Thromboprophylaxis in patients undergoing total hip replacement

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Venous thromboembolism is a common complication following a hip replacement. It was the authors' impression that prophylaxis of deep vein thrombosis has changed in recent years. The authors felt that it was important to repeat a survey, done in 1997, on the use of thromboembolism prophylaxis among British orthopaedic surgeons.

Since the author's last survey (Francis and Brenkel, 1997), there have been a number of publications which may have influenced surgeons to alter their practice with regard to deep vein thrombosis (DVT) prophylaxis. The Pulmonary Embolism Prevention trial has been published (Pulmonary Embolism Prevention Trial Collaborative Group, 2000) which looked mainly at patients with a fractured neck of femur and showed that aspirin reduced the symptomatic DVT and pulmonary embolism (PE) rate by 36%. It was not able to show statistically significant reduction in the rate of venous thromboembolism (VTE) in patients undergoing total hip replacements.

Data on a synthetic factor X inhibitor (fondaparinux) (Turpie et al, 2002a) and a direct thrombin inhibitor (desirudin) (Eriksson et al, 1997) have also been published. Turpie et al (2002a) did a meta-analysis of 7300 patients undergoing hip and knee replacements and hip fracture patients. They showed that fondaparinux was over 50% more effective than enoxaparin, with similar complication rates. Eriksson et al (1997) reported that desirudin is safe and superior to low molecular weight heparin (LMWH) in preventing asymptomatic DVT in total hip replacement.

Some orthopaedic surgeons continue to question the effectiveness of prophylaxis in preventing fatal PE (Warwick et al, 1995; McGrath et al, 1996; Murray et al, 1996; Fender et al, 1997). The authors felt therefore that it was now important to look at the current thromboprophylaxis practice of British orthopaedic surgeons in patients undergoing total hip replacements.

METHOD

All 1308 current members of the British Orthopaedic Association were surveyed. In August 2001 (phase one), a single page questionnaire (*Figure 1*), accompanying letter and self-addressed envelope was sent to the member's home. In September 2001, a reminder was sent to those who did not respond in phase one (phase two). In phase three a letter was sent to the hospital addresses of those who failed to respond in phase two.

Figure 1. Questionnaire used for this survey.
SIGN = Scottish Intercollegiate Guidelines Network;
VTE = venous thromboembolism.

Antithrombotic prophylaxis in routine primary hip arthroplasty

Do you routinely perform primary total hip arthroplasty? Yes [ ] No [ ]
If the answer is yes, do you routinely use antithrombotic therapy for patients undergoing this surgery? Yes [ ] No [ ]
Do you have a departmental policy for VTE prophylaxis? Yes [ ] No [ ]
Years in practice < 5 [ ] 6–10 [ ] 11–15[ ] >15 [ ]
What prophylactic treatment do you now routinely use?

A. Pharmacological Yes [ ] No [ ]

[ ] Low dose heparin dose..... duration .....
[ ] Low molecular weight heparin dose .....
[ ] Clexane [ ] Fragmin [ ] Innohep [ ] other duration .....
[ ] Aspirin dose ..... duration.....
[ ] Warfarin dose ..... duration .....
[ ] Other Please specify..... dose ..... duration .....
.....

Do you start your pharmacological prophylaxis?
[ ] Preoperatively [ ] Intraoperatively [ ] Postoperatively

B. Mechanical

[ ] Intermittent calf compression or stimulation
[ ] Foot pump
[ ] Graded elastic stocking [ ] above knee [ ] below knee
Early mobilization Yes [ ] No [ ]
Have you changed the type of prophylaxis you use in the last 3 years? Yes [ ] No [ ]
Why do you use prophylaxis? Medical reasons [ ] Legal [ ] Both [ ]
Will the SIGN guidelines change your practice? Yes [ ] No [ ]
Resources permitting, would you extend prophylaxis after discharge from hospital? Yes [ ] No [ ]
If yes, number of weeks .....

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Members were asked if they routinely perform hip replacements. Those that did were asked if they had a hospital policy for DVT prophylaxis. Surgeons were asked what thromboprophylaxis they use in routine hip replacements. The authors were interested to find out if surgeons had changed their prophylaxis in the last 3 years and if prophylaxis was used for medical or legal reasons. Members were asked if they would use extended prophylaxis if resources permitted. Finally members were asked if the Scottish Intercollegiate Guidelines Network (SIGN) (www.sign.ac.uk/guidelines/fulltext/62/ index.html) would influence their choice of thromboprophylaxis. Surgeons were grouped into their health regions (*Table 1*) (www.netdoctor.co.uk/directory/authorities/). The reply rate from Ireland and Northern Ireland was too low to analyse separately.

