In a chapter from his classic monograph “Low Friction Arthroplasty of The Hip” John Charnley stated “the possibility of fatal pulmonary embolism (PE) is a total hip replacement surgeon’s constant worry”.1 8% of the nearly 8000 patients he documented had a pulmonary embolism, of which 1% was fatal. In the cohort that received no prophylaxis, the results were twice as bad leading him to conclude that “all methods of prophylaxis are better than none and, therefore, it is no longer justifiable to use an untreated series as a control.”1

This conclusion holds true today. While there is widespread agreement that some type of prophylaxis must be utilised, surveys have revealed tremendous variability in approaches surgeons elect.2,3 Controversy and lack of uniformity over methods of prophylaxis resulted in the concern that patients were at risk for suboptimal prophylaxis or even no prophylaxis.

This void was filled by clinical practice guidelines (CPG’s). The effort was led by the American College of Chest Physicians (ACCP) and their first conference was held in 1985.5

There was virtually no orthopaedic surgery input until the 7th conference in 2004, when levels of recommendation were specifically categorised with the highest level being 1A defined as consistent support from large, randomised, multi-centre studies.6 In the same time frame, the U.S. federal government initiated programs mandating prophylaxis and the aggressive promotion of the highest level 1A recommendations became commonplace. The only agents accepted at the 1A level, from 2004-2012 for hip and knee replacement, was warfarin at a higher dose than had traditionally been used (target INR 2.5), low-molecular weight heparin, or a XA inhibitor, which at the time in the U.S. was only Fondaparinux. This group meets every four years and at the 8th conference, they recommended the same 1A drugs; however, there was more liberal recommendation for extended prophylaxis for up to five weeks, especially for hips and, once again, there was no risk stratification with aggressive pharmacoprophylaxis recommended for all patients.7

The landscape has changed dramatically in the last five years, most dramatically in the past year. Numerous issues were identified with the ACCP Guidelines. The analysis considered predominantly large, prospective, multi-centre randomised clinical trials with the end point of venographically proven DVT (the vast majority of which were asymptomatic). This essentially limited the studies under guideline consideration to the studies utilised to bring anticoagulant drugs to the marketplace. The resources to study low cost generic options such as aspirin, warfarin or compression devices could not reach the 1A level and; therefore, the vast published experience of leading total joint centres was largely ignored.

The historical orthopaedic U.S. standard had been low dose Coumadin with a target INR that would be in the 1.5 – 2.0 range. The pooled experience from leading total joint centres across the country has reported results as good as any anticoagulants recommended by the ACCP.8 The other issue with this methodology was the questionable clinical significance of asymptomatic DVT, the effect of lowering the incidence in DVT on the subsequent risk of symptomatic PE or death, which has not been well established, and has recently been brought into question.9

Despite these concerns, these guidelines were rapidly embraced by numerous groups, and the natural tendency was to use these guidelines as the safest standard for compliance.4 The implication clearly was the 1A protocol which was preferable, if not necessary, to meet federal guidelines, which was not the case.
The actual requirements did include aggressive drug protocols for hip replacement in addition to the option of compression devices for knee replacement but not for hip replacement. The dose and duration, however, was not specified for warfarin and aspirin (although not recommended) could be used with proper documentation. To determine whether there was concern over the routine widespread use of these “relatively aggressive” 1A protocols, one such protocol was studied. Lovenox was selected because of difficulty monitoring a high number of outpatients from across the region, which was necessary with warfarin, which previously had been utilised. The status of previous DVT prophylaxis at our facility had recently been published. The earlier protocol consisted of a short course of low-dose warfarin followed by ultrasound screening all of which was at odds with the Chest Physician Recommendations. In spite of this, the results with this unapproved protocol were excellent. There was high efficacy with no deaths (0.9% pulmonary embolism), high safety, high patient acceptance and relatively low cost. The Chest Physicians Recommendations in 2004 were against ultrasound screening at the 1A level, and recommended a higher dose and longer course of warfarin.

A prospective IRB-approved protocol was started in which patients were evaluated prior to discharge - at six weeks and six months - for wound drainage, complications, readmissions, injection site problems satisfaction and compliance. Data was only collected on about 300 patients, although the original study anticipated studying 2,000 patients. The study was terminated early due to concern for patient safety. The results were compared to the previous study from the same centre. The data showed that the major complication rate was four times higher and there was a higher incidence of DVT and PE because once patients have bleeding or excessive drainage, their anticoagulation is frequently stopped. There was also a higher incidence of wound problems and return to the operating room (Figures 1A & 1B).
Our results, and those of the University of Virginia with the unapproved protocol, were excellent and with a 1A protocol were poor.\textsuperscript{10,11,12}

Excellent results have been reported for aspirin from a number of American centres.\textsuperscript{13,14} Raphael et al recently reported the experience at the Rothman Institute with aspirin and actually had a lower incidence of PE in patients matched for co-morbidities and demographics.\textsuperscript{9}

