CLINICAL ARTICLE

Does Previous Varicose Vein Surgery Alter Deep Vein Thrombosis Risk after Lower Limb Arthroplasty?

Anahita Dua, MD[1], Santiago Neiva[2], Alasdair Sutherland, MD(Hons), FRCSEd(Tr&Orth)[3]

[1]*Center for Translational Injury Research, Houston, Texas, USA; and* [2]*Information Services Division Edinburgh, National Services Scotland, Edinburgh, and* [3]*Department of Orthopaedics, University of Aberdeen Medical School, Aberdeen, UK*

Objective: To determine the rates of deep vein thrombosis (DVT) and pulmonary embolism (PE) after total knee arthroplasty (TKA) and total hip arthroplasty (THA) in patients who have had previous varicose vein (VV) surgery.

Methods: Data on 57,364 patients who had undergone THAs and 51,859 patients who had undergone TKAs were obtained from the Scottish Arthroplasty Project and cross-referenced with patients for whom DVT/PE events had been recorded (Scottish Morbidity Database).

Results: The THA DVT rate in patients who had previously undergone VV surgery was 0.8% (27/3478), and in those with no previous VV diagnosis or surgery was 0.8% (428/53,659). In patients with a previous VV diagnosis but no VV surgery, the THA DVT rate was 3.1% (7/227) (Pearson χ^2 test, $\chi^2 = 14.8$, degrees of freedom = 2, $P = 0.001$). No significant difference was found for the corresponding data in the TKA cohort. The THA PE rate in patients who had previously undergone VV surgery was 0.7% (26/3478), and in those with no previous VV diagnosis or surgery 0.7% (376/53,659). No correlation was found between prior VV interventions and PE rates.

Conclusion: Untreated VVs are associated with an increased risk of DVT after THA. Therefore, patients with VVs should consider having them treated prior to undergoing orthopedic interventions.

Key words: Arthroplasty; Deep vein thrombosis; Pulmonary embolism; Varicose veins

Introduction

Deep vein thrombosis (DVT) is a major contributor worldwide to morbidity and mortality both in hospital and healthy populations. It causes leg pain and swelling, as well as a risk of pulmonary embolism (PE) and post-thrombotic syndrome. These conditions are grouped together as venous thromboembolism (VTE). Although the incidence of DVTs depends on the population studied, a 25-year population based study found the annual incidence, after adjusting for age and sex, to be 1.17 per 1000[1]. The 1991 Worchester DVT study concluded that approximately 270,000 individuals were hospitalized for VTE in that year[2]. These estimates may under-represent the incidence of DVT because several studies have suggested that many cases remain undiagnosed[2–6]. Only 39%–50% of autopsy-proved PEs have been diagnosed clinically[7].

When considering the risks of total joint arthroplasty, Virchow's triad of venous stasis, hypercoagulability and endothelial injury remains the best guide. Arthroplasty surgery is known to alter coagulability and limb manipulation and use of tourniquets can lead to vessel wall injury[8]. In itself, stasis is largely a permissive factor, and is of greatest importance in the post-operative period. The natural history of DVT is no longer regarded as a single clot forming event but rather a repeated cycle of recurrent clot formation and re-establishment of lumen patency that creates a platform for the most life threatening complication of DVTs, PE. Risk factors for DVT include surgery, presence of varicose veins (VVs), malignancy, age, immobilization, trauma, obesity, hematological deficiencies, and medications[9]. Of these factors, the greatest risk factor for DVT is surgical intervention; knee and hip surgery increase the

Address for correspondence Anahita Dua, MD, Center for Translational Injury Research, 6410 Fannin Street UPB 1100, Houston, Texas 77030, USA
Tel: 001-262-5658247; Fax: 001-713-5000685; Email: andua@mcw.edu
Disclosure: The authors did not receive any outside funding or grants in support of this research or preparation of this work.
Received 9 July 2012; accepted 1 August 2012

Orthopaedic Surgery

VTE risk by 48%–61%[10]. Although there is considerable debate about the risk of fatal PE and the clinical relevance of asymptomatic DVT, there is general agreement that VTE is an important consideration in the management of lower limb arthroplasty.

