

# The incidence of deep vein thrombosis in elderly Chinese suffering hip fracture is low without prophylaxis: A prospective study using serial duplex ultrasound

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## ABSTRACT

**Purpose.** To investigate the incidence of deep vein thrombosis (DVT) among elderly Hong Kong Chinese patients suffering from acute hip fracture and to analyse the risk factors associated with DVT.

**Methods.** A total of 100 consecutive Chinese hip fracture patients with a mean age of 80 years were investigated serially using duplex ultrasound scans preoperatively and at 1 week, 3 to 6 weeks, and 3 months postoperatively. No chemoprophylaxis or prophylaxis against DVT was given.

**Results.** 95 patients completed 3 duplex scans during hospitalisation; 5 (5.3%) of them were found to have developed DVT over the ilio-femoral venous segment. Of the 90 patients who had no DVT, 73 were reassessed 3 months after operation; one of them was found to have developed calf DVT. Older patients, chair-

bound or dependent patients, and patients living in institutions carried a higher risk of developing DVT.

**Conclusion.** This prospective study shows that the incidence of DVT developing after acute hip fracture in Chinese geriatric patients was low. We therefore do not recommend routine chemoprophylaxis for elderly patients with hip fracture.

**Key words:** Asian continental ancestry group; hip fracture; prospective studies; risk; ultrasonography; venous thrombosis

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## INTRODUCTION

Venous thromboembolic disease is a major cause of mortality and morbidity in Caucasian patients undergoing orthopaedic surgery. Stasis, hypercoagulability, and vessel wall injury (Virchow's triad) are the 3 major contributing factors to the

pathogenesis of venous thrombosis. Any of these factors can be activated during and after a major surgical procedure or injury of the hip and pelvis. Deep vein thrombosis (DVT) over the iliac and femoral veins (proximal DVT) is the most common cause of pulmonary embolism. The incidence of developing pulmonary embolism secondary to proximal DVT varies from 35 to 50%.<sup>1</sup>

It is controversial whether the incidence of thromboembolic disease among Asian populations is as common as that among Caucasian populations. The incidence of DVT was reported as being 2.6% using I-labeled fibrinogen tests in Chinese patients who had undergone general surgical operations.<sup>2</sup> Among Chinese patients suffering from hip fracture, a study using venography as the screening test reported that the incidence of DVT was 53.3% in 1980.<sup>3</sup> In that study, the majority of DVT were located in the calf, whereas DVT proximal to the popliteal vein occurred in only 8.3% of the patients. In a Malaysian study in 1996, a 50% incidence of DVT in patients suffering from hip fracture was reported.<sup>4</sup> In Korea, the incidence of DVT in patients undergoing major spinal surgery was only 1.3%.<sup>5</sup> In a retrospective autopsy study conducted on Hong Kong Chinese in 1990, the incidence of significant pulmonary thromboembolism increased significantly from 0.58% during 1975–1979 to 2.08% during 1985–1989.<sup>6</sup> In that study, 36% of the cases had surgery prior to death, 16% of which had undergone hip surgery.<sup>6</sup> The incidence of pulmonary thromboembolism further increased to 4.7% for the period 1990–1994.<sup>7</sup>

Hong Kong, like many other modern cities in Asia, is now adopting lifestyles and dietary habits increasingly similar to that of the West. We are concerned whether the incidence of thromboembolic diseases among Hong Kong Chinese is consequently approaching the rate observed in Caucasian populations.

We aim to investigate the incidence of DVT among elderly Hong Kong Chinese patients suffering from acute hip fractures and to analyse the risk factors associated with DVT.

## PATIENTS AND METHODS

In this prospective study, we recruited a total of 100 consecutive Chinese geriatric patients who had suffered acute hip fractures and were admitted to Queen Mary Hospital between January 1996 and July 1996. The mean duration between injury and operation of the patients was 5.3 days (range, 1–15 days). No chemoprophylaxis against DVT, elastic compression stockings, or foot pumps were used.

