The use of warfarin as thromboprophylaxis for lower limb arthroplasty

MARK R DUNBAR, PIYUSH K UPADHYAY, SHANMUGAM KARTHIKEYAN

Academic Department of Orthopaedics, Warwick Medical School, Clinical Sciences Research Institute, University Hospital, Coventry, UK

ABSTRACT

INTRODUCTION Most orthopaedic surgeons in the UK use some form of prophylaxis against venous thromboembolic events. Warfarin has been recommended as one of the preferred methods to use. The period of in-hospital postoperative rehabilitation has reduced significantly since lower limb arthroplasty was introduced. We sought to identify and quantify any delay in discharge associated in using warfarin as chemical prophylaxis.

PATIENTS AND METHODS During a 12-week period, all patients undergoing a lower limb arthroplasty procedure were identified and any delay in discharge related to their warfarin prophylaxis was recorded.

RESULTS Of the 25 arthroplasties performed in this time period, 17 (68%) were subject to a delay. The total delay in discharge was 39 days. When the standard warfarin dosing protocol was followed, 33% of patients were still delayed. When the protocol was not followed, only 23% were delayed. The majority of deviations from the protocol led to a shorter hospital stay.

DISCUSSION Patients using warfarin prophylaxis generate an additional cost of £417 related to bed occupancy. There is considerable scope for significantly reducing this cost by moving the early postoperative anticoagulation monitoring into the community. Delayed discharge is an important consideration in the economic issues that surround the choice of thromboprophylaxis.

KEYWORDS

Warfarin – Arthroplasty – Medical audit

CORRESPONDENCE TO

Mark R Dunbar, Clinical Research Fellow, Academic Department of Orthopaedics, Warwick Medical School, Clinical Sciences Research Institute, University Hospital, Clifford Bridge Road, Coventry CV2 2DX, UK

E: mdunbar@btinternet.com

Warfarin is a coumarin derivative and acts as an anticoagulant by interfering with the production of clotting factors. There is a time-lag of many hours between dose and response; therefore, close monitoring is required until a stable level of anticoagulation is achieved. This time-lag has several implications for both dosing and safe monitoring.

In the UK, many different methods are used as thromboprophylaxis for lower limb arthroplasty. Most orthopaedic surgeons use at least one method.¹ Chemical thromboprophylaxis (such as warfarin, low molecular weight heparin or aspirin) have been used either alone, or in combination with mechanical devices, such as stockings or sequential compression pumps.

There is extensive literature of variable quality regarding the efficacy of the different methods of prophylaxis. The studies where warfarin was used often differ in their treatment as target prothrombin times and International Normalised Ratios (INRs) vary from one centre to another. One of the more notable pieces of useful evidence was

produced by Amstutz *et al.*² where more than 3000 patients underwent total hip arthroplasty during the 1980s using warfarin as thromboprophylaxis. The rate of pulmonary embolism was 0.5% and no deaths occurred.

Total hip and total knee arthroplasty procedures increase the risk of developing venous thromboembolic events. In the past, the risk of fatal pulmonary embolism was thought to be as high as 1%;³ however, more recently, this risk has been shown to be significantly lower (0.1–0.2%).⁴ This has been attributed to many factors including improved operative and anaesthetic techniques, earlier mobilisation as well as routine use of thromboprophylaxis.

Total hip replacement was first performed in the 1930s and total knee replacement in the 1960s. Since that time, there have been significant changes both in the design of prostheses and in the techniques used for their implantation. More recently, there has been a move towards less invasive surgery which involves less soft tissue damage, smaller wounds and a faster recovery period.⁵

In the early days, it was common for patients to remain in hospital for several weeks after a joint replacement. These days, in most centres, patients no longer remain in hospital for a prolonged period of rehabilitation. Indeed, day-case joint replacement surgery is now a possibility. Patients' needs and health economics have changed significantly over the last few decades and a prolonged length of stay is undesirable. In the past, patients' postoperative rehabilitation was longer than the time taken for the initiation and stabilisation of warfarin therapy; now, patients may sometimes be ready for discharge before they have stabilised in the target range.

Given the aforementioned changes in postoperative regimen, it had become noticeable that many more patients were waiting in hospital solely for their INR to stabilise even though they were otherwise ready for discharge. We aimed to quantify this delay in discharge. We also wanted to examine whether or not doctors were prescribing as per protocol, and if deviation from the established protocol contributed to delay.

Patients and Methods

This study was carried out over a 12-week period in a hospital that performs elective orthopaedic surgery only. The eligibility criteria are listed in Table 1.

In order to be included, patients needed to have undergone one of the following types of lower limb arthroplasty: a total knee replacement, a unicondylar knee replacement, a patellar resurfacing, a total hip replacement, or a hip resurfacing. Patients also needed to be fit for discharge from a medical point of view. This meant that they were able to walk with the use of two sticks, were able to negotiate a single flight of stairs safely and had no on-going acute medical problems or local wound complications.

