

PREVENTION OF THROMBOEMBOLIC DISEASE AFTER NON-CEMENTED HIP ARTHROPLASTY. A MULTIMODAL APPROACH

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Thromboembolism following total hip arthroplasty is a common complication that may result in significant morbidity and mortality. Despite this, optimal prophylactic regimen is controversial. We investigated the efficacy of a comprehensive approach encompassing the use of aspirin, intermittent compression devices ('foot pumps'), and early mobilization in a cohort of 200 consecutive patients after *non-cemented* total hip replacements. The surgical procedures were carried out under epidural anesthesia in most cases (91%). All patients were allowed full weight bearing and received ambulation training starting on the first post-operative day. Ankle-high pneumatic boots ('foot pumps') and aspirin (325 mg po/qd) were used immediately after surgery. The presence of deep vein thrombosis was determined with the routine use of venous duplex scans on post-operative day number 5 to 10 (mean 6.8). The duration of the follow-up was 3 months. No patients were lost to follow-up. Four distal DVT's (2%) were detected in three patients. None of the patients developed symptomatic pulmonary embolism during the follow-up period. There were no major wound complications. Venous thromboembolic disease after hip replacement surgery is largely associated with postoperative immobilization and venous stasis. It is the authors' opinion that a prevention strategy should include mechanical as well as pharmacological measures. The concomitant use of epidural anesthesia, "foot pumps", aspirin and early full weight bearing ambulation may be effective in further reducing the incidence of DVT after surgery.

Keywords : thromboembolism ; hip ; arthroplasty ; prevention.

Mots-clés : Thrombo-embolie ; hanche, arthroplastie ; prévention.

INTRODUCTION

Total hip arthroplasty has been characterized as a high-risk procedure for the development of thromboembolic disease. Patients undergoing this type of procedure usually present multiple risk factors (age, hip fractures, prolonged immobility) (40). Since it has been demonstrated that patients receiving some form of prophylaxis are at far smaller risk for DVT and PE, prophylaxis in these patients constitutes the standard of care in orthopedic practice (5, 30, 49). However, controversy still exists regarding the adoption of pharmacological and/ or mechanic prophylactic measures. The pathophysiologic role of stasis in venous thrombosis is well-recognized (45) Postoperative venous stasis, first described by Virchow in 1859 (47) as one of the three predisposing factors in the development of thrombosis, represents one of the most important causes in the incidence of thromboembolic disease. Historically, postoperative early ambulation and active exercise has been encouraged in an attempt to decrease venous stagnation and promote blood flow (28, 31, 40, 43). It is also known that the adoption of a non-cemented hip prosthesis has been associated with delayed onset

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of weight bearing and ambulation further enhancing venous stasis (2).

The purpose of the present study was to evaluate the incidence of thromboembolic disease in a series of consecutive patients undergoing *non-cemented* total hip replacement managed with a protocol combining epidural anesthesia, immediate full weight bearing ambulation, the use of a 'foot-pump' and the administration of aspirin.

MATERIALS AND METHODS

Two hundred primary and revision total hip arthroplasties were performed in 192 patients in our institution between January 1997 and October 2000. All patients, with the exemption of those with hypersensitivity to aspirin (2 patients) or those who were already taking warfarin for other reasons (3 patients), were included in the study. Eight patients (sixteen hips) received a single staged bilateral total hip replacement. Bilateral procedures were taken into the study as separate entries.

Two patients were excluded due to documented hypersensitivity to aspirin and three patients due to concomitant use of warfarin therapy; two due to the presence of a prosthetic valve and one to history of previous pulmonary embolism.

All surgeries were performed by the same surgeon (J.F) through a posterior approach and received a non-cemented Lateral Flare™ prosthesis (8-10). One hundred and seven (53.5%) were performed in men and ninety-three (46.5%) were performed in women. The mean age was 59 years old (± 22.4 years). One hundred and eighty two procedures were primary total hip replacements and the remaining eighteen were revisions.

The use of regional anesthesia was encouraged and it was used in the majority of cases (91%). The demographics and characteristics of the groups of patients are depicted in table I.

