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Deep vein thrombosis in spinal cord injured patients

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In this study to determine the incidence of deep vein thrombosis (DVT) in spinal cord injury (SCI) patients, we evaluated 30 instances of bilateral ascending venography obtained in 31 patients. Every patient was on prophylactic low dose heparin anticoagulant therapy. The incidence of DVT was found to be 53.3%. Adverse effects due to venography were seen in 10% of patients. No major complications including postvenographic phlebitis and allergic reactions were observed.

Keywords: spinal cord injury; deep vein thrombosis; pulmonary embolism; bilateral ascending venography.

Introduction

Spinal cord injured patients are at high risk of DVT after injury. Watson observed that 74% of DVT occurred within the first month following injury.[1] Perkash and Chu reported that thromboembolism occurred at 150–160 days postinjury.[2–3] The incidence of DVT in SCI patients is estimated at 12–100% by various authors according to the methods of study used.[1–6]

The most dangerous complication of DVT is pulmonary embolism (PE), which varies from 8–14%, with a mortality rate of 2.5–4.7%.[2,4,7] Although early thrombi may form in the iliac and femoral veins the commonest site for the development of DVT is in the calf.[8,9]

Accuracy in the diagnosis of deep vein thrombosis is critical. Since however the accuracy of clinical diagnosis is unreliable and is no more than 50%, numerous different methods have been developed.[10]

In addition, DVT may be confused with a pathological fracture,[3] haemorrhage due to aggresive exercise[2,3] and heterotopic ossification.[11] Recently, duplex ultrasound and venous plethysmography have become more acceptable as noninvasive methods.[8,12,13] But both tests have some limitations.[14] Their specificity and sensitivity have varied from 70 to 95%, and both tests require skill and considerable practice to ensure a high degree of accuracy.[10,13–17]

Although venography has been criticised for being an impractical and painful procedure for patients and having at times certain complications such as local irritation, allergic reaction and postvenographic thrombus,[18,19] ascending venography is considered to be the best diagnostic study.[10] Its accuracy was proved by Hull *et al*, withholding anticoagulant therapy in patients with negative venography.[20] Additionally, all noninvasive techniques have been evaluated for accuracy compared with venography.[17,18]

Methods

This study included 31 SCI patients, 27 male and four female. Patients were transferred from the neurosurgical department of our hospital or from other hospitals. All patients were given 5000 units of prophylactic heparin subcutaneously every 12 hours. This treatment was maintained for 12 weeks from admission. No patient had been started on anticoagulant prophylaxis prior to admission to the physical medicine and rehabilitation department. Routine care of patients included turning them every 2 hours, exercise therapy both passive and active, and

chest physiotheraphy. Bladder and bowel management were carefully achieved.

Every patient was studied for the possibility of DVT as follows:

1 Physical examination for marked swelling and local hyperthermia.
2 Measurement of thigh and leg circumferences. A 2.5 cm difference between limbs was accepted as swelling. Thigh measurements were made 15 cm above and below the superior margin of the patella.
3 All patients underwent bilateral ascending venography. Venography was immediately performed when the patient had a 2.5 cm or more swelling in his/her thigh or calf or had hyperthermia in his/her lower limbs. If the SCI patients who were admitted 15 days or later had no clinical signs, their venographies were performed about the fifteenth day after admission. No patient underwent venography after beginning wheelchair activities.
4 All patients with confirmed DVT and clinical signs of DVT received standard curative anticoagulant therapy.

No patient was monitored for DVT in our hospital because noninvasive tests were not available in our institution during the study period.

The Rabinov–Paulin technique of venography was used.[21] The nonionic contrast solution (Iohexol) was given, 20–40 ml for one leg. On termination of filming, the patients were placed in slight Trendelenburg position and normal saline solution was infused for approximately 5 minutes. Venograms were interpreted blindly and separated by two of the authors (EO and IS). Five radiographs, having different interpretations, were evaluated by EO and IS together and a final decision was reached.