TABLE 1.
Health regions

Region	Health authorities included
London	
Trent	Humber South, Derbyshire North, Rotherham, Lincolnshire, Derbyshire South, Leicestershire, Nottingham, Doncaster, Barnsley, Nottinghamshire North, Sheffield
North West	Cheshire, Lancashire North West, Salford and Trafford, Wigan and Bolton, Lancashire South, Stockport, Bury and Rochdale, Wirral, Morecombe Bay, West Pennine, Cheshire, Sefton, Lancashire East, Liverpool, St Helens and Knowsley, Manchester
West Midlands	Herefordshire, Wolverhampton, Coventry, Shropshire, Staffordshire North, Sandwell, Dudley, Walsall, Birmingham, Solihull, Worcestershire, Warwickshire, Staffordshire South
South West	North and East Devon, Gloucestershire, Avon, South and West Devon, Dorset, Cornwall and Isles of Scilly, Somerset, Wiltshire
South East	Berkshire, Northampton, Buckingham, Sussex East, Brighton and Hove, Sussex West, Kent East, Portsmouth and South East Hampshire, Isle of Wight Health, Kent West, Oxfordshire, Surrey East, Surrey West, North and Mid Hampshire
Eastern	Bedfordshire, Norfolk, Essex South, Herefordshire West, Suffolk, Essex North, Herefordshire East and North, Cambridge and Huntington
Northern and Yorkshire	Tees Health, Newcastle and North Tyneside, Cumbria, East Riding, Calderdale and Kirkless, Northumberland, Yorkshire North, Gateshead and South Tyne, Bradford, Sunderland Health, Leeds, County Durham, Wakefield
Scotland	
Wales	
Northern Ireland and Ireland	

RESULTS

Six hundred and six surgeons responded in phase one (46%). By the end of phase three, 941 surgeons (72%) had responded. Of these 67 had retired and 184 did not routinely do total hip replacements. This left 690 orthopaedic surgeons, which formed the core of this analysis.

All surgeons use some form of prophylaxis. Eighty five per cent of surgeons are using some form of pharmacological prophylaxis. This means mechanical prophylaxis alone is used by 15% of surgeons. Twenty per cent of surgeons use aspirin as their only form of pharmacological prophylaxis. Less than 1% (5 consultants) use early mobilization alone and nearly 2% (13 consultants) use graded stockings and early mobilization as their only form of prophylaxis. Seventy four per cent of surgeons have a unit policy on DVT prophylaxis (*Table 2*).

LMWH was used by 55% of consultants. Enoxaparin was the most common LMWH used, but this varied widely according to health regions. Only 26% used it in Scotland, while 82% used enoxaparin in Wales (*Table 3*). The

TABLE 2.
Use of thromboprophylaxis among British orthopaedic surgeons

	Total	Scotland	Northern and Yorkshire	North West	Trent	Wales	West Midlands	Eastern	South West	South East	London
Number	1308	116	132	133	112	54	120	124	119	224	109
Reply	941 72%	102 88%	98 74%	84 63%	90 80%	39 72%	85 71%	86 69%	89 76%	164 73%	61 56%
Doing total hip replacement	690 53%	74 64%	69 52%	63 47%	65 72%	31 79%	58 68%	66 77%	67 75%	127 77%	43 70%
Departmental policy for DVT prophylaxis	510 74%	57 77%	56 81%	46 73%	49 75%	22 68%	44 76%	40 61%	44 66%	99 78%	32 74%
Pharmacological prophylaxis	584 85%	69 93%	53 77%	54 86%	63 97%	20 65%	54 93%	56 85%	51 76%	101 80%	37 86%
Pharmacological prophylaxis excluding aspirin	449 65%	42 57%	39 57%	43 68%	49 75%	20 65%	50 74%	44 67%	37 55%	76 60%	35 81%
Aspirin without other pharmacological prophylaxis	141 20%	27 36%	14 20%	11 18%	14 22%	0 0%	5 9%	12 18%	14 21%	25 20%	2 5%
Mechanical prophylaxis only	103 15%	5 7%	17 25%	9 14%	2 3%	11 35%	4 7%	9 14%	16 24%	26 20%	7 16%

DVT = deep vein thrombosis

regimen used for LMWH was fairly consistent. Most consultants use the drug until discharge. Only two surgeons use LMWH for more than 2 weeks. The standard European dose was used by half of the surgeons, and the rest used half the recommended dose. Only 5% of British surgeons use low dose heparin (LDH) (*Table 3*).

Aspirin is used by 30% of British surgeons (*Table 4*). Most surgeons use aspirin 75 mg or 150 mg daily for 6 weeks. Warfarin is not popular in Britain and is used by 5% of surgeons (*Table 4*). Only 11 surgeons use dextran, one uses hydroxychloroquine and none use a thrombin inhibitor.