All patients received aspirin 325 mg P.O. qd while hospitalized and for at least 1 month after discharge. A "Foot Pump" (A-V Impulse System, Novamedix, Hampshire, UK) was used immediately after surgery which was discontinued shortly after the onset of active ambulation and routinely during bathing and while in the Rehabilitation Department. The device consists of an anatomically shaped inflation pad and cushioned foot cover that withstand a period of rapid inflation (0.4 seconds) followed by a 3 second impulse hold time to achieve a pressure of 130 mmHg. and a 20 second deflation period.

Table I. — Data on 200 consecutive THR

Sex	Male	53.5%	107
	Female	46.5%	93
Age (mean \pm SD)		59 y/o (± 22.4)	
Groups	Primary THR	91%	182
	Revision THR	9%	18
Venous Duplex Scan (mean \pm SD)		5.9 \pm 1.6	

Ambulation on full-weight bearing was started on the first postoperative day and permitted ad-lib and with a physical therapist at least twice a day. Fifty-six percent of the patients were transferred to an Acute Rehabilitation Center and the remaining 44% were discharged directly from the Hospital.

Bilateral Venous Duplex scans were routinely performed in all patients to assess the presence of deep venous thrombosis on postoperative day # 4 to 9 (mean 5.9) in the Vascular Imaging Dept. by vascular technicians. A vascular surgeon analyzed and reported the results on all imaging thereafter. The exam was routinely performed from the external iliac veins to the calf veins.

All patients were followed for 3 months after the surgery and none was lost to follow-up. Standardized clinical criteria were used to identify probable cases of late DVT (tenderness or discomfort of the calf or thigh, a positive Homan's sign, edema of the leg and ankle, and increase in local temperature) or pulmonary embolism (pleuritic chest pain, dyspnea, ABG's measurements, changes in the chest xray and/ or changes in the EKG, V/Q scans.)

RESULTS

The prevalence of deep vein thrombosis was 2% (four DVT's in 200 procedures). Two patients demonstrated evidence of distal symptomatic DVT after a primary total hip replacement and one other patient had a bilateral popliteal DVT after a revision procedure. There were no episodes of symptomatic pulmonary embolism during the hospital stay and the follow-up period.

There were no major bleeding complications. Three wound hematomas were successfully treated conservatively. One patient suffered a myocardial

infarction in the postoperative period and another patient had an episode of congestive heart failure exacerbation requiring transfer to the Intensive Care Unit.

DISCUSSION

There is extensive controversy in the literature around any specific approach to the prevention of thromboembolism after total joint replacements. We used a protocol that addresses each component of the known Virchow's triad separately.

We stress the importance of the venous stasis that normally occurs during and after this type of procedure. Venous flow abnormalities play an essential role in the development of the thromboembolic disease and in the initiation and propagation of DVT (46). The soleal sinuses and the apices of the venous valves are the anatomical regions where the stasis is more prominent (20, 26, 32, 33) and where most thrombi originate after total hip replacements (21). Consequently there is a highly significant association between the reduction of blood flow and the development of deep vein thrombosis in the affected limb (29)

During normal weight bearing, in addition to the physiological '*vis a tergo*' and '*vis a latere*' mechanisms, venous flow is increased by expressing the plantar plexus through the flattening of the metatarsal arch during stance (12, 13). The resulting 'washout' effect further prevents blood stagnation from the calf veins through the femoral veins. The compression devices or 'foot pumps' used in this study mimics this physiological mechanism by emptying the venous plantar plexus and transmitting a pulsatile wave through the posterior tibial, popliteal and femoral veins (22). It has previously been reported that the use of mechanical measures alone or in conjunction with antithrombotic/antiplatelet drugs carries a significant effect in the prevention of DVT after total hip replacements (11, 44) and total knee replacements (51, 52).

The Lateral Flare femoral stem used in this trial loads the proximal femur both medially and laterally creating a stable interface and broader base of support (8-10, 48) allowing patients to ambulate with 'full weight bearing' without the common

concern for migration, micromotion, lack of bonding and subsidence linked to *non-cemented* stems (48). Furthermore, the venous flow is increased by these mechanisms and by the emptying of the plantar plexus. This may play a crucial role in the postoperative stage since it has been demonstrated that the velocity of the venous flow decreases significantly after joint replacement surgery (27).

