Original Research
Comparison of General and Epidural Anesthesia in Patients Undergoing Primary Unilateral THR

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ABSTRACT

One hundred ninety-five consecutive patients underwent 195 primary unilateral total hip arthroplasties between January 1988 and December 1993. Patients were divided into three groups based on the type of anesthesia utilized for their procedure. Group I consisted of 108 patients (59 women and 49 men; average age 56 years) who had general endotracheal anesthesia alone. Group II consisted of 70 patients (41 women and 29 men, average age 58 years) who had general endotracheal anesthesia with epidural augmentation intraoperatively and postoperatively. Group III consisted of 17 patients (6 women and 11 men, average age 62 years) who had epidural anesthesia only. Data were analyzed by anesthesia group to compare a variety of clinically relevant factors. No statistically significant differences among groups were noted regarding average age at surgery, the underlying diagnoses leading to joint replacement, the number of preexisting medical conditions, length of hospitalization, nonsurgical operating room time, intraoperative blood transfusions, intraoperative femur fractures, deep venous thrombosis, deep infections, death, or the prevalence of postoperative urinary tract infections. Postoperative urinary tract infections correlated with duration of Foley catheterization, but not the duration of epidural catheterization. Significant differences among anesthesia groups were observed for two factors: 1) estimated intraoperative blood loss was highest for Group I (P < .05) and was primarily a function of surgical time (P < .0001), and 2) postoperative Hemovac output (over the first and second postoperative 24-hour periods) was greatest for Group II (P < .05). Epidural anesthesia appears to be a safe modality in patients undergoing primary unilateral total hip replacement.

Although a number of surgeons performing total hip replacements (THR) prefer using regional anesthesia, either alone or in conjunction with general anesthesia, there is little information regarding the relative safety of this anesthetic modality. The reported advantages of regional anesthesia over general anesthesia in patients undergoing THR include a lower incidence of deep vein thrombosis, less intraoperative and postoperative blood loss, reduced blood replacement, and reduced coagulability (a more rapid return to normal levels of antithrombin III). By contrast, Lessire et al10 found a significant decrease in cardiac output in patients undergoing THR under general anesthesia with epidural augmentation, and speculated that this type of anesthesia “could lead to significant cardiovascular instability and cardiac depression and therefore should be used with caution in the high-risk patient.”

Few investigators have examined the overall safety of regional compared to general anesthesia in patients undergoing THR. In 1975, Sculco and Ranawat5 studied the effects of spinal and general anesthesia in 199 patients undergoing THR. These authors reported a reduction in total blood loss, operative blood loss, postoperative suction drainage, blood replacement, and postoperative complications in the spinal anesthesia group, and suggested that

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spinal anesthesia is the preferred modality in patients undergoing THR.

The purpose of this study was to compare the perioperative outcomes of patients undergoing primary unilateral THR under general endotracheal anesthesia, general endotracheal anesthesia with epidural augmentation, and epidural anesthesia alone. The specific aims of this study were to assess whether the type of anesthetic effects a variety of clinical factors including mortality, intraoperative blood loss, operative time, postoperative blood loss, intraoperative and postoperative complications, and length of hospitalization.

**MATERIALS AND METHODS**

Using a hospital-based computer information system, 464 consecutive cases were identified from ICD-9 codes as having undergone a hip replacement between January 1988 and December 1993 at Hermann Hospital, Houston, Tex. Two-hundred sixty-nine cases identified as either revision THR, hemiarthroplasty, or bilateral THR were excluded from the analysis. The remaining 195 patients who underwent 195 primary operations performed by 21 attending surgeons constituted the study group. Three different types of anesthesia were used. Group I consisted of 108 patients who underwent 108 operations under general endotracheal anesthesia alone. Group II consisted of 70 patients who underwent 70 operations under general endotracheal anesthesia with epidural augmentation intraoperatively and postoperatively. Group III consisted of 17 patients who underwent 17 operations under epidural anesthesia alone. Epidural catheters were placed in the operating room for all cases in which they were used. All 195 patients underwent THR using the posterior (Kocher-Langenbach) approach.

The medical record of each patient was analyzed to determine the type of anesthesia, age, gender, tobacco use, diagnosis (related to the hip), American Society of Anesthesiologists (ASA) Physical Status Class, prevalence of preexisting medical illnesses (including: hypertension, malignancy, angina pectoris, coronary artery disease, diabetes [requiring daily medication], renal disease, peripheral vascular disease, asthma [requiring daily medication], chronic obstructive pulmonary disease, cerebrovascular accident [in the past], myocardial infarction [in the past], and liver disease), surgeon, length of hospitalization, type of prosthetic fixation (cemented or cementless), total operating room time (the time actually billed to the patient; this reflects both the set-up and take-down time), surgical time, non-surgical operating room time, estimated intraoperative blood loss, postoperative Hemovac output during the first, second, and third postoperative 24-hour periods, intraoperative complications, volume of blood transfused intraoperatively, duration of Foley catheterization, duration of postoperative epidural catheterization, and postoperative complications. Data regarding length of hospitalization and duration of postoperative Foley and epidural catheterization were rounded to the nearest day.