A study from Great Britain using a large database, reported that aspirin efficacy was equivalent to low-molecular weight heparin.\textsuperscript{15}

Another major issue with the ACCP guidelines is under reporting of complications. There are many hospital readmissions of patients on 1A protocols that don’t meet ACCP guidelines of a major bleed defined as overt bleeding associated with at least one of the following: death or life-threatening clinical event, bleeding confirmed to be retroperitoneal, intracranial or intraocular, transfusion of more than two units blood, or a decrease in haemoglobin greater than 20 g/l compared with the relevant post-operative level.\textsuperscript{16} Bleeding sufficient to cause a substantial haemarthrosis following TKA (Figure 2) usually will not meet these criteria, yet will frequently lead to a poor clinical result.\textsuperscript{17-19}

A recent database analysis showed a higher infection rate associated with LMWH and suggested that this should be indicated in future analyses.\textsuperscript{20} The orthopaedic literature has consistently confirmed a link between prolonged drainage and infection drainage.\textsuperscript{19,21,22}

Yet another issue with Chest Physicians Guidelines was virtually all of the authors had numerous conflicts of interest.\textsuperscript{23}

The response to the numerous problems identified with the ACCP was the AAOS forming DVT/PE workgroup in 2007, which was updated in 2011.\textsuperscript{24} The goal was to obtain balance in minimising risk while maximising efficacy. Patients were classified based on risk for PE and risk for bleeding. The data was not sufficient to recommend any commonly used modality. Both aspirin and mechanical compression devices were accepted for hip and knee replacement. A more rational approach was recommended, with more aggressive prophylaxis for those with prior VTE and less aggressive for those with bleeding disorders. This placed the Academy in direct conflict with Chest Physicians in every recommendation until last year.

The matter was resolved in 2012 with the 9th edition of the Chest Physician Guidelines.\textsuperscript{25} The conflict of interest issue was addressed as the majority of authors had no conflicts to disclose in stark contrast to the previous guidelines. The methodology changed with the focus placed on clinically important outcomes rather asymptomatic DVT with a major focus on bleeding and wound drainage.\textsuperscript{19}

There were no 1A recommendations because of inadequate evidence when only clinical endpoints were utilised. Such events are currently so rare that an adequately, statistically-powered study would require well over 30,000 patients.\textsuperscript{15,26} The 1B recommendations included every commonly used strategy, including newer anticoagulants (Xa inhibitors and direct thrombin inhibitors), adjusted dose Coumadin, aspirin and intermittent pneumatic compression devices (IPCD) were accepted at the 1C level. >>

Figure 2: Postoperative haematoma in a Total Knee which occurred when INR exceeded 3.0, resulting in persistent pain, stiffness and a compromised clinical result.
When an IPCD is utilised, a mobile device with a compliance monitoring chip was recommended. This is a new technology that is worn continuously, ideally eighteen or more hours daily. The next generation device has the potential to detect proximal flow obstruction and is currently under development. Results with such a device have been as good as a 1A drug (Lovenox) in a randomised trial with similar excellent results in a larger multi-centre registry study. New oral anticoagulants advocated by the ACCP have positive and negative features. While they don’t require monitoring and are relatively inexpensive, they are difficult to monitor or to reverse. Also, while they are touted as equivalent to or better than low-molecular weight heparin in preventing DVT, which are largely asymptomatic, the incidence of bleeding and wound complications has been reported by numerous orthopaedic surgeons to be significantly increased.

The ACCP and the AAOS are now largely in agreement for the first time. Both focus on clinically symptomatic events and avoiding complications. Both recognise all major options for prophylaxis, including aspirin and compression devices. The initial experience with a mobile compression device with a monitoring chip has been positive and is clearly adequate for the vast majority of total joint patients.

A final piece of the puzzle has fallen into place just recently. The Center for Medicare and Medicaid Services (CMS) administers the Surgical Care Improvement Program (SCIP) which monitors compliance with VTE prophylaxis practices for hospitalised patients. Previously, their audit guidelines were largely in accordance with the pre-2012 ACCP guidelines (although allowing compression devices for TKA, but not THA). It was recently announced that aspirin and compression devices will be viewed as acceptable for THA, TKA, and hip fracture in alignment with the new recommendations of both the AAOS and the ACCP.

John Charnley was a visionary regarding most aspects of total hip arthroplasty. Regarding thromboembolism, he stated that “a better quality of early function might have helped to reduce pulmonary embolism,” and, secondly, that “if a prophylactic agent were so effective that it completely suppressed clot formation in the calf it might interfere with the beneficial aspects of the clotting mechanism so necessary inside the operated hip.” THA today is a faster, less-invasive procedure, mobilisation far quicker, and, according to Charnley, avoided the need for prophylaxis.

References


37. Charnley J. Prophylaxis of postoperative thromboembolism [abstract]. Lancet 1972;2:134-5. The author attests that he has received research support for a device related to DVT prophylaxis but has had full control of the article and data used therein.