Patients were excluded if they were on a method of prophylaxis other than warfarin or if they required warfarin for

Stop NSAIDs unless rheumatoid	
Consider ranitidine if history of DU	
Pre-operative INR	
Day 1 (evening of surgery)	10 mg warfarin
Day 2	Omit warfarin
Day 3 – check INR	
INR > 2	Omit warfarin, INR next day
INR 1.5–2.0	Start at 2 mg warfarin
INR 1.5–2.0	3 mg warfarin, INR next day
INR < 1.5	4 mg warfarin, INR next day
Subsequently – check INR	
INR > 2	Omit warfarin, INR next day
INR 1.5–2.0	Same warfarin dose, INR in 2 days
Warfarin given yesterday	
INR 1.5–2.0	Reduce dose by 1 mg warfarin, INR in 2 days
No warfarin given yesterday	
INR < 1.5	Increase dose by 1 mg warfarin, INR next day

Figure 1 Warfarin dosing schedule.

another medical condition (*e.g.* atrial fibrillation or mechanical heart valve replacement).

Current departmental warfarin protocol

Within our own department, several different thromboprophylaxis regimens are being used. Seven of the 12 consultants who routinely perform joint replacement surgery used warfarin as their only method of prophylaxis. Warfarin prophylaxis was commenced in the evening, just after surgery had been performed with the aim of achieving a target INR of 1.5–2.0. It was continued for 3 weeks after discharge (Fig. 1). Graduated compression stockings were not routinely used.

Patients were discharged home when they had made an adequate recovery from their operation and once the INR was stable. The management of their warfarin regimen was then taken over by the out-patient anticoagulation clinic which is run by specialist nurses and supervised by a haematology consultant.

Information was collected on the total number of patients delayed and how long each was delayed for. The daily warfarin dosing schedule was examined to determine how closely the departmental protocol was followed. If there was any deviation from the protocol, a judgement was made as to whether the deviation led to a shorter or longer hospital stay.

Results

During the 12-week period, 25 joint replacements were performed on patients where warfarin was used for

Table 1 Inclusion and exclusion criteria

Inclusion criteria	
Total knee replacement	
Unicondylar knee replacement	
Patellofemoral resurfacing	
Total hip replacement	
Hip resurfacing	
Medically fit for discharge	
Exclusion criteria	
Prophylaxis other than warfarin	
Warfarin use for a medical condition

thromboprophylaxis. There was a total delay of 39 days comprising 17 (68%) patients, with most patients being delayed for between 1–3 days (Fig. 2). There was, therefore, an average delay of 1.6 days per patient which represents approximately 20% of the average length of stay. The longer delays of 6 and 8 days were in patients who were particularly resistant to warfarin therapy. The type of joint replacement had no effect on the average delay experienced by patients (Table 2)

Warfarin dosing compliance

Eight warfarin dosing charts were compliant and there was no discharge delay. Four charts were completely compliant with the established dosing schedule, but patients were still delayed. When the dosing schedule deviated from the protocol, all patients were delayed, but 10 (77%) would have ended up staying even longer if the protocol had not been modified to account for their response to warfarin. Three charts did not follow the protocol and this caused the additional delay.

When the warfarin dosing schedule was followed, 33% of patients were delayed.

Discussion

There is a delay in discharge associated with the use of warfarin as thromboprophylaxis for lower limb arthroplasty. This delay results in extra costs and unnecessary use of scarce resources such as bed-space and nursing time. In our trust, an in-patient bed for elective lower limb arthroplasty costs approximately £267 per day. Therefore, patients who are on warfarin generate an average additional cost of £417, purely in terms of bed-occupancy. In most cases, patients are keen to return to their familiar home environment as soon as possible and any unnecessary delay is frustrating. Indeed, during the study period, two patients self-discharged and left early (3-day and 6-day delays).

How could the delayed discharge be prevented? One solution would be to transfer the management of warfarin therapy into the community or out-patient department. Excluding transport costs, an out-patient attendance at an anticoagulation clinic costs less than £10 in our trust. Even if frequent checks are required in the early stages, this is still a considerable cost saving. Full-time employment of a community-based specialist nurse team may also provide savings. In the aggressive market-place of the modern UK healthcare system, where individual trusts compete for money from their primary care trust, any savings on a cost-per-case basis can mean the difference between a profitable service and a loss-making service.

Many of the other methods of thromboprophylaxis do not require such close monitoring and, therefore, should not contribute to delay. However, with the exception of aspirin, the drug-cost of all the other agents is greater than that of warfarin; although this cost-differential is reduced when the INR monitoring costs are included.^{6,7} However, the health economics surrounding postoperative thromboprophylaxis is complicated with many factors that have not yet been quantified satisfactorily.⁸ The three methods of prophylaxis that received the highest recommendation by the

Table 2 Discharge delay grouped by type of joint replacement

Joint replacement	Patients (n)	Patients delayed (n)	Days delayed (mean)*
Total knee replacement	7	5	12 (2.4)
Total hip replacement	10	7	15 (2.1)
Unicondylar knee replacement	3	2	4 (2.0)
Hip resurfacing	4	3	8 (2.3)
Patellofemoral resurfacing	1	0	0 (–)

*This includes only those patients that were subject to a delay. Analysis by one-way ANOVA showed that there was no significant difference ($P > 0.05$) in delay between any of these groups of patients.

American College of Chest Physicians are warfarin, Fondaparinux and low molecular weight heparin.⁹ When comparing these three methods, drug-cost, rate of complications and effectiveness at preventing venous thromboembolic events are all important.

Conclusions

We have shown that, from an economic point of view, delayed discharge caused by warfarin prophylaxis after joint arthroplasty is also an important consideration in the UK healthcare system.

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