when she was 42. Her sister had ulceration of the leg. There was no history of thrombosis at any time and she had never been in bed on account of illness of note or operation, nor had she suffered any injury. The Wassermann reaction was negative. The first ulcer appeared in the right leg at the age of 51. Nine years later a phlebogram showed blockage of the deep veins of the right thigh near the knee.

Venous Stasis with No History of Thrombosis

In addition to the patient mentioned above there were others with no history of thrombosis.

1. Venous Stasis due to Varicose Veins

There were 29 patients whose venous stasis and ulceration might have been due to varicose veins. Of these, 24 were women, of whom 17 were parous. In the whole group the family history of two was uncertain, but 17 of the remaining 27 gave a family history of varicose veins or ulcers of the legs or both. The age at which ulceration occurred varied from 20 to 78 years (mean 45.4 years). All but one had suffered from varicose veins for many years before ulceration appeared, and the problem arises whether these are cases of true varicose ulcer—i.e., ulcer due to varicose veins—or whether they are post-thrombotic, the thrombosis having been symptomless. Some of these patients had ulcers "riding" over a vein, to use the description applied by Homans (1939) to true varicose ulcers. The possibility of previous thrombosis in the other patients remains. The question of varicose ulceration is discussed later, but even were it assumed that most of the patients

in this group suffered from varicose ulceration they represent less than 11% of the whole series.

A tram driver weighing 84 kg., with a striking family history of varicose veins and ulcers of the leg, had varicose veins from the age of 12. An ulcer appeared on the right leg when he was 20 and on the left leg when he was 26. There had been no history suggesting thrombosis. Bilateral injection of varicose veins with sclerosing fluid was carried out when he was 20, and ligation and injection of the veins when 26, on both occasions after the ulcers had appeared. The veins were injected again when he was 29. The Wassermann reaction was negative. The early ulcers in this patient would seem to have been true varicose ulcers.

A mother of five children, who had been a baker, developed varicose veins at the age of 26 while bearing her first child. There was no family history of varicose veins or ulcers. One of the veins burst when she was 42 and an ulcer formed at the site. The varicose veins were treated by operation soon after with no benefit to the ulcer, and were injected when she was 50. Tremendous swelling of the leg resulted, no doubt due to a thrombosis of deep veins. She now has calcification of the varicose veins, much induration of the legs, and diabetes. Her weight is 76 kg.

gravitational ulcer. The pathology of thrombosis will not be discussed here, as the subject has been fully reviewed by Allen, Barker, and Hines (1946), Zilliacus (1946), and Birger (1947). Causative factors may be slowing of the blood flow, alteration in the composition of the blood leading to an increased tendency to clot, and injury to the intima of the vein. The blood flow in a leg vein may be slowed by lack of muscular activity, by pressure on the vein from outside, and owing to defective venous valves. Thrombosis may take place with no apparent cause, as in 19 patients in this series.

Homans (1934) pointed out the importance of the deep veins of the calf as the site of origin of thrombosis in the lower limb. In two large series of cases of pulmonary embolism examined post mortem by Rössle (1937) and Neumann (1938) the calf or plantar veins were the site of thrombosis in the majority. This was confirmed by Putzer (1939), Frykholm (1940), Bauer (1941), and Hunter, Krygier, Kennedy, and Sneeden (1945). Only 10% of all thromboses in the femoral veins are not associated with deep thrombosis below the knee (Homans, 1943).