Although 91% of surgeons use mechanical prophylaxis, only 15% use mechanical prophylaxis without pharmacological prophylaxis (*Tables 2* and *5*). Intermittent calf compression (ICC) is used by 22% of surgeons. It is popular in Wales (45%), but unpopular in Scotland (9%). Foot pumps are used by 19% of surgeons (9% in Trent and 51% in the south west). Graded compression stockings (GCS) are used by 70% of surgeons (88% in Scotland and 58% in Wales). Below knee stockings are used by 53% (68% in the Northern and Yorkshire region and 33% in Wales) (*Table 5*).

Nearly half the consultants in Scotland (47%) have changed their regimen in the last 3 years, compared to 19% in London. The SIGN guidelines on DVT prophylaxis would influence 39% of Scottish surgeons to change their regimen, but only 3% of surgeons in the south west. Only 8% of surgeons use prophylaxis for legal reasons. Thirty per cent use it for medical reasons, while the majority use it for both medical and legal reasons. Forty five per cent of surgeons would use extended prophylaxis. Most said they would use it for 6 weeks. Forty seven per cent start prophylaxis preoperatively, only 10% start it intraoperatively and 33% start it postoperatively (10% did not answer this question).

Forty six per cent of surgeons use or would use extended prophylaxis if resources permitted. At present 21% of surgeons use aspirin for more than 4 weeks postoperatively. Only two surgeons use LMWH for 4 weeks or more, and only eight surgeons use warfarin for 4 weeks or more.

These results were compared with a similar survey done by the senior author in 1997 (Francis and Brenkel, 1997). The results show that LMWH is still the most common chemical agent used.

TABLE 3.
The use of LMWH among British orthopaedic surgeons

		Total	Scotland	Northern and Yorkshire	North West	Trent	Wales	West Midlands	Eastern	South West	South East	London
LDH	PP	31/584 5%	2/69 2%	1/53 1%	2/54 4%	6/63 10%	3/20 15%	2/54 4%	2/56 4%	6/51 12%	2/101 2%	5/37 14%
	THR	31/690 5%	2/74 2%	1/69 1%	2/63 3%	6/65 10%	3/31 10%	2/58 3%	2/66 3%	6/67 9%	2/127 2%	5/43 12%
LMWH	PP	381/584 65%	38/69 55%	36/53 68%	39/54 72%	39/63 62%	17/20 85%	28/54 52%	41/56 73%	30/51 59%	68/101 67%	29/37 78%
	THR	381/690 55%	38/74 51%	36/69 57%	39/63 62%	39/65 60%	17/31 55%	28/58 48%	41/66 62%	30/67 45%	68/127 54%	29/43 67%
Enoxaparin		202/381 53%	10/38 26%	14/36 39%	21/39 54%	20/39 51%	14/17 82%	17/28 61%	35/41 85%	14/30 47%	33/68 49%	13/29 45%
Dalteparin		120/381 31%	22/38 58%	19/36 53%	9/39 23%	10/39 26%	0/17 0%	7/28 25%	5/41 12%	11/30 37%	20/68 29%	16/29 55%
Tinzaparin		37/381 10%	3/38 8%	1/36 3%	5/39 13%	6/39 15%	1/17 6%	2/28 7%	1/41 2%	3/30 10%	11/68 16%	0/29 0%

LDH = low dose heparin; LMWH = low molecular weight heparin; PP = surgeons using pharmacological prophylaxis; THR = surgeons doing total hip replacements

TABLE 4.
Use of oral agents among British orthopaedic surgeons

		Total	Scotland	Northern and Yorkshire	North West	Trent	Wales	West Midlands	Eastern	South West	South East	London
Aspirin	PP	202/584 35%	38/69 55%	24/53 45%	17/54 31%	17/63 27%	3/20 15%	16/54 30%	18/56 32%	21/51 41%	36/101 36%	6/37 16%
	THR	202/690 30%	38/74 51%	24/69 35%	17/63 27%	17/65 26%	3/31 10%	16/58 28%	18/66 27%	21/67 31%	36/127 28%	6/43 14%
Warfarin	PP	31/584 5%	1/69 1%	0/53 0%	2/54 4%	4/63 6%	1/20 5%	13/54 24%	2/56 4%	2/51 4%	4/101 4%	1/37 3%
	THR	31/690 5%	1/74 1%	0/69 0%	2/63 3%	4/65 6%	1/31 3%	13/58 22%	2/66 3%	2/67 3%	4/127 4%	1/43 2%

PP = surgeons using pharmacological prophylaxis; THR = surgeons doing total hip replacements