Exclusion criteria were patients who had a history of DVT, who suffered pathological fracture, or who had a known coagulation disorder. During the course of the study, 5 more patients were excluded. One of the 5 had liver disease with a deranged coagulation profile. The remaining 4 died before completion of the study. The causes of death were not related to DVT or pulmonary embolism. Postmortem of the deceased patients was not performed because the families did not consent to it. 95 patients completed the follow-up assessment and the screening using duplex ultrasound scanning during hospitalisation.

The mean age of the 95 patients was 80 years and the female-to-male ratio was 2 to 1. Of the patients, 48 suffered intertrochanteric femoral fracture, 8 suffered subtrochanteric femoral fracture, and 39 suffered femoral neck fracture. Standard orthopaedic operations were carried out including: dynamic hip screw fixation in 56 patients, hemiarthroplasty in 28 patients, intramedullary nail surgery in 2 patients, and multiple cancellous screw fixation in 9 patients. One patient treated with hemiarthroplasty had additional cement augmentation. Another patient treated with dynamic hip screw fixation had additional cerclage wiring performed.

## Risk factor assessment

All patients were interviewed and examined by orthopaedic surgeons. The calf circumferences of the injured and un-injured limbs were measured. Any swelling or pain over the calves was noted. Medical histories such as ischaemic heart diseases, congestive heart failure, arrhythmia, varicose veins, peripheral vascular diseases, lower limb paralysis, cerebrovascular accidents, and malignant diseases were recorded. Also, lifestyles such as smoking and drinking habits were asked. The intervals from injury to admission for surgery were measured. The types

Table 1  
Pre-morbid ambulatory status of the patients

|           | Description  |
|-----------|--|
| Class I   | Bed-bound, totally dependent on others for daily living                              |
| Class II  | Chair-bound, needs assistance in walking and activities of daily living; house-bound |
| Class III | Frame walker, able to self-care; home walker, able to climb stairs                   |
| Class IV  | Stick walker, able to self-care; community walker with limitations on exercise       |
| Class V   | Able to walk unaided, able to self-care; able to do outdoor activity and exercise    |

**Table 2**  
**Details of patients developing deep vein thrombosis**

| Patient No. | Age (years)/sex | Causes of the fracture* | Operation procedure <sup>†</sup> | Site of deep vein thrombosis <sup>‡</sup>                              | Time diagnosed |
|-------------|-----------------|-------------------------|----------------------------------|--|----------------|
| 1           | 89/M            | TOF                     | DHS                              | Ipsilateral SFV, ipsilateral CFV                                       | Preoperatively |
| 2           | 92/M            | TOF                     | DHS                              | Ipsilateral SFV  | Day 5          |
| 3           | 81/F            | TOF                     | DHS with cerclage                | Ipsilateral SFV, ipsilateral PV  | Day 7          |
| 4           | 87/F            | TOF                     | DHS                              | Ipsilateral CFV, ipsilateral IV  | Day 21         |
| 5           | 81/F            | NOF                     | AMA                              | Ipsilateral SFV, ipsilateral CFV, contralateral SFV, contralateral CFV | Day 42         |
| 6           | 91/F            | TOF                     | DHS                              | Calf vein  | 3 months       |

\* TOF denotes intertrochanteric femoral fracture, NOF femoral neck fracture

<sup>†</sup> DHS denotes dynamic hip screw fixation, AMA Austin Moore hemiarthroplasty

<sup>‡</sup> SFV denotes superficial femoral vein, CFV common femoral vein, PV popliteal vein, IV iliac vein

of hip fracture, operative procedures, amount of intra-operative blood loss, duration of operation, positions of patients during operation, and types of anaesthesia used were recorded. Perioperative complications, including systemic and wound infections, sciatic nerve paralysis, cerebrovascular accident, and hip prosthesis dislocation were documented.

The residence of our patients, such as old-age home, hospital, or home, before hospitalisation was noted. The walking ability of our patients before the injury was asked and divided into 5 classes. class-I patients were bed-bound and required total assistance from others, whereas class-V patients had no limitations and were able to walk unaided (Table 1).