Varicose veins develop due to increased backpressure in the venous system, leading to valvular incompetency, both in the superficial veins and at the junctions between the deep and superficial systems[11]. Valvular incompetency can result in venous stasis and vessel damage within the superficial venous system and this is transmitted to the deep veins via the perforators. Although VVs are an established risk factor for DVT, there are few published reports detailing the association between prior VV surgery and DVT or PE in high risk populations such as patients undergoing knee or hip arthroplasty[12].

This study aimed to determine the rates of DVT and PE after total knee arthroplasty (TKA) and total hip arthroplasty (THA) in patients with a diagnosis of VVs who had or had not undergone previous VV surgery, in an attempt to determine if prior VV diagnosis or surgery alters the risk of DVT or PE after arthroplasty.

Materials and Methods

The Scottish Arthroplasty Project is a compulsory register that has recorded all total joint arthroplasties in Scotland since 1989. The data are held centrally by the Information Services Division of the National Health Service (NHS), Scotland and can be cross-referenced to national hospital morbidity records in the Scottish Morbidity Register, SMR 01, which captures data on all hospital episodes.

All patients undergoing hip or knee arthroplasty between 1989 and 2009 were cross-referenced with SMR 01 data on patients who had or had not had previous VV surgery. Operating Procedure Code Supplement version 4 (OPCS-4) codes were utilized. In UK health care, the OPCS Classification of Interventions and Procedures (OPCS-4) is a procedural classification for the coding of operations, procedures and interventions performed during in-patient stays, day case surgery and out-patient attendances within the NHS. Responsibility for its revision and maintenance is currently with NHS Connecting for Health. Though its code structure is different, as a code set, OPCS-4 is comparable to the American Medical Association's Current Procedural Terminology. OPCS-4 is an alphanumeric nomenclature, with a four character code system similar to that of the International Classification of Disease version 10 (ICD-10), the exceptions being that OPCS-4 classifies procedures and interventions rather than diagnoses. VV surgery was defined by the following OPCS-4 codes: L841, L842, L843, L844, L845, L846, L848, L849, L851, L852, L853, L858, L859, L861, L862, L868, L869, L871, L872, L873, L874, L875, L876, L877, L878, L879, L881, L882, L883, L888, L889, L891, L893, L895, and L898. ICD-10 codes for DVT were defined as L801, L802 and 4511. Scottish Morbidity Register data were then examined for all TKA and THA patients who had previously undergone VV surgery and who were recorded as having been admitted (elective, transfer or emergency) with a diagnosis of DVT and/or PE within 90 days of THA or TKA. A three-month follow-up was chosen given that VTE can occur up to 90 days (3 months) after surgical interventions[13]. Only patients with primary successful VV interventions were included. Patients with a known VTE history and those taking anticoagulants were excluded from this study. All patients who underwent arthroplasty procedures were screened for VTE prior to surgery. The primary outcomes were DVT or PE within 90 days and mortality. VTE was documented based on OPCS-4 codes. Pearson χ^2 test was used to assess statistical significance within the three groups, statistical significance being defined as $P < 0.05$. Statistical analysis was performed with SPSS 15.0 (SPSS, Chicago, IL, USA). The protocol for the research project was approved by a suitably constituted Ethics Committee of the institution within which the work was undertaken.

Results

We retrieved data on 57,364 patients who had undergone THA and 51,859 patients who had undergone TKA. We documented DVT and PE rates for three cohorts: (i) patients with no previous diagnosis of VVs or VV operations; (ii) patients with a previous VV diagnosis and surgery; and (iii) patients with a VV diagnosis but no documented surgery.