TABLE 5.
Mechanical prophylaxis with pharmacological prophylaxis

		Total	Scotland	Northern and Yorkshire	North West	Trent	Wales	West Midlands	Eastern	South West	South East	London
Mechanical treatment		627/690 91%	68/74 92%	59/69 86%	57/63 90%	55/65 85%	28/31 90%	50/58 86%	61/66 92%	65/67 97%	115/127 91%	43/43 100
Intermittent calf compression		150/690 22%	7/74 9%	8/69 12%	21/63 19%	9/65 14%	14/31 45%	9/58 16%	17/66 26%	9/67 13%	29/127 23%	12/43 28%
Foot pump		129/690 19%	15/74 20%	8/69 12%	14/63 22%	6/65 9%	4/31 13%	6/58 10%	14/66 21%	34/67 51%	22/127 17%	4/43 9%
GCS		485/690 70%	59/74 80%	44/69 64%	38/63 60%	43/65 66%	18/31 58%	41/58 71%	41/58 74%	43/67 64%	101/127 80%	38/43 88%
GCS	Below knee	251/485 52%	35/59 59%	30/44 68%	16/38 42%	23/43 53%	6/18 33%	18/41 44%	26/49 53%	23/43 53%	48101 48%	24/38 63%
	Above knee	215/485 44%	22/59 37%	14/44 32%	21/38 53%	20/43 47%	12/18 66%	21/41 51%	22/49 45%	17/43 40%	44/101 44%	13/38 34%
	Not stated	20/485 4%	2/59 4%	0/44 0%	2/38 5%	0/43 0%	0/18 0%	2/41 5%	1/49 2%	3/43 7%	9/101 8%	1/38 3%

GCS = graded compression stocking

Fifty five per cent of surgeons use it compared to 65% in 1997. Aspirin use has increased from 5% to 30%. Warfarin and LDH use has fallen (*Table 6*). GCS are still used by nearly two thirds of surgeons. There has been a big increase in the use of ICC compared to 1997 (3% to 22%). Foot pump use has increased from 12% to 19% (*Table 6*).

DISCUSSION

This survey shows that LMWH remains the most common pharmacological agent used by British orthopaedic surgeons in hip replacement surgery. Many studies show that LMWH is the most effective way to reduce asymptomatic DVT compared to placebo (Lassen et al, 1991; Torholme et al, 1991), dextran (The Danish Enoxaparin Group, 1991) and LDH (German Hip Arthroplasty Trial (GHAT) Group, 1992; Colwell et al, 1994). There have been five large studies comparing LMWH to warfarin. If the results were pooled the DVT rates were 20% in the warfarin group and 13.7% in the LMWH group. The proximal DVT rate was 4.8% and 3.3% respectively (Geerts et al, 2001). In addition two meta-analysis studies showed LMWH to be the most effective agent in preventing asymptomatic DVT (Imperiale and Speroff, 1994; Freeman et al, 2000). These studies did not comment on clinical DVT. Colwell et al (1999), however, in a large prospective randomized trial, looked at clinical outcomes. They compared LMWH to warfarin. They found the incidence of VTE was 0.3% among patients receiving LMWH compared to 1.1% in the warfarin group. The benefit of LMWH was lost after hospital discharge when both treatments were stopped.

TABLE 6.
Deep vein thrombosis prophylaxis in total hip replacements in British orthopaedic surgeons 1997 *vs* 2001

Method	1997 (*n*=777)	2001 (*n*=690)
Low molecular weight heparin	474 (61%)	381 (55%)
Low dose heparin	83 (11%)	31 (5%)
Warfarin	60 (8%)	31 (5%)
Aspirin	35 (5%)	201 (30%)
Graded compression stocking	608 (78%)	485 (70%)
Intermittent calf compression	24 (3%)	150 (22%)
Foot pump	89 (12%)	129 (19%)

The current study found that 99% of surgeons in the UK use LMWH for less than 2 weeks. This may not be the most effective regimen for this drug. Dahl (2000) has shown that the risk of thrombosis extends beyond 5 weeks postoperatively. When LMWH is discontinued at hospital discharge there is an immediate increase in coagulation activity. This may predispose patients to thrombosis after discharge. This may explain the studies which showed that extended prophylaxis significantly reduced the DVT rate compared to in-hospital prophylaxis only (Cohen et al, 2001a; Eikelboom et al, 2001).

It may also explain the findings of White et al (2000) who used administrative data from the Californian Medicare records. They studied 297 patients who had undergone total hip replacements who were re-admitted with thromboembolism and compared them to 600 controls. They found that in-hospital prophylaxis of unfractionated heparin, LMWH and warfarin failed to decrease the thromboembolism rate. Prophylaxis with warfarin after discharge, however, was effective.