### Duplex ultrasound scanning

Duplex ultrasound scanning was used as the screening test for venous thrombosis. Both the injured and the non-injured limbs were tested. The tests were done at the immediate preoperative period (1–2 days before operation), early postoperative period (5–7 days after operation), late postoperative period (3–6 weeks after operation), and follow-up period (3 months after operation).

One vascular technologist from the vascular laboratory of the Department of Surgery at the University of Hong Kong performed all the scanning tests using an Acuson 128XP/4 (Acuson, Mountain View [CA], US). Each scanning result of whether DVT was present was recorded; afterwards, the scanning results were examined by a vascular surgeon. The patients were monitored clinically for any symptoms of pulmonary embolism.

A diagnosis of DVT was made if any of the following sonographic criteria was shown: sonographic visualisation of thrombus in vein, loss of com-

pressibility of vein by ultrasonic probe pressure, and loss of phasic flow signal or loss of augmentation of flow with distal compression.

### Statistical methods

Factors such as age, residence, and pre-morbid walking status were compared between patients with DVT and patients without DVT. Significant difference was assumed when  $p < 0.05$ . The interval data were compared using a Student's *t* test for equality of the mean. The nominal data were compared using the Pearson Chi squared test. All statistical tests were performed using the Statistical Package of Social Sciences (SPSS 9.0, SPSS Inc., Chicago [IL], US).

### RESULTS

Five patients (3 women, 2 men) were found to have developed DVT over veins proximal to the popliteal vein during hospitalisation; however, only one patient was symptomatic. One patient was found to have DVT in the injured leg preoperatively who had no symptoms or history of DVT or venous diseases. The remaining 4 patients had negative preoperative scans but developed DVT postoperatively. Two of the 4 were identified with DVT in the early postoperative period (5–7 days) and the other 2 in the late postoperative period (3–6 weeks). Four of the 5 patients underwent dynamic hip screw fixation after suffering intertrochanteric fracture of the femur; the remaining one underwent Austin Moore hemiarthroplasty after suffering femoral neck fracture. Four of the 5 patients had DVT over the injured limb alone; the remaining one had bilateral DVT (Table 2).

Of the 90 patients who had no DVT during

**Table 3**  
Risk factor analysis

| Risk factors                    | Pearson's Chi squared test | Student's t test for equality of mean |
|---------------------------------|----------------------------|---------------------------------------|
| Sex                             | 0.941                      |                                       |
| Age*                            |                            | 0.048                                 |
| Residing in institutions*       | 0.029                      |                                       |
| Non-walker before injury*       | 0.043                      |                                       |
| Medical condition†              | 0.962                      |                                       |
| Smoking                         | 0.868                      |                                       |
| Drinking                        | 0.545                      |                                       |
| Fracture type                   | 0.228                      |                                       |
| Operation type                  | 0.843                      |                                       |
| Anaesthesia type                | 0.624                      |                                       |
| Position during operation       | 0.252                      |                                       |
| Duration from injury to surgery |                            | 0.346                                 |
| Operation time                  |                            | 0.141                                 |
| Blood loss                      |                            | 0.311                                 |
| Complication                    | 0.116                      |                                       |

\* Statistically significant

† Congestive heart failure, ischaemic heart disease, arrhythmia, cerebrovascular accident, peripheral vascular disease, varicose vein, lower limb paralysis, malignant disease with no evidence of pathological hip fracture

hospitalisation, 73 were called back and reassessed 3 months after operation. 51 of 73 were examined physically and with duplex ultrasound scanning. Only one of the 51 patients had asymptomatic calf DVT over the injured limb (patient 6). She suffered intertrochanteric femoral fracture and underwent dynamic hip screw fixation (Table 2). 22 patients refused to attend follow-up assessment and were interviewed by telephone regarding leg and chest symptoms; all of them were asymptomatic. Of the 17 patients who did not have follow-up assessment at 3 months postoperatively, 5 patients were dead and their causes of death were not known. 12 patients were lost in contact.