All patients were kept under observation and control at the physical medicine and rehabilitation department following venography until they were discharged.

DVT was diagnosed if there was an intraluminal filling defect or a nonfilling venous segment that was present in all films. If a part of the deep venous system was poorly visualised despite repeated examinations, the venogram was classified as inadequate.[21]

Direct radiography of the limbs was also done and haemoglobin, haematocrit and alkaline phosphatase levels were studied in every patient in order to exclude a pathological fracture, intramuscular haemorrhage due to aggressive exercise and heterotopic ossification.

Results

Number with adequate venography

Attempts to demonstrate bilateral ascending venography were made in 31 patients. The veins of one patient were impossible to cannulate due to serious spasticity and this patient was excluded. The remaining 30 pairs with venography were considered to be satisfactory for study.

Incidence

DVT was found in 16 out of a total 30 patients (53.3%).

Localisation

A total of 36 different thrombi were observed in 16 patients. Of 16 patients, 14 had multiple thrombi. There was bilateral involvement in six patients. Sixteen had thrombi (44.4%) which were seen in the right leg and 20 had thrombi seen in the left leg (55.6%). Nineteen proximal (52.8%), and 17 distal (47.2%) thrombi were found. There were no differences between right and left sides or proximal and distal aspects (Tables I–III).

Demographic findings and neurological level

Seventeen patients were in the 20–30 year age group, five patients in the 30–40 year age group, two patients were in the 40–50 year age group and six patients in the 50–60

Table I Localisation of DVT

Iliac region	2	Proximal	19
Femoral region	17		
Popliteal region	6	Distal	17
Crural region	11		
Total	36		36

Table II Delay in admission, commencement of heparin therapy and detection of DVT. Level of SCI and DVT

	Number	Delay in admission to centre and commencement of subcutaneus heparin (days)	Detection of DVT (days)		Cervical	Thoracic	Lumbar
	12	12.25	83.4	DVT +	1	2	1
				DVT −	3	4	1
	18	40.98	86.1	DVT +	5	6	1
				DVT −	2	2	2
		26.61	84.7	DVT +	6	8	2
				DVT −	5	6	3
Total	30				11	14	5

Table III Clinical and venographic findings

	Number	DVT +	DVT −	%
Patient	31			
Venography	30	16	14	53.4
Right side thrombi	16/36	16	—	44.4
Left side thrombi	16/36	20	—	55.2
Proximal thrombi	16/36	19	—	52.8
Distal thrombi	16/36	17	—	47.2
Swelling (2.5 cm)	10	9	1	56.3
Local temperature	7	6	1	37.5
Spasticity	16	9	7	56.3

year age group. There were 11 cervical, 14 thoracic and five lumbar spinal lesions. According to the Frankel classification,[22] 24 patients had a total lesion and six patients a partial lesion. Six cervical patients (54.5% of total cervical group) and eight thoracic patients (57.1% of the total thoracic group) and two lumbar patients (40% of the total lumbar group) had DVT. These differences were not statistically significant (Table II).

Time interval between injury and admission
Twelve patients were admitted within the first 2 weeks (mean 12.25 ± 2.2 days) and 18 were admitted within the first 2 months (mean 40.98 ± 3.75 days). Mean value of the total patient group was 26.61 ± 3.17 days.

Clinical findings and DVT
Ten out of 30 patients showed abnormal increase of leg circumferences (more than 2.5 cm). Nine of these patients had thrombosis (56.3% of total patients with DVT). The remaining patient had negative venography. Further investigation revealed the development of heterotopic ossification. Local temperature was detected in seven patients and six out of seven patients showed DVT (37.5% of total patients with DVT). Pretibial oedema was seen in one patient and this patient had DVT. On the other hand we observed a high incidence of DVT in patients clinically suspected of DVT (90% of the patients with swelling and 87.7% of the patients with hyperthermia).