Aspirin has been widely used in clinical trials (14-17, 36, 40, 41) after total hip replacements and exerts its antithrombotic activity by the irreversible inhibition of the platelet cyclooxygenase, preventing the production of thromboxane A2 and impairing platelet aggregation (39) which constitutes an important factor in the genesis of the thrombus. It was concluded from data gathered in a meta-analysis which included 56 clinical trials and 7976 patients (19), that aspirin alone is less effective in preventing thromboembolic disease after total hip replacements than other modalities (standard unfractionated heparin, low-molecular-weight-heparin and warfarin). However, the rates of bleeding complications were significantly higher with warfarin (1.3%), LMWH (1.8%) and heparin (2.6%) than aspirin (0.4%) and placebo (0.3%). This study addresses the role of a pharmacological agent *as part* of a prophylaxis protocol that includes other interventions (epidural anesthesia, 'foot pumps' and early ambulation on full weight bearing).

Venous Duplex Scan is a non-invasive and reliable method of detecting venous thromboembolic disease (3, 4, 25, 34, 35, 38). In our trial all patients were screened bilaterally for DVT regardless of the presence of symptoms. Two previous studies (1, 50) independently reported an overall sensitivity of 85% for duplex ultrasonic scanning when compared to contrast venography. The second study noted above by Westrich *et al.* investigated the role of technician and radiologist experience in the use of duplex ultrasound for detection of DVT after TKA (50). They found the sensitivity of duplex ultrasonic examination increased from 75% to 85% after two years using one technician and one radiologist for the examinations. Two other studies report lower rates of detection for duplex ultrasound when compared to contrast venography (6,

24). In the current study, all ultrasonographers in our vascular imaging laboratory center were experienced in performing venous duplex scanning. We agree with Westrich *et al.* that individual institutions should validate the reliability of imaging studies and the experience of the technicians performing the studies (50).

In similar studies, Hooker *et al.* (18) reported a DVT incidence of 3.8% in a trial with only 502 hips managed only with thigh-high compression devices during and after surgery and also screened with Doppler scans. Sarmiento *et al.* (40) found an incidence of clinically symptomatic DVT of 1.01%, a non-fatal PE of 0.94% and a fatal PE rate of 0.13% in a cohort of 1492 patients managed with aspirin and an exercise protocol with the use of graded elastic stockings or intermittent compression devices. In his study, only the symptomatic limbs were scanned postoperatively for the presence of thromboembolism, explaining the narrow difference between the incidences of symptomatic DVT and non-fatal PE.

In our study, epidural anesthesia was encouraged and used in the vast majority of patients (91%). The effectiveness of the regional anesthesia as a factor in the prevention of DVT has been documented extensively (23, 37, 40, 42). When compared with general anesthesia, the use regional anesthesia results in a five-fold decrease in the incidence of DVT (37).

Thromboembolism after arthroplasty constitutes a multifactorial disease requiring multiple therapeutic approaches during the preoperative phase as well as in the operating room and during the rehabilitative period. As stated above, venous stasis, activation of the coagulation cascade during the preparation of the femoral canal, kinking of the femoral vein and potential injury to its inner layer as well as the presence of preoperative risk factors, play a role in the pathogenesis of the thromboembolic disease. It is our view that a prevention strategy should address most of these factors through intra-operative (type of anesthesia, autologous blood transfusion, a quicker surgery, the minimization of bleeding) and postoperative maneuvers (early full weight bearing ambulation, the use of foot pumps, aspirin as well as an effective post-

operative pain management), being the primary objective to mobilize the patients on full weight bearing as soon as possible after the surgical intervention.

Finally, one of the shortcomings of the present prospective cohort study is the absence of a control group with another type of prophylaxis protocol (i.e. low molecular weight heparin, unfractionated heparin). The reported experience in our institution with the use of either heparin or LMWH reflected an increase in the incidence of bleeding complications after surgery as well as the length of stay in the acute hospital (7), consequently we designed the present study as a prospective uncontrolled trial. The aim of this study has also been to report the results of a comprehensive DVT prophylaxis protocol in the everyday orthopedic setting and may be of additional value to most clinicians.