Deep Vein Thrombosis

Of the patient cohort that underwent THA, 462 (0.8%) had a diagnosed DVT within 90 days of orthopedic intervention. The DVT rate in patients who had previously undergone VV surgery was 0.8% (27/3478), and in those with no previous VV diagnosis or surgery was 0.8% (428/53,659). In patients with a previous VV diagnosis but no VV surgery, the DVT rate was 3.1% (7/227, Pearson χ^2 test, $\chi^2 = 14.8$, degrees of freedom (d.f.) = 2, $P = 0.001$). In the TKA cohort, 304 (0.6%) patients had DVTs diagnosed within 90 days. The DVT rate in patients who had previously undergone VV surgery was 0.6% (22/3820), and in those with no previous VV diagnosis or surgery was 0.6% (281/47,807). In patients with a previous VV diagnosis but no VV surgery, the DVT rate was 0.4% (1/232), a difference that did not reach statistical significance (Pearson χ^2test, $\chi^2 = 0.1$, d.f. = 2, $P = 0.95$). Data are summarized in Table 1.

Pulmonary Embolism

Of the patient cohort that underwent THA, 403 (0.7%) had a diagnosed PE within 90 days of surgery. The PE rate in patients who had previously undergone VV surgery was 0.7% (26/3478), and in those with no previous VV diagnosis or surgery was 0.7% (376/53,659). In patients with a previous VV diagnosis but no VV surgery that PE rate was 0.4% (1/227), a difference that did not reach statistical significance (Pearson χ^2 test, $\chi^2 = 0.3$, d.f. = 2, $P = 0.85$). In patients who had undergone TKA, 411 (0.8%) had diagnoses of PE within 90 days. The PE rate in patients who had previously undergone VV surgery was 0.9% (35/3820), and in those who did not have a VV diagnosis was 0.8% (374/47,807). In patients with a VV diagnosis but no surgery the PE rate was 0.9% (2/232), a difference that did not

TABLE 1 Rate of DVT in patients undergoing THA or TKA

Type of joint replacement			DVT within 90 days: No	DVT within 90 days: Yes	Total
Hip arthroplasty	Patients with no previous VV surgery or diagnosis	Total number	53,231	428	53,659
		%	99.2	0.8	100.0
	Patients with previous VV diagnosis and surgery	Total number	3451	27	3478
		%	99.2	0.8	100.0
	Patients with previous VV diagnosis but no documented surgery	Total number	220	7	227
		%	96.9	3.1	100.0
	Total	Number	56,902	462	57,364
		%	99.2	0.8	100.0
Knee arthroplasty	Patients with no previous VV surgery or diagnosis	Total number	47,526	281	47,807
		%	99.4	0.6	100.0
	Patients with previous VV diagnosis and surgery	Total number	3798	22	3820
		%	99.4	0.6	100.0
	Patients with previous VV diagnosis but no documented surgery	Total number	231	1	232
		%	99.6	0.4	100.0
	Total	Number	51,555	304	51,859
		%	99.4	0.6	100.0

reach statistical significance (Pearson χ^2 test, $\chi^2 = 0.8$, d.f. = 2, $P = 0.66$). Data are summarized in Table 2.

Deep Vein Thrombosis/Pulmonary Embolism

Overall, the combined incidence of DVT/PE in this population was 1.4% (829/57,364) in patients undergoing THA with 1.4% of cases (49/3429) occurring in patients who had previously undergone VV surgery and 1.4% (772/53,659) in patients with no previous VV diagnosis. In the THA cohort that had a VV diagnosis but no surgery the rate of combined DVT/PE was 3.5% (8/227), a difference that reached statistical significance (Pearson χ^2 test, $\chi^2 = 6.9$, d.f. = 2, $P = 0.03$). The combined incidence of DVT/PE in this population was 1.3% (691/51,859) in patients undergoing TKA with 1.5% of cases (56/3820) occurring in patients who had previously undergone VV surgery and 1.3% (632/47,807) in patients who did not have a previous VV diagnosis. In the TKA group that had a previous VV diagnosis but no surgery the rate of DVT/PE was 1.3% (3/232). There were no statistically significant findings in the TKA cohort. These results are summarized in Table 3.