A summary of demographic data for all patients is shown in Table 1. The average age of all patients in Group I was 56 years (range: 21 to 88). Fifty-nine patients were women and 49 were men. The underlying diagnoses were osteoarthritis in 65 patients (60%), osteonecrosis in 26 (24%), posttraumatic arthritis in 6 (6%), rheumatoid arthritis in 4 (4%), developmental dysplasia of the hip in 4 (4%), and 1 patient each with Legg-Calvé-Perthes disease, ankylosing spondylitis, and multiple epiphyseal dysplasia. The average number of preexisting medical illnesses was 1.4 (range: 0 to 5). Forty patients (37%) were smokers. Nineteen patients (18%) had cemented or hybrid prostheses, while 89 patients (82%) had cementless prostheses. A complete Stage IV level of anesthetic was obtained in each patient using standard agents such as isoflurane and vecuronium or succinylcholine. No nitrous gases were used in any patient.

The average age of all patients in Group II was 58 years (range: 25 to 86). Forty-one patients were women and 29 were men. The underlying diagnoses were osteoarthritis in 36 patients.
(51%), osteonecrosis in 15 (21%), posttraumatic arthritis in 8 (11%), rheumatoid arthritis in 8 (11%), developmental dysplasia of the hip in 2 (3%) and Legg-Calvé-Perthes disease in 1. The average number of preexisting medical illnesses was 1.5 (range: zero to 6). Nineteen patients (27%) were smokers. Fourteen patients (20%) had cemented or hybrid prostheses, while 56 (80%) had cementless prostheses. A light (Level III) anesthesia was employed using either isoflurane, sevoflurane, or propofol without a paralyzing agent. Epidurals were all administered in a standard method utilizing either 0.25% bupivacaine or lidocaine preoperatively in the operating room.

The average age of all patients in Group III was 62 years (range: 27 to 80). Six patients were women and 11 were men. The underlying diagnoses were osteoarthritis in 12 patients (71%), osteonecrosis in 4 (24%), and rheumatoid arthritis in 1 (6%). Seven patients (41%) were smokers. The average number of preexisting medical illnesses was 1.6 (range: 0 to 5). Five patients (29%) underwent cemented or hybrid arthroplasty, while 12 (71%) were non-cemented. Anesthesia consisted of either an intradural or epidural injection of bupivacaine/lidocaine to achieve an anesthetized sensory level of T-6. The epidural catheter was retained postoperatively in 9 of these patients for pain control.

The possible relationship between age at surgery and anesthesia group, and diagnosis leading to total hip arthroplasty and anesthesia group, was investigated. No significant difference was observed regarding the average age and anesthesia group (P > .10). To test for an association between diagnosis and anesthesia group, we deleted the diagnosis groups with six or fewer patients. This left a total of 185 patients in four diagnostic groups (avascular necrosis, osteoarthritis, rheumatoid arthritis, and posttraumatic arthritis). A Fisher-Irwin two-sided test showed no significant association between diagnosis and anesthesia group (P = .25).

Similarly, no significant differences among the three anesthesia groups was observed regarding the prevalence of smoking (P = .32) or the proportion of patients who had a non-cemented procedure (P = .52). No significant difference among groups was seen regarding the average number of pre-existing medical illnesses (P = .59). Similarly, no significant difference was observed in the distribution of ASA Physical Status Class among the three anesthesia groups (P = .21).

To analyze perioperative outcomes by surgeon, we compared the results of the four surgeons who performed the procedure most frequently (these four surgeons accounted for 148 of the 195 procedures, and each surgeon performed 19 or more procedures). For the purpose of statistical analysis the outcomes of the remaining 47 cases (performed by 17 surgeons) were combined.

One-hundred sixty-one of 195 patients received pharmacologic prophylaxis for deep venous thrombosis using either low-molecular weight heparin or warfarin (Coumadin). The remaining 34 patients received no pharmacologic prophylaxis or aspirin alone.

Data were tabulated and subjected to statistical analysis. Statistical methods used included Analysis of Variance (ANOVA) with Tukey's most significant difference multiple comparisons, Analysis of Covariance (ANCOVA), Chi-square test, and Fisher-Irwin Test. A P-value of less than .05 was considered statistically significant.

**RESULTS**

**Surgeon.** No significant difference was found among surgeons for each of the following variables: length of hospitalization (P = .10); total operating room time (P = .06); estimated intraoperative blood loss (P = .87); total Hemovac output (P = .59); postoperative Hemovac output during the first (P = .63), second (P = .70), and third (P = .71) postoperative 24-hour periods; deep infection (P = .73); and urinary tract infection (P = .82). A highly significant difference in surgical time (skin-to-skin) was seen among surgeons (P = .006) with shorter times for surgeons performing a greater number of procedures.