The mean age of patients with DVT was 87 years (standard deviation [SD], 5 years). The mean age of patients without DVT was 79 years (SD, 9 years). The difference was significant ( $p=0.048$ ). Patients living in institutions such as old-age homes or hospitals are 9 times more likely to develop DVT ( $p=0.029$ ). There were 34 patients living in institutions; 5 (83%) of the 6 patients with DVT lived in an institution, whereas only 31% of the patients without DVT did so. The odds of developing DVT for patients living in institutions and at home were 1 to 6.8 and 1 to 61, respectively. All 6 patients with DVT had poor pre-morbid ambulatory ability (class II pre-morbid

walking status). They were either chair-bound with activities limited at home or requiring assistance on activities of daily living. There were 47 patients in pre-morbid ambulatory status of classes I and II. Of the patients without DVT, 53.3% were community walkers and 30% needed no walking aids. The difference was statistically significant ( $p=0.043$ ). In other words, one out of 7.8 patients would develop DVT if they had compromised walking ability before injury.

Respectively between patients with DVT and patients without DVT, the mean operation time was 85 minutes (SD, 36 minutes) and 66 minutes (SD, 31 minutes), the mean blood loss was 217 ml (SD, 175 ml) and 156 ml (SD, 137 ml), the mean duration from injury to surgery was 6.5 days (SD, 4.0 days) and 5.2 days (SD, 3.3 days). The differences were not statistically significant (Table 3).

Of 4 patients (all women) who had postoperative complications, one had postoperative deep wound infection, who had undergone dynamic hip screw fixation for intertrochanteric fracture of the femur. Two had cerebrovascular accidents, who had undergone Austin Moore hemiarthroplasty for fracture of the femoral neck. One had septic prosthesis dislocation, who had undergone Austin Moore hemiarthroplasty for fracture of the femoral neck. She had DVT over both lower limbs as well (patient 5).

## DISCUSSION

DVT is common among Caucasian hip fracture patients. The overall incidence of DVT without prophylaxis has been measured between 35% and 42%.<sup>8</sup> The incidence of DVT proximal to the popliteal vein (proximal DVT) was 16% even with prophylaxis.<sup>9</sup> Proximal DVT increases the risk of developing emboli.<sup>10</sup> In contrast, thrombi over the calf (distal DVT) rarely results in emboli and usually resolves spontaneously.<sup>11</sup> The embolic risk of distal venous thrombi is 0% to 13%, whereas that of proximal venous thrombi is 50%.<sup>1</sup> The risk of calf vein thrombosis extending to the thigh veins varies, and the reported incidence ranges from 0% to 20%.<sup>1</sup>

In the past, DVT was uncommon and pulmonary embolism was rare among Chinese populations.<sup>2</sup> In 1980, the overall incidence of DVT (proximal and distal) in Chinese populations was comparable to that in Caucasian populations. In a study using ascending venography to detect DVT in a series of Chinese hip fracture patients who received no prophylaxis against venous thrombosis, the overall incidence of DVT was 53%, of which 15.4% was located proximally

to the popliteal vein.<sup>3</sup> In another study published in 1999 in elderly Hong Kong Chinese hip fracture patients using Doppler ultrasound investigation, the incidence of DVT was 37%.<sup>12</sup> However, no preoperative screening tests were performed in these 2 studies and pre-existing DVT was not excluded. Therefore, those studies were unable to identify whether DVT was a new development following hip fracture or operation. In our study, we paid special attention to define the incidence of DVT occurring after fracture and operation.

We used serial duplex ultrasound to screen for DVT before and after hip operation. Duplex ultrasound is non-invasive and repeatable. It has a sensitivity of 91% to 95% and a specificity of 98% to 100% in detecting proximal DVT.<sup>9,13,14</sup> Although single duplex ultrasound scanning only has a sensitivity of 62.5% and 53.6% for proximal and distal venous thrombosis, respectively, in screening asymptomatic patients,<sup>15</sup> serial duplex ultrasound scanning has a high sensitivity close to that of venography. Repeated scanning can detect proximal propagation of distal venous thrombus, which may result in embolism. Cronan et al.<sup>9</sup> published in 1991 the results of their prospective study using serial duplex scanning in detecting DVT in 88 hip fracture patients preoperatively and postoperatively every 3 to 4 days until discharge. The results of the duplex scan were correlated with ascending venography. 12 of the 76 patients who completed the study were detected to have venous thrombosis in the proximal venous segment. Venography confirmed DVT in each case and detected no additional femoral or popliteal thrombus. The sensitivity in their study was 100%.