The timing of the initiation of prophylaxis seems to be important. In a meta-analysis Hull et al (2001) found that LMWH started 12 hours pre-

operatively or 12–24 hours postoperatively was no more effective than warfarin. LMWH started in close proximity to surgery at half the recommended dose resulted in a relative risk reduction of 42–55%. If the LMWH was started within 4–6 hours of surgery it provided superior efficacy compared to warfarin without increasing overt bleeding. If started 2 hours preoperatively it was just as efficient but caused more bleeding.

In North America only 15% of surgeons who responded to a survey use LMWH (Mesko et al, 2001), while in Canada 36% use this form of prophylaxis (Gross et al, 1999).

Very few surgeons in Britain, North America (Mesko et al, 2001) and Canada (Gross et al, 1999) use unfractionated heparin. This is not surprising as Palmer et al (1997) did a meta-analysis of 20 studies involving about 7000 patients between 1966–94. They demonstrated that LMWH was superior to standard LDH with respect to DVT and resulted in significantly fewer minor bleeding complications. A more recent meta-analysis (Freeman et al, 2000) looked at all randomized studies published from January 1996 to May 1998. Bilateral venograms had to be performed for the study to be included. Fifty-two studies which covered a total of 10 929 patients met the inclusion criteria. The risk of total DVT ranged from 17.7% (LMWH) to 31.1% (unfractionated heparin).

Warfarin therapy remains the most popular prophylactic method in the United States (67%; Mesko et al, 2001), and Canada (46%; Gross et al, 1997). In Britain only 5% use warfarin.

There has been a substantial increase in the use of aspirin. In 1997 only 4.5% of British surgeons used aspirin (Francis and Brenkel, 1997), compared to 30% in 2001. The most likely reasons are as follows:

1. The Pulmonary Embolism Prevention (Pulmonary Embolism Prevention Trial Collaborative Group, 2000) trial was published.
2. Sarmiento and Goswami (1999) administered aspirin after 1492 hip replacements. They found a fatal PE occurred in 0.13% of patients, non-fatal PE occurred in 0.94% of patients and a clinical DVT occurred in 1.01% of patients.
3. Evidence suggests that prophylaxis should be used for 4–6 weeks postoperatively (Cohen et al, 2001a; Eikelboom et al, 2001). Aspirin is perceived to be safe and can be given orally for an extended period of time.

Meta-analysis studies, however, looking specifically at hip arthroplasty, showed that aspirin has little effect in preventing asymptomatic DVT (Imperiale and Speroff, 1994; Freeman et al, 2000). A simple antiplatelet regimen would be practical and cost effective to administer after hospital discharge when the risk of VTE remains high. There is no evidence, however, that aspirin would be as effective as LMWH in decreasing the out-of-hospital asymptomatic and symptomatic DVT rate.

Only 22% of British surgeons use extended prophylaxis and most of these use aspirin. In North America 95% use extended prophylaxis. Warfarin is used by 50%, aspirin by 32% and LMWH by 9% for an average of 5 weeks (Mesko et al, 2001). In Canada 29% use extended prophylaxis (Gross et al, 1999).

GCS are more popular in Britain (70%) than in North America (43%) (Mesko et al, 2001) and Canada (34%) (Gross et al, 1999). Wells et al (1994), in a meta-analysis of GCS use, found only one proper randomized controlled study in patients undergoing total hip replacement. This study showed that 30% of patients treated with GCS had a venous thrombosis compared to 46% of the controls.

Hui et al (1996) showed that GCS were ineffective in preventing DVT after hip replacements. In a further study from the same department, Best et al (2000) showed that 98% of GCS failed to produce the ideal gradient of 18, 14 and 8 mmHg from the ankle to the knee. Fifty four per cent produced a reversed gradient. These patients had a significantly higher incidence of DVT than those with a normal gradient (25.6% *vs* 6.1%). Although this study had only small numbers and only used below knee stockings it suggested that below knee stockings were effective in preventing DVT. They also quoted three other studies which show that below knee stockings were as effective as their above knee counterparts.

In Britain 52% of surgeons use below knee stockings compared to 29% in North America (Mesko et al, 2001). Samama et al (1997) demonstrated that in patients undergoing total hip replacement there was a 50% reduction in the prevalence of DVT using GCS and LMWH over GCS alone. This was a small trial and larger randomized studies are required to show if GCS are effective in preventing DVT in patients undergoing total hip replacements on their own or in combination with some other form of prophylaxis. Despite their widespread use GCS are not free of side effects. Further research is required to justify the continued use of these devices in the modern management of orthopaedic surgery. A large randomized multicentre study is currently underway (Cohen et al, 2001b).

Pneumatic devices were used by 51% of North American hip surgeons, 24% use foot pumps and 26% ICC (Mesko et al, 2001). In Britain,

41% use pneumatic devices, 19% use foot pumps and 22% use ICC.