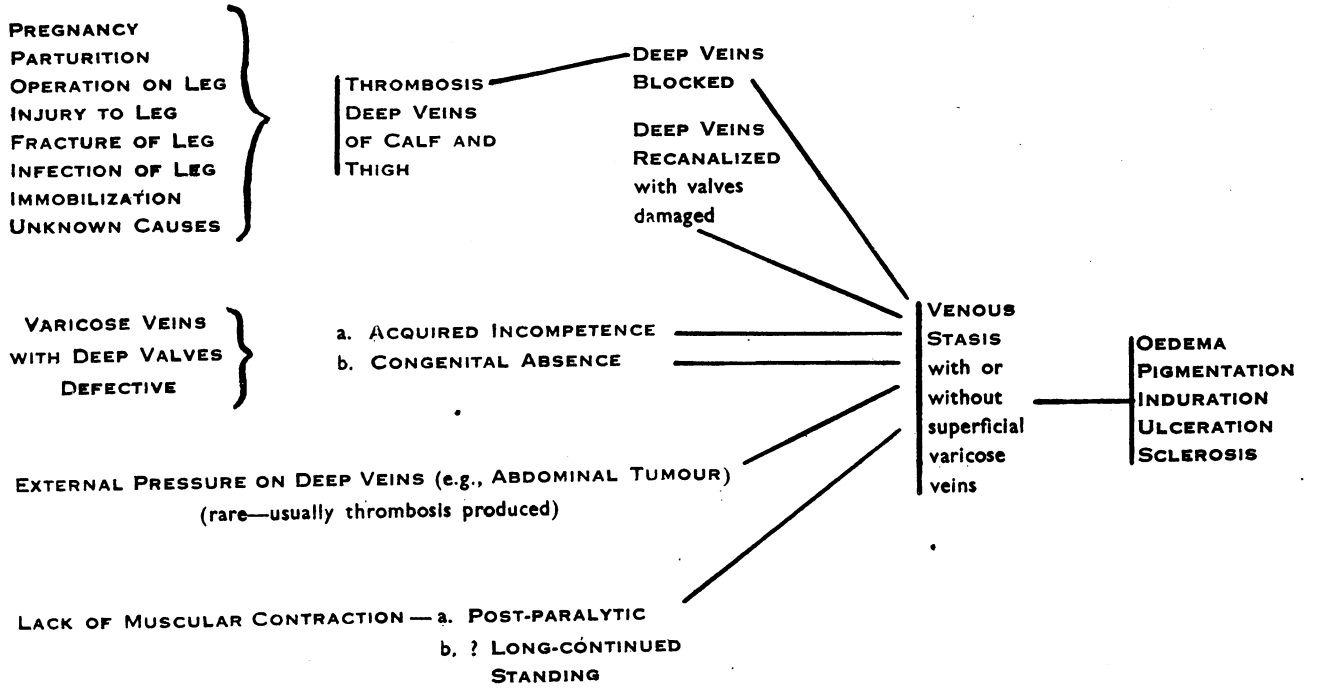

FIG. 2.—Causes of venous stasis in the lower limb.

2. Venous Stasis due to Miscellaneous Causes

A woman with congenital haemolytic icterus suffered from ulceration of the leg from the age of 17. Her mother and two sisters had ulcers of the legs.

A boot-repairer, whose mother had an ulcer of the leg, had suffered from acute anterior poliomyelitis as a child. His left leg was wasted and he wore a walking-calliper. A gravitational ulcer appeared when he was 26. No varicose veins were present and there was no history of thrombosis. The ulcer was probably due to venous stagnation caused by lack of muscular contraction in the leg.

Discussion

The causes of chronic venous stasis, and hence of gravitational ulceration of the leg, are summarized in Fig. 2.

Thrombosis of Deep Veins of the Lower Limb

This had been present in about 89% of patients in the series and seems to have been the most important cause of

Thrombosis in the veins of the calf may cause pain and deep tenderness (Homans, 1934; Boyd, 1948), but often a "silent thrombosis" has been demonstrated in patients with pulmonary embolism (Homans, 1943) and by phlebographic examination (Bauer, 1941). The absence of any history of thrombosis in a patient with gravitational ulceration is therefore no evidence that the latter is not post-thrombotic in origin, and probably only by phlebography or dissection can the point be settled in a particular case. It is possible that some of the patients in the present series with no history of thrombosis had suffered from a "silent thrombosis."

Thrombosis originating in the lower part of the leg tends to extend centrally, often into the ilio-femoral vein. As a result of such thrombosis the venous return from the lower limb is impaired, as Gay (1868) observed, the lumen of the deep veins being occluded, though sometimes not

completely. Periphlebitis secondary to an aseptic inflammation of the wall of the veins (phlebitis) may be present (Bauer, 1948). Later, recanalization of the thrombosed vein may take place, but the valves are permanently destroyed (Homans, 1917; Edwards and Edwards, 1937; Bauer, 1948). This recanalization and valve destruction in the popliteal and femoral veins leads to marked venous stasis in the lower limb when the individual is erect. Linton and Hardy (1948) believe that ulceration of the leg does not take place until the thrombotic veins have become recanalized, and that this may take from one to 29 years from the time of venous thrombosis.

Varicose Veins

These may usefully be considered as primary or secondary. The primary type develops spontaneously and is probably due to inherited weakness in the structure of the vein—dilatation of the vein leading to incompetence of the valves (Edwards and Edwards, 1940)—or to congenital absence of valves as described by Eger and Casper (1943) and Curtis and Helms (1947). The secondary type develops as the result of thrombosis of deep veins in the lower limb (Meyer, 1932), though if the latter has been "silent" it may be difficult to distinguish this type from the primary. Post-thrombotic ulcers may be associated with such varicose veins of secondary type.