Relation between DVT and severe spasticity
DVT was found in nine patients with spasticity (56.3% of total patients). The degrees of spasticity in these patients were severe in three, moderate in two and mild in four.

Pulmonary embolism
No patient was diagnosed as having pulmonary embolism clinically and radiologically. One patient felt sudden pain in his chest in the radiology department while being prepared for venography. Pain abated within a few minutes. Lung radiography and lung perfusion scintigraphy failed to show pulmonary embolism.

Complications of venography
One patient had mild urticaria (3.3%). Two patients had an inflammatory reaction at the venipuncture site, beginning 6 hours after needle insertion (6.6%). Symptoms subsided on the third day. No major complication, serious allergic reaction or postvenographic thrombosis based on clinical observation were found.

Discussion

Watson found the incidence of DVT to be 12%, Hachen 21% and Kulkarni 26% by clinical diagnosis. Perkash established the incidence of DVT to be 16% by venous plethysmography and Chu found an incidence of DVT of 19% using plethysmography plus Doppler ultrasound. The highest incidence of DVT was established by Todd 61% using plethysmography and 100% by ^{125}I-fibrinogen uptake leg scanning. Our incidence of 53.3% is higher than previous reports except for Todd's study. The difference may be related to the high specificity and sensitivity of venography.

Except in Watson's and Kulkarni's series, all other studies included a relatively small number of patients as in our patient group. Thus the difference of the incidence of DVT was not attributed to the number of patients.

As in Todd's and Perkash's study, there was no difference in the frequency between the left and right sides.

Marked spasticity is generally considered to be the benchmark for stopping prophylactic anticoagulant therapy. But Perkash indicated that anticoagulant prophylaxis has not prevented patients with spasms, especially those with mild spasms, from the development of DVT. Silver and Nouri showed that a 3 month course of prophylactic anticoagulation therapy may not prevent DVT.[23] Our observation of the development of DVT in three patients with severe spasticity and two patients with moderate spasticity showed that spasticity does not mean that the patient will remain thrombosis free. Our findings are in agreement with Perkash's study. But we did not monitor patients on admission. For this reason, this topic needs further investigation.

When the patients were in our department, we did not clinically observe pulmonary embolism. The observation may be attributed to the heparin prophylaxis.

Venography can detect thrombosis in the calf and iliac veins[24,25] in contrast to plethysmography and ultrasound. Twenty percent of calf vein thrombosis propagate to the proximal side.[9–13] Anticoagulant therapy appears to prevent extension and embolisation. Watson found that the pelvic veins were the side of thrombosis seen at postmortem examination in a fatal case with pulmonary embolism.

Despite these advantages, venography has been critised for its limitations and complications.[3,13,15,18,] Inadequate venograms were claimed to be common in up to 10% of all films.[18–26] In our study no inadequate venogram was seen, except in one patient. A contrast reaction may occur in 3%,[8] but such reactions are said to be minor and are very rarely fatal.[16] We observed that the incidence of urticaria and inflammatory reactions was very close to that reported by Bettmann and Paulin[19] and by O'Donnel *et al*.[16] The incidence and diagnosis of postvenographic thrombosis are debatable. It was generally accepted to develop in 2–3% of patients following venography. Bettmann and Paulin found an incidence of 8% with ^{125}I-fibrinogen uptake, and Albrechtsson and Olson[26] found an incidence of 33% with the same test. Since fibrinogen uptake is associated with minimal endothelial changes, the ultimate significance of the findings is unclear. The positive fibrinogen uptake may show contrast induced alterations in the endothelial cells and not frank thrombosis formation, and it is

claimed that postcontrast flushing with a heparinised saline solution led to this outcome. We did not use heparinised saline but we did not see postvenographic thrombosis.

Perkash *et al*[2] insisted on more aggressive prophylactic anticoagulant therapy considering the high incidence of deep vein thrombosis. More recently Kulkarni *et al*[6] reported on the need for a higher dose of heparin prophylactically for patients at risk. This topic still requires further investigation.

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