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VENOUS INSUFFICIENCY AS A LATE COMPLICATION AFTER TIBIAL FRACTURE

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Thirty-eight patients were followed up 13 to 17 years after sustaining a fracture of the tibia. The aim was to establish the frequency of post-thrombotic venous insufficiency. All patients were examined clinically and with a modified ultrasound technique. In addition some were studied using phlebography. Fifteen patients had symptoms of venous insufficiency in the fractured leg. Seven had only local symptoms, while in the other eight the venous insufficiency was verified objectively. The following factors predisposed to the development of venous insufficiency: Age above 45 years at the time of trauma, a high energy trauma resulting in comminuted fractures, and a long immobilization period.

Key words: tibial fracture; venous insufficiency

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Lower limb fractures are often complicated by deep vein thrombosis. This is especially well documented in patients with hip fractures (Sevitt & Gallagher 1959, Culver et al. 1970, Field et al. 1972). The frequency of this complication has also been found to be high after fractures of the lower leg. Hjelmstedt (1968) found a high frequency of advanced post-thrombotic phlebographic alterations, and oedema in 11 out of 75 patients with lower leg fractures after an average follow-up time of 45 months. Apart from the Hjelmstedt study we have found no other long-term follow-up of this particular problem. The aim of this study was to make a retrospective follow-up examination of patients who sustained tibial fractures 13–17 years previously and to assess the frequency and clinical symptoms of venous insufficiency.

PATIENTS

During 1960–1964, 66 patients, 25 years of age and older, were treated for tibial fractures, including trimalleolar and medial condyle fractures. Thirty-eight patients were followed up. Of the remaining 28, 10 were not available and 18 could not be studied for reasons shown in Table 1. There were 23 males and 15 females. The mean age at the time of trauma was 49 years, range 25–79 years. Table 2 shows the fracture type according to conventional morphologic criteria. A further subdivision was made into fractures caused by low or high energy trauma (Edwards 1965).

Twelve patients had fractures in the upper third of the tibia, 9 in the middle third, and 17 in the lower third. Ten patients were treated conservatively with plaster of Paris and 28 were operated on. The immobilization period for trimalleolar fractures was 2–10 months (mean 5 months), for medial tibial condyle fractures 1–3.5 months (mean 2 months), and for the other fractures 2–25 months (mean 5 months).

METHODS

The mean follow-up period was 14.5 years (range 13 to 17). At the clinical examination subjective symptoms (heaviness, tiredness, paraesthesias and night cramps)

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Table 1. Patients not followed up

Fatal pulmonary embolism	2
Leg amputation (osteomyelitis)	1
Repeated fractures (muscular dystrophy)	1
Death	14
	18

Table 2. Fracture type and energy of the trauma

Fracture type	High energy	Low energy	Total
Comminuted	6	2	8
Transverse	9	5	14
Longitudinal	0	5	5
Trimalleolar	0	3	3
Medial tibial condyle	2	6	8
Total	17	21	38

and objective signs (superficial varicose veins, pitting oedema, brown pigmentation, skin induration, eczema and ulceration) were recorded. Classification was made into three groups:

Group 1. Local symptoms such as oedema and pain in direct connection with the fracture

Group 2. Suspected venous insufficiency (tiredness, coolness, leg pain and intermittent oedema)

Group 3. Venous insufficiency (pitting oedema possibly associated with brown pigmentation eczema or ulceration at the medial malleolus).

All patients were tested with an ultrasound blood flowmeter (Sonicaid BV 380), mainly according to Folse & Alexander (1970), Lewis (1974) and Hobbs (1977). The measurements were made with the patient in a standing position but without weight on the tested leg. Figure 1 shows a variety of ultrasound registrations. Manual calf compression (C) was followed by decompression (D) and registration was made initially over the popliteal vein. This test gives information regarding the draining flow from the leg veins and the reflux (R) indicating cusp insufficiency in the femoral vein (Figure 1a). Valsalva manoeuvre (V) and popliteal registration gives information as to whether or not there is a total cusp insufficiency from the heart and distally (Figure 1b). When registration is made over the distal posterior tibial vein behind the medial malleolus, reflux at calf compression indicates insufficiency in the lower leg veins (Figure 1c).

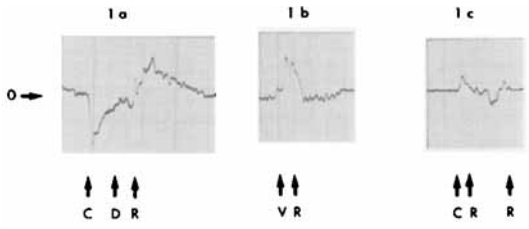

Figure 1. Ultrasound registration. Manual calf compression (C), Valsalva manoeuvre (V), decompression (D), reflux (R). Venous reflux gives rise to a positive curve, whereas venous emptying leads to a negative curve.
a. Cusp insufficiency in the femoral vein
b. Total cusp insufficiency from heart and distally
c. Cusp insufficiency in the lower leg veins

In 5 patients the clinical and ultrasound investigations were supplemented by ante- and retrograde phlebography; in another two only retrograde phlebography was performed.

On the basis of these investigations venous insufficiency was defined as

persistent or intermittent lower leg pitting oedema in connection with

ultrasound-registered venous reflux in the femoral vein passing the popliteal vein into the lower leg veins.

In some cases the presence of recanalized valveless veins in the upper and lower leg was verified by phlebography.

