ABSTRACT
Deep vein thrombosis (DVT) and pulmonary embolism are serious complications following hip and knee replacement surgery. Both surgical procedures have significantly high postoperative rates of DVT. In total hip replacement, the rate of proximal thrombi tends to be higher. However, total knee replacement produces a high rate of calf thrombi and a higher overall rate of thrombosis.

In a search for innovative ways to reduce the risk of thrombosis, three types of anesthesia were examined: general anesthesia, epidural anesthesia, and hypotensive epidural anesthesia in which a controlled hypotension is provided. The hypotension commonly exists with epidural anesthesia also, unless blood pressure is maintained with an agent such as ephedrine. When blood pressure is allowed to drop in a controlled fashion, hypotensive anesthesia is effected.

HYPOTENSIVE EPIDURAL ANESTHESIA IN HIP REPLACEMENT SURGERY
Lieberman and Salvati1 examined the rates of deep vein thrombosis (DVT) in primary total hip replacement under hypotensive epidural anesthesia. Two hundred fifty patients were randomly assigned to receive either aspirin and pneumatic compression boots or aspirin alone as the primary form of prophylaxis. Venography was performed on each patient on the seventh postoperative day. The mean operative time was 86 minutes, minimizing the time that the leg was in a dislocated position, possibly kinking the femoral vein. Intraoperative blood loss was 220 mL, and the mean number of blood units transfused was 1 mL. The overall DVT rate, combining proximal and distal rates, was 6% in the aspirin group and 6% in the group that received aspirin and compression boots.

A similar follow-up study also was performed by Salvati and Huk.2 They used three prophylactic modalities: aspirin, indomethacin (Indocin), and warfarin (Coumadin). Venography, once again, was performed on the seventh postoperative day. Four hundred patients were enrolled with findings similar to those of the previously described study (Fig 1). The DVT rate, ranging from 6-10%, was much lower than the historical control and much lower than rates of DVT from previous experimentation.3-6

Normotensive epidural anesthesia also appears to lower the rate of DVT to roughly half the rate of general anesthesia.7,8 In venographic studies of patients who received epidural anesthesia with no prophylaxis, DVT rates were not low (33% and 40%), but they were much lower than with general anesthesia.
Reduction in DVT rate can be attributed to three factors. First, increased blood flow is obtained in the leg when you use an epidural anesthesia. Second, it is postulated that the epidural anesthesia itself may stimulate, or at least limit, the inhibition of the fibrinolytic system, thus avoiding a hypercoagulable state. Third, there is less blood loss, probably affecting the rate of thrombosis.

**Hypotensive Epidural Anesthesia in Knee Replacement Surgery**

In total knee replacement, the rate of DVT may be reduced with epidural anesthesia, although it is probably not clinically significant. In a retrospective review of 541 patients with 705 primary total knee replacements, aspirin was the primary prophylactic, venography was done on the fourth to sixth postoperative day, and lung scan was done on the fifth to seventh postoperative day.

In the Hospital for Special Surgery in New York, around 1986, there was a large increase in the use of epidural anesthesia, corresponding to a decrease in use of general anesthesia (see Table and Fig 2). In comparing the incidence of DVT using the two types of anesthesia, it is obvious that, in both unilateral and bilateral procedures, there was an overall reduction with epidural anesthesia, but the rates were still high (65-42%) (Fig 3). The incidence of positive lung scans was reduced also, from 9% to 6%, which may be clinically significant.

To assess the risk for DVT using epidural versus general anesthesia, we conducted a randomized, prospective study. Routine protocol using continuous passive motion was begun in the recovery room, a tourniquet was used, and ambulation was started on the second postoperative day. Aspirin was the method of prophylaxis, and all patients underwent postoperative venography.

One hundred forty patients were randomly assigned to receive either general anesthesia (78) or epidural anesthesia (62). The group receiving general anesthesia had a 48% rate of DVT compared to the epidural group with a rate of 40%. In this study, there was no difference in the rate of positive lung scans.

**Discussion and Conclusion**

These findings demonstrate a difference between epidural and general anesthesia in rates of
DVT following hip surgery but not following knee surgery. However, the major difference is probably the use of a tourniquet. The intraoperative change in blood flow with epidural anesthesia has no effect in total knee arthroplasty because of the use of the tourniquet. There could also be differences in the postoperative stasis.

Total hip replacement performed under epidural anesthesia results in fewer DVTs. Hypotensive epidural anesthesia appears to provide even greater protection. While epidural anesthesia may lower the DVT rate following total knee replacement, the reduction appears to be negligible. However, it is clear that routine DVT prophylaxis is necessary in all total joint replacements.

REFERENCES