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Thromboembolism in orthopaedic surgery

Guest Editorial

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One of the classical contributions on thromboembolism is from the field of orthopaedic surgery. Sevitt & Gallagher demonstrated in a paper in *The Lancet* in 1959 on "Prevention of venous thrombosis and pulmonary embolism in injured patients", not only that pulmonary embolism is a common cause of death after hip fractures, but also that mortality can be decreased by prophylaxis with oral anticoagulants.

For many years following this paper most research on thromboembolism was done by general surgeons, but during the last decade orthopaedic surgeons have become more and more active in this field. Their interest in this area has been further stimulated by new extensive orthopaedic procedures, notably hip arthroplasty. Following this procedure, at least 1 per cent of the patients die from pulmonary embolism unless they are given specific prophylaxis; using objective diagnostic methods, such as the ^{125}I-fibrinogen test or phlebography, more than half of the patients are found to develop deep venous thrombosis (DVT) (Bergqvist 1983). Other orthopaedic operations which carry a high risk of thromboembolism are fracture surgery, amputations, operations on the vertebrae, total knee replacement and even extirpation of a meniscus. Many of these operations are not undertaken for a life-threatening disease, but with the purpose of improving the quality of life, which makes it even more difficult to accept potentially fatal complications. Recent data suggest that the incidence of post-thrombotic venous insufficiency also is high after DVT following orthopaedic surgery.

Pathogenetic factors

The pathogenesis of postoperative DVT is multifactorial. Decreased venous flow rate and changes within the haemostatic system are now well documented, most commonly leading to the formation of calf vein thrombosis. After lower limb and hip surgery, there is also a risk for development of another type of thrombus formed in direct connection to the operative trauma, where gross endothelial damage is of pathogenetic importance. In this specific situation it is possible that platelet adhesion and aggregation play a greater role than usual in postoperative DVT.

In order to give selective thromboprophylaxis, much work has recently been done to define risk factors and to identify risk patients preoperatively. It has not yet been possible to find simple laboratory tests to solve this problem. There are, however, some clinical parameters which are important, the most obvious being the patient's age. Other factors are previous thromboembolism, malignancy, infectious complications, magnitude of surgical trauma, type of anaesthesia, presence of severe heart disease and hemiparesis. As far as orthopaedic surgery is concerned, preoperative

trauma, i.e. hip fracture before hip surgery, also increases the risk (Ahlberg et al. 1968). On the other hand, in hip arthroplasty, rheumatoid arthritis and a posterior operative approach decrease the risk (Buchanan & Kraag 1980, Gallus et al. 1983). An intraoperative bloodless field with a tourniquet probably increases the risk. Total knee replacement is associated with a higher incidence of DVT than total hip replacement (Buchanan & Kraag 1980).

The use of specific prophylaxis

In accordance with this relatively crude risk factor identification, it is reasonable to give specific thromboprophylaxis to all patients over 40–50 years of age, undergoing operations of at least 1 hour's duration. In addition, some special groups of younger patients with a particularly high risk of developing DVT may deserve prophylaxis. Examples are patients with previous DVT, patients with fracture, or patients subjected to a major trauma such as total hip replacement or scoliosis surgery. The scanty data that are available indicate that it is economically more beneficial to use a general prophylaxis than either no prophylaxis at all, or general screening and treatment when DVT is diagnosed – both attitudes which are advocated by some colleagues.

The problem is, however, what kind of prophylaxis to use. An ideal method must be effective, work already peroperatively, be simple, safe and inexpensive, and require no laboratory analysis. In orthopaedics, one of the following methods might be considered:

1. *Oral anticoagulants.* This is a classical thromboprophylactic method since Sevitt & Gallagher (1959) demonstrated its value. However, it has some drawbacks: to be effective peroperatively it must be started preoperatively, it carries a definite risk of bleeding complications, and it cannot be used without frequent laboratory analyses. However, it may be advantageous in patients who require long-term prophylaxis, for instance those in continuous traction.
2. *Dextran.* There are several studies showing the effectiveness of dextran in decreasing the incidence of thromboembolic complications in orthopaedic surgery, reducing the frequency of both DVT and fatal pulmonary embolism (Bergentz 1978, Fredin et al. 1984). Anaphylactoid reactions, previously a feared complication, can now be effectively prevented by preinfusion of hapten dextran (Renck et al. 1983). Plasma volume expansion with increased cardiac load must be kept in mind, especially in elderly patients. In a recent study in patients with hip fracture, the addition of dihydroergotamine significantly potentiated the prophylactic effect of dextran (Bergqvist et al. 1984a). Dextran 70 is given as 500 ml intraoperatively, 500 ml immediately postoperatively and 500 ml on Day 1 postoperatively. In immobilized patients another 500 ml may be given on Days 3 and 5. Provided this dose is not exceeded, bleeding problems are extremely rare. Care should be taken, however, in patients with any type of bleeding diathesis.
3. *Low-dose heparin* alone does not seem to be effective enough in orthopaedic surgery, especially in fracture surgery. In those patients the coagulation system is already activated when they arrive at the hospital. Observations in hip arthroplasty patients have recently suggested that it is possible to obtain a good effect with individual dosage according to activated partial thromboplastin time analyses (Leyvraz et al. 1983). However, this makes the management of prophylaxis rather complicated for routine use.
4. *Dihydroergotamine in combination with low-dose heparin* gives an effective prophylaxis in orthopaedic patients, also after hip fractures. In an extensive Swiss multicenter trial it was shown to be equal to dextran in reducing the frequency of fatal pulmonary embolism (Gruber 1982). Half a mg of dihydroergotamine is given subcutaneously in combination with 5000 IU of heparin with the first injection preoperatively, and then every 12 h for at least 7 days. The risk of side effects from the dihydroergotamine is extremely low, but care should be taken in patients with arterial insufficiency. Bleeding problems from the heparin are relatively rare, but are probably more common than after dextran (Fredin et al. 1984).

5. *Platelet function inhibitors* have largely been found to be ineffective. However, in a few studies, also under way, acetylsalicylic acid (ASA) has been shown to prevent DVT in male patients undergoing elective hip surgery (Harris et al. 1977). This sex difference of ASA has also been documented in rabbits.
6. *Mechanical methods,* such as intermittent leg compression or graded elastic compression, have given conflicting results, but do not seem to be the optimal way to prevent thromboembolism in orthopaedic surgery. Present data indicate that distal calf vein thrombi can be abolished but not proximal thrombi (Gallus et al. 1983).

Clinically relevant methods today are dextran and dihydroergotamine-heparin. The scientific documentation on dextran is so far more extensive, as it has been used for a longer period.

The Future

The thromboprophylactic situation is continuously changing. Surgery is possible in older patients, new operations appear and new drugs are made available. Of great interest now is heparin with a low molecular weight of around 4000–5000 daltons which effectively inhibits factor Xa with little effect on thrombin. Theoretically, it should work thromboprophylactically with little risk for haemorrhagic complications (Bergqvist et al. 1984b). Research activities are also being directed to finding heparin analogues. At least one – sodium pentosan polysulphate – seems to be effective in hip surgery (Bergqvist et al. 1980, Fredin et al. 1982).

As DVT is multifactorial, it is logical to evaluate the possible potentiation of combination prophylaxis. Dihydroergotamine in combination with low-dose heparin and dextran has already been mentioned. Other potential combinations are dextran and oral anticoagulants (with a certain bleeding risk) and dextran and graded mechanical compression.

In conclusion, orthopaedic patients run a high risk of developing postoperative thromboembolic complications. A simple, effective and economic way of treating this problem is to institute a general prophylaxis in patients over 40–50 years of age, undergoing surgery of the trunk or lower extremities of at least 1 hour's duration. Today, there are two generally applicable prophylactic methods which are equally effective – dextran and low-dose heparin in combination with dihydroergotamine.

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