Paiement et al (1987) and Francis et al (1992) showed that ICC decreased calf thrombosis compared to warfarin, while warfarin had a better effect than ICC on proximal thrombi. A prospective audit showed ICC to be effective in decreasing the DVT rate after hip replacements (Hooker et al, 1999). A larger prospective randomized study is needed to confirm these findings.

Gardner and Fox (1983) demonstrated a large venous plexus in association with the lateral plantar arteries in the sole of the foot. When the metatarsal arch is flattened on weight bearing, this plexus is stretched, expressing about 30 ml of blood into the deep venous system of the lower limb. This bolus flushes the valve cusps where thrombi form and it may enhance fibrinolysis. Foot pumps have been developed to reproduce this physiological mechanism in patients who are unable to weight bear.

To date this technology has only been used in orthopaedic surgery. Most data suggest efficacy in prevention of asymptomatic DVT at discharge (Fordyce and Ling, 1992; Stannard et al, 1996; Warwick et al, 1998). There is no evidence that these devices reduce symptomatic DVT or PE. Skin necrosis has been reported. Discomfort from the device can lead to poor compliance.

The literature has shown that both fondaparinux and desirudin are more effective than LMWH in preventing asymptomatic DVT following a hip replacement (*Table 7*).

Turpie et al (2002a) did a meta-analysis of four multicentre, double blind randomized trials in patients undergoing elective hip replacement, (Lassen et al, 2002; Turpie et al, 2002b), elective major knee surgery (Bauer et al, 2001) and surgery for hip fractures (Eriksson et al, 2001) (n=7344). They compared fondaparinux 2.5 mg starting 6 hours after surgery with approved enoxaparin regimens in preventing VTE. They found that fondaparinux significantly reduced the incidence of VTE by day 11 (6.8%) compared with enoxaparin (13.7%). The benefit was seen across all types of surgery.

Although LMWH and fondaparinux substantially reduce the risk of VTE following total hip and knee replacements, they can only be given subcutaneously. Eriksson et al (2002) have published data on an oral direct thrombin inhibitor (ximelagatran). In a double blind randomized multicentre trial, they compared a dose response relation of subcutaneous melagatran followed by oral ximelagatran after total hip and knee replacements. They compared this regimen to a standard dose of dalteparin. The frequency of VTE was significantly lower with the highest dose of melagatran/ximelagatran compared to dalteparin (15.1% *vs* 28.2%). Excessive surgical bleeding was uncommon but more frequent in the highest dose group.

It remains to be seen whether British orthopaedic surgeons are convinced that these findings are sufficiently conclusive, and are willing to alter their practice on this basis.

TABLE 7.
Comparative efficacy of thromboprophylaxis in hip replacement

	Total DVT		Proximal DVT	
Prophylaxis regimen	Prevalence	Risk reduction	Prevalence	Risk reduction
Placebo/control	54%	–	27%	–
Graded compression stockings	42%	23%	26%	4%
Aspirin	40%	26%	11%	57%
Low dose heparin	30%	45%	19%	27%
Warfarin	22%	59%	5%	80%
Intermittent pneumatic compression	20%	63%	14%	48%
Desirudin	16%	70%	4%	85%
Low molecular weight heparin	16%	70%	6%	78%
Danaranoid	16%	70%	4%	85%
Adjusted dose heparin	14	74%	10%	62%
Fondaparinux	5%	88%	1%	96%

Adapted from Geerts et al (2001). DVT = deep vein thrombosis

CONCLUSION

This survey shows that the majority of British orthopaedic surgeons still use pharmacological thromboprophylaxis. Since the previous survey in 1997, there has been a significant increase in the use of aspirin from 5% to 30%. Aspirin is often combined with mechanical prophylaxis. This has led to an increase in the use of ICC (3% to 22%), and foot pumps (12% to 19%). LMWH use has fallen by 10%. HM

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Bauer KA, Eriksson BI, Lassen MR, Turpie AG (2001) Fondaparinux compared with enoxaparin for the prevention of venous thromboembolism after elective major knee surgery. *N Engl J Med* **345:** 1305–10

Best AJ, Williams S, Croszier A et al (2000) Graded compression stockings in elective orthopaedic surgery. An assessment of the in vivo performance of commercially available stockings in patients having a hip and knee replacement. *J Bone Joint Surg* **82-B:** 116–8

Cohen AT, Bailey CS, Aliknan R, Cooper DJ (2001a) Extended thromboprophylaxis with low molecular weight heparin reduces symptomatic venous thromboembolism following lower limb arthroplasty- a meta-analysis. *Thromb Haemost* **85:** 940–1