Discussion

This study examined a large, retrospective data set to assess the risk of symptomatic DVT or PE associated with lower limb arthroplasty and any influence of previous VV diagnosis and surgery. Surgery of any type is a formidable risk for DVT. Lower limb arthroplasty is a particular risk, as the combination of hypercoagulability, vessel wall damage due to manipulation

TABLE 2 Rate of PE in patients undergoing THA or TKA

Type of joint replacement			PE within 90 days: No	PE within 90 days: Yes	Total
Hip arthroplasty	Patients with no previous VV surgery or diagnosis	Total number	53,283	376	53,659
		%	99.3	0.7	100.0
	Patients with previous VV diagnosis and surgery	Total number	3452	26	3478
		%	99.3	0.7	100.0
	Patients with previous varicose veins diagnosis but no documented operation	Total number	226	1	227
		%	99.6	0.4	100.0
	Total	Number	56,961	403	57,364
		%	99.3	0.7	100.0
Knee arthroplasty	Patients with no previous VV surgery or diagnosis	Total number	47,433	374	47,807
		%	99.2	0.8	100.0
	Patients with previous VV diagnosis and surgery	Total number	3785	35	3820
		%	99.1	0.9	100.0
	Patients with previous VV diagnosis but no documented surgery	Total number	230	2	232
		%	99.1	0.9	100.0
	Total	Number	51,448	411	51,859
		%	99.2	0.8	100.0

TABLE 3 Combined rate of DVT/PE in patients undergoing THA or TKA

Type of joint replacement			DVT/PE within 90 days No	DVT/PE within 90 days Yes	Total
Hip arthroplasty	Patients with no previous VV surgery or diagnosis	Total number	52,887	772	53,659
		%	98.6	1.4	100.0
	Patients with previous VV diagnosis and surgery	Total number	3429	49	3478
		%	98.6	1.4	100.0
	Patients with previous VV diagnosis but no documented surgery	Total number	219	8	227
		%	96.5	3.5	100.0
	Total	Number	56,535	829	57,364
		%	98.6	1.4	100.0
Knee arthroplasty	Patients with no previous VV surgery or diagnosis	Total number	47,175	632	47,807
		%	98.7	1.3	100.0
	Patients with previous VV diagnosis and surgery	Total number	3764	56	3820
		%	98.5	1.5	100.0
	Patients with previous VV diagnosis but no documented surgery	Total number	229	3	232
		%	98.7	1.3	100.0
	Total	Number	51,168	691	51,859
		%	98.7	1.3	100.0

and stasis due to immobility comes into play[10,11]. Lower extremity DVT is relatively common after TKA and THA[14,15]. A study by Schindler and Dalziel found the rate of asymptomatic DVT was 37.6% in knee patients and 34.0% in hip patients despite thromboprophylaxis with low-molecular-weight heparin[4], although prophylaxis does appear to reduce the risk of post-thrombotic syndrome[16]. The rationale behind thromboprophylaxis in patients undergoing total joint arthroplasty involves assessment of additional risk factors[8,17]. There is much discussion in published reports about the magnitude of risk factors, and the relative additional risks associated with use of heparin, fragmented heparin and the newer factor Xa inhibitors, as well as controversy about the clinical relevance of asymptomatic DVT[17–20].

The presence of VVs is an established increased risk for development of DVT after lower limb arthroplasty, because they contribute to venous stasis[9,21]. Few previous studies have attempted to determine whether previous VV stripping affects the probability of DVT post TKA or THA. A study from Romania concluded that surgical treatment of peripheral venous pathology in patients scheduled for TKA actually reduced the risk of postoperative DVT[22]. This report went so far as to state that preoperative treatment of varicose veins in the lower limb is mandatory for successful TKA. However, these conclusions were based on one patient with untreated VVs who had a proven DVT after knee replacement, compared with a group of 30 patients who had their VVs treated and who had two DVTs (6.6%) and one PE (3.5%)[22]. Furthermore, by their very nature VVs allow stasis of blood and up to 14% of patients who undergo VV surgery have clots in their venous branches, which lead to an increased risk of further thrombosis[21]. However, there is little evidence to quantify the relationship between previous VV surgery and TKA/THA-associated DVT. A study by van Rij *et al.* found that 5.3% of patients developed DVT within 12 months of VV stripping without another surgical intervention[23]. However, of this cohort, only eight were symptomatic and no patients developed symptoms consistent with PE. The authors concluded that, although the incidence of DVT following VV surgery was higher than previously thought, these DVTs had minimal short- or long-term clinical significance provided there were no other mitigating factors[23]. In a review of published reports, Guex concluded that superficial vein thromboses significantly increase the risk of future DVT[12].