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SAMENVATTING

A. LEALI, J. FETTO, A. MOROZ. Veelvoudige aanpak van de preventie van thrombo-embolische verwikkelingen na ongecementeerde totale heup.

Thrombo-embolische verwikkelingen na totale heup zijn frequent, en kunnen naast een belangrijke morbiditeit, ook mortaliteit voor gevolg hebben. Er bestaat nog veel controverse rond de beste therapie. De schrijvers hebben nagegaan of een gecombineerde therapie op basis van aspirine, intermitterende compressie en vroege mobilisatie, afdoende was bij een groep van 200 opeenvolgende patiënten, die een ongecementeerde totale heup ontvingen. De ingreep verliep meestal onder peridurale anesthesie (91% van de gevallen). Onmiddellijk na de ingreep werden voetspompjes aangelegd en werd aspirine (325 mg/dag) gestart. Gangreëducatie met volledige belasting volgde de dag na de ingreep. Testen op DVT gebeurde bij middel van duplexscan tussen de 5° en 10° dag postoperatief (gemiddeld 6.8° dag). Alle patiënten werden 3 maanden opgevolgd. Viermaal (bij drie patiënten) werd een diepe DVT (2%) ontdekt. Geen enkele ontwikkelde een symptomatische longembolie. Er waren geen majeure wondproblemen. Veneuze thrombo-embolische verwikkelingen na totale heup zijn grotendeels het gevolg van postoperatieve immobilisatie. De schrijvers menen dat de strategie van preventie zowel mechanische als medicamenteuze maatregelen moet inhouden. Een veelvoudige aanpak bestaande uit een combinatie van epidurale anesthesie, aspirine, voetspompjes en vroegtijdige gangherneming kan een verdere effectieve vermindering van het DVT risico betekenen na totale heup.

RÉSUMÉ

A. LEALI, J. FETTO, A. MOROZ. Prévention des complications thrombo-emboliques après arthroplastie de hanche sans ciment : approche multimodale.

Les complications thrombo-emboliques après arthroplastie de hanche sont fréquentes et peuvent entraîner une morbidité et une mortalité significatives. Le choix de la meilleure prophylaxie reste cependant un sujet de controverse. Les auteurs ont étudié l'efficacité d'une approche globale associant l'administration d'aspirine, l'utilisation d'un système de compression intermittente et la mobilisation précoce, dans une cohorte de 200 patients successifs qui avaient subi une arthroplastie

totale de la hanche sans ciment. Les opérations ont été faites sous anesthésie péridurale dans la plupart des cas (91%). La remise en charge complète a été autorisée dès le lendemain de l'opération. Dès la fin de celle-ci, les patients ont reçu de l'aspirine (325 mg/jour per os) et ont été pourvus de bottes pneumatiques remontant au-dessus de la cheville. Les patients ont subi en routine un échoduplex entre le 5^{ème} et le 10^{ème} jour post-opératoire (en moyenne à 6,8 jours) pour rechercher la présence d'une thrombose veineuse profonde. Ils ont été suivis pendant trois mois ; il n'y a pas eu de perdus de vue. Quatre thromboses profondes distales (2%) ont été détectées chez trois patients. Aucun patient n'a présenté

d'embolie pulmonaire symptomatique pendant la période de suivi. Il n'y a eu aucune complication importante au niveau de la plaie opératoire. La maladie thromboembolique après chirurgie de remplacement de la hanche est en bonne partie secondaire à l'immobilisation post-opératoire et à la stase veineuse. Les auteurs sont d'avis qu'une stratégie de prévention doit inclure des mesures mécaniques aussi bien que pharmacologiques. L'association d'une anesthésie péridurale, d'un système pneumatique de compression intermittente, de l'administration d'aspirine et de la reprise précoce de la marche avec appui complet s'est avérée efficace dans la réduction des complications thrombo-emboliques.