Cohen A, Brenkel IJ, Colerige-Smith P, Skinner J, Warick D, Phillips C (2001b) A multi-centre, randomised, open-label,

parallel group, comparative study of the efficacy and safety of once daily fondaparinux 2.5mg versus fondaparinux 2.5mg plus graduated compression stockings for the prevention of venous thromboembolism in patients undergoing elective or emergency hip surgery. British Orthopaedic Association symposium, Birmingham: 13 September
Colwell CW, Spiro TE, Trowbridge AA et al (1994) Use of Enoxoparin, a low molecular-weight heparin for the prevention of deep venous thrombosis after elective hip replacement. *J Bone Joint Surg (Am)* **76-A:** 3–14
Colwell CW, Jolla LA, Collis DK et al (1999) Comparison of Enoxaparin and warfarin for the prevention of venous thromboembolic disease after total hip replacement. *J Bone Joint Surg* **81-A:** 932–40
Dahl OE (2000) Continuing out of hospital; prophylaxis following major orthopaedic surgery: What now? *Haemostasis* **30**(suppl): 95–100
Eikelboom JW, Quinian DJ, Douketis JD (2001) Extended-duration prophylaxis against venous thromboembolism after total hip or knee replacement: a meta-analysis of the randomized trials. *Lancet* **358:** 9–15
Eriksson BI, Jorgenson PW, Kalebo P et al (1997) A comparison of recombinant hirudin with a low molecular weight heparin to prevent thrombo-embolic complications after total hip replacement. *N Engl J Med* **337:** 1329–35
Eriksson BI, Bauer KA, Lassen MR, Turpie AG (2001) Fondaparinux compared with enoxaparin for the prevention of venous thromboembolism after hip fracture surgery. *N Engl J Med* **345:** 1298–304
Eriksson BI, Berquest D, Kalebo P et al (2002) Ximelagatran and melagatran compared with dalteparin for prevention of venous thromboembolism after total hip replacement: the METHRO II randomized trial. *Lancet* **360:** 1441–7
Fender D, Harper WM, Thompson JR, Gregg PJ (1997) Mortality and fatal pulmonary embolism after primary total hip replacement. *J Bone Joint Surg* **79-B:** 896–9
Fordyce MJF, Ling RSM (1992) A venous foot pump reduces thrombosis after total hip replacement. *J Bone Joint Surg (Br)* **74-B:** 45–9
Francis CW, Pelligrini VD Jr, Marder VJ et al (1992) Comparison of warfarin and external pneumatic compression in prevention of venous thrombosis after total hip replacement. *JAMA* **267:** 2911–5
Francis RM, Brenkel IJ (1997) Survey on the use of thromboprophylaxis for routine hip replacements by British orthopaedic surgeons. *Br J Hosp Med* **57:** 427–31
Freeman KB, Brookenthal KR, Fitzgerald RH et al (2000) A meta-analysis of thromboembolic prophylaxis following elective total hip arthroplasty. *J Bone Joint Surg* **82-A:** 929–38
Gardner AMN, Fox RH (1983) The venous pump of the human foot: preliminary report. *Bristol Med Chir J* **98:** 109–14
Geerts WH, Heit JA, Clagett GP et al (2001) Prevention of venous thromboembolism. *Chest* **119:** 132S–175S
German Hip Arthroplasty Trial (GHAT) Group (1992) Prevention of deep vein thrombosis with low-molecular-weight-heparin in patients undergoing total hip replacement. A randomised trial. *Arch Orthop Trauma Surg* **63:** 133–43
Gross M, Anderson DR, Nagpal S, O'Brien B (1999) Venous thromboembolism prophylaxis after total hip or knee arthroplasty: a survey of Canadian orthopaedic surgeons. *Can J Surg* **42:** 457–61
Hooker JA, Lachiewicz PF, Kelley SS (1999) Efficiency of prophylaxis against thromboembolism with intermittent pneumatic compression after primary and revision hip replacement. *J Bone Joint Surg* **81:** 690–6
Hui AC, Heras-Palou C, Dunn I, Triffitt PD, Crozier A, Imeson J, Gregg PJ (1996) Graded compression stocking for prevention of deep-vein thrombosis after hip and knee replacement. *J Bone Joint Surg* **78-B:** 550–4
Hull RD, Pineo GF, Stein PD et al (2001) Timing of initial administration of low molecular weight heparin prophylaxis against deep vein thrombosis in patients following elective hip arthroplasty. *Arch Intern Med* **161:** 1952–60
Imperiale TF, Speroff T (1994) A meta-analysis of methods to prevent venous thromboembolism following total hip replacement. *JAMA* **271:** 1780–5
Lassen MR, Borris LC, Christiansen HM et al (1991) Prevention of thromboembolism in 190 hip arthroplasties: comparison of LMW heparin and placebo. *Acta Orthop Scand* **62:** 33–8