Our data suggest that, for THA, the presence of untreated VVs significantly increases the risk of postoperative DVT, whereas the risk in patients with previous VV surgery is the same as in patients with no previous VV diagnosis. We did not see this effect in TKA patients and it did not translate to an increased risk of PE in either the THA or TKA patient groups. Proximal DVT in the absence of thromboprophylaxis reportedly occurs in 9%–20% of TKA patients and at a higher baseline rate of 23%–36% in THA patients[3].

A systematic review of randomized control trials concluded that, although the incidence of both total DVT and proximal DVT in patients undergoing elective TKA appears to have declined over time in patients enrolled in large clinical trials, DVT rates have not declined in patients undergoing THA[3]. In our study, we noted that VV intervention decreased the rate of DVT in the THA group but not in the TKA cohort.

Several important factors that influence rates of VTE in the THA and TKA cohorts are not present in both groups. Firstly, the average duration of surgery has steadily decreased over time. In 1996, the average duration of surgery was 124.3 minutes; by 2003, it had decreased to 97.3 minutes[3]. There is a documented relationship between the duration of anaesthesia and incidence of postoperative VTE in patients undergoing hip and knee arthroplasty[24].

Another important difference is some relevant patient variables in the THA versus the TKA group. Age is an important risk factor for development of DVTs[3]. With the increasing rate of obesity, there is a trend towards younger patients undergoing knee arthroplasties[3]. These patients may be less likely to have severe VV pathology and may be more capable of mobilizing earlier, thus reducing their overall rate of DVT. Furthermore, THA has become so standardized that the procedure is now offered to patients at high risk, particularly patients that are older and more fragile.

Another difference is placement and overall use of tourniquets by orthopedic surgeons when performing TKAs. While there is no consensus on the overall relationship between tourniquet application and DVT, the overall duration of tourniquet application has declined along with a decline in duration of surgery; hence, tourniquet impact on DVT rates would have also been less in the TKA group.

Overall, a variety of factors affect VTE rates. The difference noted in VV manipulation of the THA cohort is significant given the other factors that influence DVT rates and the established data that note a higher rate of symptomatic DVT in THA patients than in TKA patients[3].

Limitations

The use of joint registry data, cross-referenced with hospital morbidity data, allows assessment of large numbers of patients, something that is impossible at the level of individual units or even multi-centre studies. A potential weakness of such an approach lies in the quality of the coded data held centrally; it is possible that our study underestimates the rate of DVT by focusing on coded episodes of hospital admission. We attempted to account for this by including patients with previously diagnosed VVs but no documented surgery and their rates of DVT and PE.

Conclusion

Deep vein thrombosis and PE are major contributors worldwide to morbidity and mortality, one of the highest risk factors being lower limb arthroplasty. Because untreated VVs are associated with an increased risk of DVT after hip arthroplasty, maybe patients with VVs presenting for hip arthroplasty should consider treatment of their VVs prior to undergoing orthopedic interventions.

References

1. Silverstein MD, Heit JA, Mohr DN, *et al*. Trends in the incidence of deep vein thrombosis and pulmonary embolism: a 25-year population-based study. Arch Intern Med, 1998, 158: 585–593.

2. Anderson FA Jr, Wheeler HB, Goldberg RJ, *et al*. A population-based perspective of the hospital incidence and case-fatality rates of deep vein thrombosis and pulmonary embolism. The Worcester DVT Study. Arch Intern Med, 1991, 151: 933–938.

3. Xing KH, Morrison G, Lim W, *et al*. Has the incidence of deep vein thrombosis in patients undergoing total hip/knee arthroplasty changed over time? A systematic review of randomized controlled trials. Thromb Res, 2008, 123: 24–34.

4. Schindler OS, Dalziel R. Post-thrombotic syndrome after total hip or knee arthroplasty: incidence in patients with asymptomatic deep venous thrombosis. J Orthop Surg (Hong Kong), 2005, 13: 113–119.