RESULTS

There were two cases of fatal pulmonary embolism, one of which was verified by autopsy. Another two patients had clinical intravascular coagulation, both having transverse fractures after high energy trauma. One patient had clinical

Table 3. Results at follow-up investigations in patients with clinical symptoms in the legs

Classification		Ultra sound positive	Venography positive	Ultrasound and venography positive	Total positive
Group 1	(n=5)	1			1
Group 2	(n=6)	1	1	1	3
Group 3	(n=4)	1		3	4
Total	(n=15)	3	1	4	8

signs of deep vein thrombosis and was treated with heparin and dicumarol.

At follow-up, 23 of the 38 patients had no symptoms or signs of venous insufficiency. In all these 23 patients the ultrasound investigation gave normal results. Table 3 shows the results in the 15 patients with symptoms. In 8 patients venous insufficiency was diagnosed by one or both of the objective methods used. Three patients had proximal fractures, 2 had middle fractures and 3 had distal fractures. The patient who had been treated for acute clinical thrombosis belonged to Group 3 with positive ultrasound-venography investigations.

Table 4 shows the leg symptoms in relation to the type of fracture. Patients who had sustained a comminuted fracture had a significantly higher frequency of venous insufficiency than the patients with the other fracture types ($X^2 = 7.50$, $P < 0.01$). Table 5 shows that high energy trauma, a long immobilization time and age above 45 years were significantly associated with venous insufficiency at follow-up.

Table 4. Leg symptoms and type of fracture

Type of fracture	Clinical symptoms: Venous insufficiency	Local symptoms	No symptoms	Total
Comminuted	5	1	2	8
Transversal	3	2	9	14
Longitudinal	0	1	4	5
Trimalleolar	0	1	2	3
Medial condyle	0	2	6	8
Total	8	7	23	38

Table 5. Venous insufficiency correlated to energy of trauma, immobilization time and age at trauma

	Energy of trauma		Time of immobilization (months)		Age (years)	
	High	Low	≥3	<3	≥45	<45
Venous insufficiency	7	1	7	1	7	1
No venous insufficiency	10	20	14	16	13	17
x^2	7.50		4.26		4.94	
P	<0.01		<0.05		<0.05	

DISCUSSION

There are very few studies on the frequency of deep vein thrombosis after tibial fracture. Venous lesions are immediately seen at the level of the fracture in the majority of cases (Hjelmstedt 1968, Spiegler et al. 1972, Nylander & Semb 1972, Preter et al. 1972), and in around 50 per cent of the patients (over 25 years of age) a thrombotic process develops (Hjelmstedt 1968). The frequency is rather constant in the various studies and of the same magnitude as after knee surgery for arthritis (Cohen et al. 1973).

One drawback of this study is that it is impossible to know the exact venous status of the patients at the time of fracture. (None of the patients had previously sustained a fracture.) The study shows the incidence of venous insufficiency in tibial fracture patients as a group, when a long time had elapsed after the trauma. Patients with deep vein thrombosis are mostly in the older age groups making long-term follow-up investigations difficult.

But tibial fracture is often seen in comparatively young, active people and the development of a venous insufficiency post-thrombosis in these patients can cause considerable problems.

The frequency of pulmonary embolism was in agreement with the studies by Hjelmstedt (1968) and Solonen (1963). Eight of the 38 patients (21 per cent) had venous insufficiency and this by far exceeds the incidence found by Gjöres (1956) for the Swedish population as a whole (2.1 per cent). For methodological reasons it is difficult to compare our results with those of Hjelmstedt who found *oedema* in 11 out of 75 patients. His follow-up time was rather short. The time taken for the development of post-thrombotic venous insufficiency is not known. Järvinen & Asp (1975) found that 3 years is an adequate follow-up period.

Stören & Auensen (1971) found roentgenological recanalization in about 85 per cent in

femoral thrombi 9 months after hip fracture. Two-thirds of these patients had persisting oedema or skin induration suggesting that a post-thrombotic syndrome had developed. Bergvall & Hjelmstedt, on the other hand, found the process of recanalization was slow in patients with tibial fractures (more than 3–4 years).

Becker et al. (1970) performed a phlebographic follow-up an average of 33 weeks after postprostatectomy deep vein thrombosis and found residual pathological findings in half of the cases. But they did not relate the phlebographic findings to clinical symptoms and the possibility of further regression must be kept in mind.

Shull et al. (1979) has clearly shown the importance of the popliteal cusp for a well functioning venous system whatever the status of the femoral vein and this cusp can perhaps be saved by prophylaxis.

A few minor studies have been performed after thrombosis diagnosed by the ^{125}I-fibrinogen test (Hedlund 1975, Browse & Clemenson 1974, Bergqvist & Hallböök 1979). Although the follow-up period was rather short post-thrombotic manifestations were already found in some patients. The follow-up period in the present study was much longer and should be sufficient for the development of a post-thrombotic syndrome. There have been no similar studies based on such a long follow-up time. Very little is known about the type of patients who develop the post-thrombotic syndrome. From our study some risk factors in connection with tibial fractures can clearly be pointed out: age above 45 years, high energy trauma with comminuted fracture, and long immobilization time.

Patients with tibial fracture are by tradition only seldomly given any prophylaxis against DVT. Pulmonary embolism is rare and mainly seen in old patients. This is confirmed both by this study and the one by Hjelmstedt. Moreover, "clinical thrombosis" is rarely seen. One such thrombus was treated in our series. Nonetheless a large number of patients develop objectively diagnosed post-thrombotic venous insufficiency, and this fact must lead to a new attitude to thrombosis prophylaxis in this category of patients. Trauma patients probably also constitute a special problem group as regards prophylaxis as their coagulation system has already been activated on arrival at hospital, before any treatment can be instituted (Bergqvist et al. 1979).

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