Lassen MR, Bauer KA, Eriksson BI, Turpie AG (2002) European Pentasaccharide Elective Surgery Study (EPHESUS). Post operative Fondaparinux versus preoperative Enoxaparin for the prevention of venous thromboembolism in elective hip replacement A randomized double blind comparison. *Lancet* **359:** 1715–20
McGrath D, Dennyson WG, Rolland M (1996) Death rate from pulmonary embolism following joint replacement surgery. *J R Coll Surg Ed* **41:** 265–6
Mesko JW, Brand RA, Iora R et al (2001) Venous thromboembolic disease management patterns in total hip arthroplasty and total knee arthroplasty patients. A survey of AAHKS members. *J Arthroplasty* **16:** 697–88
Murray DW, Britton AR, Bulstode CJK (1996) Thromboprophylaxis and death after total hip replacement. *J Bone Joint Surg* **78-B:** 863–70
Paiement GD, Wesinger SJ, Waltman AC et al (1987) Low-dose warfarin versus external pneumatic compression for prophylaxis against venous thromboembolism following total hip replacement. *J Arthroplasty* **2:** 23–6
Palmer AJ, Koppenhagen K, Kirchof B et al (1997) Efficiency and safety of low molecular weight heparin, unfractionated heparin and warfarin for thromboembolism prophylaxis in orthopaedic surgery. A meta-analysis of randomised clinical trial. *Haemostasis* **27:** 75–84
Pulmonary Embolism Prevention Trial Collaborative Group (2000) Prevention of fatal post operative pulmonary embolism and deep vein thrombosis with low dose aspirin; Pulmonary Embolism Prevention (PEP) trial. *Lancet* **355:** 1295–302
Samama CM, Clergue F, Barre J, Montefiore A, Ill P, Samii K (1997) Low molecular weight heparin associated with spinal anaesthesia and gradual compression stockings in total hip replacement surgery. Arar Study Group. *Br J Anaesth* **78**(6): 660–5
Sarmiento A, Goswami AD (1999) Thrombo-embolic prophylaxis with the use of aspirin, exercise and graded elastic stockings or intermittent compression devices in patients managed with a total hip replacement. *J Bone Joint Surg* **81-A:** 339–46
Stannard JP, Harris RM, Bucknell LA et al (1996) Prophylaxis of deep of deep venous thrombosis after total hip arthroplasty by using intermittent compression of the plantar venous plexus. *Am J Orthop* **25:** 127–34
The Danish Enoxaparin Group (1991) Low-molecular-weight-heparin (enoxaparin) vs dextran 70. The prevention of post operative deep vein thrombosis after total hip replacement. *Arch Intern Med* **151:** 1621–4
Torholme C, Broeeng L, Jorgensen PS et al (1991) Thromboprophylaxis by low-molecular-weight-heparin in elective hip surgery: a placebo controlled study. *J Bone Joint Surg* **73-B:** 434–8
Turpie AG, Bauer KA, Eriksson BI, Lassen MR (2002a) Fondaparinux compared with enoxaparin in major orthopaedic surgery: a meta-analysis of 4 randomized trials. *Arch Intern Med* **162**(16): 1806–8
Turpie AG, Bauer KA, Eriksson BI, Lassen MR (2002b) Postoperative fondaparinux versus postoperative enoxaparin for the prevention of venous thromboembolism after elective hip replacement surgery: a randomized double blind trial. *Lancet* **359:** 1721–6
Warwick DJ, Williams M, Bannister GC (1995) Death and thromboembolic disease after total hip replacement: a series of 1162 cases with no routine chemical prophylaxis. *J Bone Joint Surg (Br)* **77-B:** 6–10
Warwick D, Harrison J, Glew D et al (1998) Comparison of the use of a foot pump with the use of low molecular weight heparin for the prevention of deep venous thrombosis after total hip replacement. *J Bone Joint Surg* **80:** 1158–66
Wells PS, Lensing AWA, Hirsh J (1994) Graded compression stockings in the prevention of post operative venous thromboembolism. *Arch Intern Med* **154:** 67–72
White RH, Gettner S, Newman JM et al (2000) Predictors of rehospitalization for symptomatic venous thromboembolism after total hip replacement. *N Engl J Med* **343:** 1758–64

KEY POINTS

- The majority of British orthopaedic surgeons use pharmacological thromboprophylaxis in patients undergoing total hip replacements.
- Low molecular weight heparin is still the most common drug used.
- Aspirin use has increased from 5% to 30% in the last 5 years.
- Forty five per cent of surgeons would consider using extended prophylaxis.