5. Rossman I, Rodstein M, Bornstein A. Undiagnosed diseases in an aging population. Pulmonary embolism and bronchopneumonia. Arch Intern Med, 1974, 133: 366–369.

6. Sobreira ML, Maffei FH, Yoshida WB, *et al*. Prevalence of deep vein thrombosis and pulmonary embolism in superficial thrombophlebitis of the lower limbs: prospective study of 60 cases. Int Angiol, 2009, 28: 400–408.

7. Gross JS, Neufeld RR, Libow LS, *et al*. Autopsy study of the elderly institutionalized patient. Review of 234 autopsies. Arch Intern Med, 1988, 148: 173–176.

8. White RH, Henderson MC. Risk factors for venous thromboembolism after total hip and knee replacement surgery. Curr Opin Pulm Med, 2002, 8: 365–371.

9. Delis KT, Hunt N, Strachan RK, *et al*. Incidence, natural history and risk factors of deep vein thrombosis in elective knee arthroscopy. Thromb Haemost, 2001, 86: 817–821.

10. Meissner MH, Wakefield TW, Ascher E, *et al*. Acute venous disease: venous thrombosis and venous trauma. J Vasc Surg, 2007, 46 (Suppl. S): S25–S53.

11. Thomson H. The surgical anatomy of the superficial and perforating veins of the lower limb. Ann R Coll Surg Engl, 1979, 61: 198–205.

12. Guex JJ. Thrombotic complications of varicose veins. A literature review of the role of superficial venous thrombosis. Dermatol Surg, 1996, 22: 378–382.

13. Kearon C. Duration of venous thromboembolism prophylaxis after surgery. Chest, 2003, 124 (6 Suppl.): S386–S392.

14. Lonner JH, Frank J, McGuire K, *et al*. Postthrombotic syndrome after asymptomatic deep vein thrombosis following total knee and hip arthroplasty. Am J Orthop (Belle Mead NJ), 2006, 35: 469–472.

15. Lowe GD, Haverkate F, Thompson SG, *et al*. Prediction of deep vein thrombosis after elective hip replacement surgery by preoperative clinical and haemostatic variables: the ECAT DVT Study. European Concerted Action on Thrombosis. Thromb Haemost, 1999, 81: 879–886.

16. Mant MJ, Eurich DT, Russell DB, *et al*. Post-thrombotic syndrome after total hip arthroplasty is uncommon. Acta Orthop, 2008, 79: 794–799.

17. Colwell CW Jr. Rationale for thromboprophylaxis in lower joint arthroplasty. Am J Orthop (Belle Mead NJ), 2007, 36 (9 Suppl.): S11–S13.

18. Eikelboom JW, Karthikeyan G, Fagel N, *et al*. American Association of Orthopedic Surgeons and American College of Chest Physicians guidelines for venous thromboembolism prevention in hip and knee arthroplasty differ: what are the implications for clinicians and patients? Chest, 2009, 135: 513–520.

19. Geerts WH, Pineo GF, Heit JA, *et al*. Prevention of venous thromboembolism: the Seventh ACCP Conference on Antithrombotic and Thrombolytic Therapy. Chest, 2004, 126 (3 Suppl.): S338–S400.

20. Friedman RJ. New oral anticoagulants for thromboprophylaxis after total hip or knee arthroplasty. Orthopedics, 2009, 32 (12 Suppl.): S79–S84.

21. Campbell WB, Ridler BM. Varicose vein surgery and deep vein thrombosis. Br J Surg, 1995, 82: 1494–1497.

22. Ruxanda A, Grecu D, Surlin V, *et al*. Lower limb varicosity in patients, with indication for total knee arthroplasty. Chirurgia (Bucur), 2005, 100: 251–254. abstract only reviewed; Romanian publication.

23. van Rij AM, Chai J, Hill GB, *et al*. Incidence of deep vein thrombosis after varicose vein surgery. Br J Surg, 2004, 91: 1582–1585.

24. Jaffer AK, Barsoum WK, Krebs V, *et al*. Duration of anesthesia and venous thromboembolism after hip and knee arthroplasty. Mayo Clin Proc, 2005, 80: 732–738.