Do varicose veins of the primary type lead to venous stasis and ulceration? Varices may occur, as Meisen (1932) pointed out, with stasis and without stasis, and stasis may occur without varices (as in 31 patients in this series). The two may be independent. Clinical experience suggests that primary varicose veins, sometimes quite severe, occur not uncommonly without venous stasis. However, stasis and ulceration may be found with primary varicose veins, and the condition is well described by Bauer (1948). A family history of varicose veins is usual, a history of deep thrombosis is absent, women are affected twice as often as men, a bursting sensation is present in the legs on standing, oedema and other signs of chronic venous insufficiency are present similar to those following thrombosis, but phlebography and operative exploration differentiate the conditions. Bauer (1948) believes that idiopathic or non-thrombotic femoral incompetence, as he names it, is due to deficiency of the valves of the femoral and popliteal veins caused by phlebosclerosis affecting the deep veins, and not merely the superficial veins as in primary varicose veins, without evidence of venous insufficiency. Probably a similar result is produced by congenital absence of valves in the deep veins (Eger and Casper, 1943; Curtis and Helms, 1947).

Thus with primary varicose veins ulceration may be present if there is congenital or acquired absence or incompetence of valves of the deep veins. Ulceration may be absent if only the superficial veins are varicose. Thrombosis may occur, however, in the deep veins of patients with the latter condition, following treatment of the superficial varices, or may be due to any of the causes which lead to thrombosis in an individual without varicose veins. A post-thrombotic ulcer may result. In the present series primary varicose veins do not seem to have been a cause of ulceration in many patients, as only 32 (11%) gave no history of previous thrombosis. Three of these did not have primary varicose veins, and of the others some may have had a "silent" thrombosis.

Venous stasis due to complete absence of muscular contraction is rare, only one patient in the series having gravitational ulceration from this cause (previous anterior poliomyelitis), but comparative lack of movement while standing at work may be a secondary factor of note in some patients with ulcers.

Arterial Disease

Gay (1868) and Heller (1943) considered arterial disease to be an important cause of some chronic ulcers of the lower part of the leg. More recently Hines and Farber (1946) have described ulceration of the leg due to arteriosclerosis and ischaemia occurring in the presence of hypertensive disease, with no other vascular or cutaneous disease. Although in the present series no ulcer was thought to be due only to arterial or arteriolar disease, the high proportion of patients with hypertension suggests that this condition may be a factor in the aetiology of gravitational ulcers. Obliterative arterial disease may occur without a rise in blood pressure. The presence of an arterial factor in the causation of some ulcers may account for the beneficial effect of sympathectomy in certain patients (Borrie and Barling, 1948).

The treatment of chronic venous insufficiency and ulcers of the leg will not be discussed here, but it is clear that to be effective an accurate diagnosis of the cause and a knowledge of the aetiological factors involved are important.

Treatment

In this country at the present time the concentration on treatment of superficial varicose veins in patients with venous stasis is neither rational nor useful, and the results, as shown in several patients in this series, may be appalling. More often than not it is harmful, increasing the degree of stasis already present. Progress will be achieved only by a better understanding of the essential causes of the condition. Measures to prevent thrombosis are important, and when venous stasis has appeared the continued use of elastic supports to prevent oedema is essential. Various surgical techniques, such as those of Bauer (1948) and Linton and Hardy (1948), require consideration.

Summary

A series of 270 patients with gravitational ulcer has been investigated. This type of ulcer results from chronic venous stasis of the lower limb. In 88.6% venous stasis was due to previous thrombosis of deep veins in the leg. Varicose veins may be present as a result of thrombosis, but primary varicose veins rarely cause venous stasis and gravitational ulcer. The futility of treatment of the condition by attention to superficial varicose veins is stressed.

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A NEW NEONATAL SYNDROME

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During the ten-months period December, 1946, to October, 1947, a new syndrome affecting infants appeared in the nurseries of the Birmingham Maternity Hospital. Eight cases were observed, the predominant feature being a circulatory disturbance in one or both lower limbs, while some cases in addition showed muscular weakness or palsy. The case incidence was sporadic, and on only one occasion was the interval between cases less than three weeks. The aetiology was unknown, and neither the medical nor the nursing staff could recall similar cases. Search for guidance in standard textbooks proved fruitless, and it was concluded that the syndrome must have been caused by some new factor, such as a new line of treatment, that had never before operated.