Venography is the gold standard for detecting DVT; however, we did not use it as the screening tool because it is invasive and can cause thigh or calf pain (30%–59%), allergic reactions (3%), local ulceration at the site of contrast injection, and venous thrombosis (2%–15%).<sup>16</sup> It is also impossible to perform the test before surgery because patients with hip fracture are unable to stand up. In addition, technical difficulties of venography remain such as failure in filling the deep femoral vein (50%) and the unreliability of contrast enhancement of the muscular branches of the calf veins. Interpersonal observer error may occur and has been reported to be as high as 10%.<sup>17</sup>

In our study, we did not use any prophylaxis against DVT. Five patients were found to have proximal DVT during hospitalisation; therefore, the incidence of in-hospital DVT was 5.3%, which was relatively low compared to that observed in Caucasians. We excluded 4 patients who died during hospitalisation before they completed the 3 in-

hospital duplex ultrasound scans. We could not exclude DVT or pulmonary embolism in these cases because postmortems were not performed. In a worst case scenario, if all of them were to have developed proximal DVT, the incidence of DVT during hospitalisation would have been 9.1%. Comparing the incidence of proximal DVT in our study with that in another study on a Chinese population in 1980,<sup>3</sup> we found no increase in the incidence of proximal DVT in the Chinese elderly suffering hip fracture within the 16-year period.

In our dataset, the incidence of proximal DVT was found to be higher in the injured limb than the non-injured limb, and higher in patients suffering intertrochanteric femoral fracture than the femoral neck fracture. However, the differences were not statistically significant.

Elderly patients—who were chair-bound with compromised self-care function or who lived in institutions—were at higher risk of developing DVT (Table 3). Patients living in institutions usually walk little, and immobility may cause venous stasis and play an important role in the development of DVT in our patients.

The duration of operation was longer and the amount of blood loss was greater among patients with DVT, suggestive of a greater magnitude of surgical trauma to the soft tissue and the vessels. However, the differences were not statistically significant.

Anticoagulation therapy is the standard prophylaxis for Caucasians who are kept on bed-rest or who underwent major surgery. It is effective in preventing DVT but is associated with the risk of major complications. The risk of postoperative bleeding using adjusted-dose heparin prophylaxis ranged from 3.5% to 8.3%,<sup>18,19</sup> which was substantial. Only recently has low-molecular-weight heparin become available. It is not only as effective as adjusted-dose heparin, but reduces the risk of haemorrhage to around 1%.<sup>18,19</sup> However, there is insufficient evidence to confirm the benefits of different heparin preparations in protection against pulmonary embolism or in the overall outcome.<sup>20</sup> Drugs should only be used when a clear cost-benefit ratio exists. Foot and calf pumping devices appear to be able to prevent DVT and pulmonary embolism and reduce mortality, but their compliance remains a problem.<sup>20</sup>

The majority of our DVT cases occurred during the early postoperative period (within 6 weeks). This concurred with the findings that DVT is more common in the early postoperative period compared to the late rehabilitation period.<sup>21</sup> We lost contact with 12 (13.3%) of 90 patients 3 months postoperatively. This percentage loss was comparable to that of another study on hip fracture patients.<sup>22</sup>

## CONCLUSION

This prospective study shows that the incidence of DVT developing after acute hip fracture in Chinese geriatric patients was low. Older patients ( $p=0.048$ ), chair-bound or dependent patients ( $p=0.043$ ), and patients living in institutions ( $p=0.029$ ) carried a higher risk of developing DVT. Because the incidence of proximal DVT in our patients with no prophylaxis was only 5.3%, we do not recommend routine chemoprophylaxis for elderly

patients with hip fracture. However, prophylaxis for patients with higher risk (older, chair-bound or dependent, or living in institutions) may be considered individually.

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