Case Reports

Case 1.—On April 6, 1947, a 60-hours-old infant was found to have a flaccid paralysis of the right lower limb with apparently complete sensory loss below mid-thigh; the leg was pale and cold and no arterial pulsation could be detected. The appearance suggested an embolism of the common femoral artery, but the exact time of onset was uncertain. Next day the foot was still pale and cold, but the calf showed a mottled cyanosis and in a short time the whole limb became warm and flushed. Patches of local discoloration persisted on the front of the leg, the heel, and great toe, and desquamation was followed by scab formation and a chronic ulcer over the anterior border of the tibia. At 1 month old there was still a small unhealed ulcer, and considerable weakness in the anterior tibial group of muscles. At 2 years old there was a pes cavus, a limp, and poor dorsiflexion of the foot.

In an attempt to elucidate the aetiology the obstetric history was checked in detail. The mother, a primigravida, had been treated in hospital from the 34th to 38th week of pregnancy for pre-eclamptic toxaemia. Labour had been induced surgically, but after three days' inertia delivery had been effected by lower-segment caesarean section under general anaesthesia. The child was asphyxiated at birth, and was resuscitated with oxygen and an injection of nikethamide into the umbilical cord. It weighed 5 lb. 3 oz. (2.35 kg.). It had not been delivered through the incision by traction on one leg, and no injection was recorded as having been given into the buttock. The only conclusion that could be reached was that spontaneous thrombosis or embolism of unknown origin had occurred in the main artery to the limb.

It was then recalled by the ward sister that a somewhat similar though more severe case had occurred a few months previously, and that the child had subsequently died.

Case 2.—On consulting the records it appeared that a child had been delivered spontaneously on Dec. 14, 1946, following surgical induction of labour at 37 weeks for disproportion in a primigravida; the second stage of labour had been prolonged to three hours, and the child, weighing 6 lb. 9 oz. (2.98 kg.), had been born in a state of white asphyxia. Its condition being critical, nikethamide followed by lobeline and a second dose of nikethamide had been injected into the umbilical cord without any immediate effect. Six hours later the right leg was seen to be cyanosed and flaccid, with some oedema of the buttock, and during the next day it became cold and anaesthetic. Gangrene of the extremity developed and the infant died on the eleventh day from peritonitis. Necropsy showed thrombosis of the right common iliac artery and also of the inferior mesenteric vessels; there was gangrene and perforation of the sigmoid colon.

No common aetiological factor could be deduced from these two cases, although it seemed probable that the one was a more severe variant of the other. However, the next three months produced five more cases which, although not so severe, presented sufficient similarity to those preceding to warrant grouping together.

Case 3.—A child was delivered on April 30, 1947, by caesarean section for placenta praevia; a general anaesthetic was used. The child was sleepy and asphyxiated at birth, and three injections of nikethamide were given into the cord before respiration was established. On the second day the left buttock was found to be discoloured and indurated as though severely bruised; there was no concomitant paralysis, and the condition resolved in a few weeks without ulceration. It could easily have passed unrecorded had the previous cases not stimulated interest and observation.

Case 4.—This child was seen on May 25. Labour had been induced at 37 weeks in a primigravida with a posterior position of the occiput, but there was an interval of three days before the onset of labour. Intrauterine infection developed, and eventually a small infant 5 lb. 3 oz. (2.35 kg.) was delivered in a state of white asphyxia. Nikethamide was injected into the cord, and recovery was uneventful until the third day, when an area of discoloration was noticed on the right buttock. This area was indurated as though severely bruised, and the overlying skin became necrotic, to produce an unhealthy ulcer which healed with difficulty in about a month. There was never any demonstrable paralysis.

Two further cases were recorded within 24 hours of each other three weeks later.

Case 5.—A baby born on June 18 was the second child of a woman aged 47; during a difficult forceps extraction of a 9-lb. (4-kg.) infant there was considerable delay in delivery of the shoulders, and the child was born in white asphyxia. Two doses of nikethamide were injected into the umbilical cord. Twelve hours later there was extensive discoloration of the right buttock and right side of the scrotum, and during the next two days the gluteal skin broke down to form an ulcer, and a tense hydrocele developed. Movements of the right lower limb were greatly diminished, and there was temporary palsy of the anterior tibial group of muscles. The gluteal ulcer healed in a month, and leg and ankle movements gradually returned to normal.

Case 6.—The coincident case was less serious. Labour had been induced at 37 weeks for disproportion in a primigravida, and an infant weighing 7 lb. 3 oz. (3.26 kg.) was delivered with forceps for foetal distress; its condition was only fair, and one injection of nikethamide was given into the cord. Three