**Length of Hospitalization.** The average length of hospitalization for Group I was 8.1 days, Group II, 8.1 days, and Group III, 7.4 days. No statistically significant difference was observed among the groups regarding length of hospitalization (P = .71).

**Total Operating Room Time.** The average total operating room time was 238 minutes for Group I, 221 minutes for Group II, and 203 minutes for Group III. ANOVA showed a statistically significant difference among groups regarding operating room time (P = .03).

**Surgical Time.** Actual surgical time (skin-to-skin) was 149 minutes for Group I, 138 minutes for Group II, and 116 minutes for Group III (P = .03). ANOVA showed that the apparent differences in surgical times between groups was a function of the operating surgeon (the fastest surgeon used epidural anesthesia alone) and not the anesthesia (P < .05).

**Nonsurgical Operating Room Time.** The average nonsurgical operating room time was 88 minutes for Group I, 83 minutes for Group II, and 87 minutes for Group III. No statistically significant difference was seen among the three groups regarding nonsurgical operating room time (P = .45).

**Estimated Intraoperative Blood Loss.** The average estimated intraoperative blood loss for Group I was 885 mL, Group II was 783 mL, and Group III was 577 mL. We performed an ANOVA of the log of estimated blood loss because histograms of the data in all three groups were highly skewed to the right, and the within-group standard deviations were large and correlated to the within-group means. Therefore, these data were not suitable for a conventional ANOVA because they violated the assumptions of approximately normal distributions and approximately...
TABLE 2

Summary of intraoperative and postoperative complications

<table>
<thead>
<tr>
<th></th>
<th>Overall (All Three Groups Combined) (n = 195)</th>
<th>Group I (n = 108)</th>
<th>Group II (n = 70)</th>
<th>Group III (n = 17)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Intraoperative Complications</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transfusion</td>
<td>43 (22%)</td>
<td>23 (21%)</td>
<td>16 (23%)</td>
<td>4 (24%)</td>
</tr>
<tr>
<td>(any amount)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>One unit</td>
<td>21 (11%)</td>
<td>10 (9%)</td>
<td>10 (14%)</td>
<td>1 (6%)</td>
</tr>
<tr>
<td>Two units</td>
<td>21 (11%)</td>
<td>12 (11%)</td>
<td>6 (9%)</td>
<td>3 (18%)</td>
</tr>
<tr>
<td>Three or more units</td>
<td>1 (0.5%)</td>
<td>1 (1%)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Femur fracture</td>
<td>9 (5%)</td>
<td>3 (3%)</td>
<td>5 (7%)</td>
<td>1 (6%)</td>
</tr>
<tr>
<td>Nerve palsy</td>
<td>2 (1%)</td>
<td>2 (2%)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Death</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Postoperative Complications</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deep venous thrombosis</td>
<td>1 (0.5%)</td>
<td>0</td>
<td>0</td>
<td>1 (6%)</td>
</tr>
<tr>
<td>Death</td>
<td>1 (0.5%)</td>
<td>1 (1%)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Deep infection</td>
<td>5 (3%)</td>
<td>2 (2%)</td>
<td>2 (3%)</td>
<td>1 (6%)</td>
</tr>
<tr>
<td>Urinary tract infection</td>
<td>19 (10%)</td>
<td>11 (10%)</td>
<td>8 (11%)</td>
<td>0</td>
</tr>
<tr>
<td>Skin breakdown (decubitus)</td>
<td>2 (1%)</td>
<td>0</td>
<td>2 (3%)</td>
<td>0</td>
</tr>
</tbody>
</table>

n = the number of patients and also the number of total hip arthroplasties (all cases were unilateral)

TABLE 3

Cross tabulation of postoperative urinary tract infection by duration of Foley catheterization and anesthesia group

<table>
<thead>
<tr>
<th>Duration of Foley Catheterization</th>
<th>Postoperative Urinary Tract Infection</th>
<th>Anesthesia Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>I</td>
</tr>
<tr>
<td>2 days or less</td>
<td>No</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>5</td>
</tr>
<tr>
<td>3 days or more</td>
<td>No</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>6</td>
</tr>
</tbody>
</table>

equal within-group standard deviations. This suggested taking a logarithmic transformation; the transformed data showed more nearly bell-shaped or normal histograms and nearly equal within-group standard deviations. Using this approach, a statistically significant difference in estimated blood loss was seen among groups (P = .02), with Group I patients having a significantly higher estimated blood loss than Group III patients (P < .05). Using ANCOVA, we determined that the apparent differences in estimated intraoperative blood loss among groups primarily correlated with surgical time (P < .0001) and not surgeon (P = .29) or type of prosthetic fixation (cemented or cementless) (P = .82).

Cell saver technology was used in 143 of our 195 cases. Cell saver volumes averaged 403 mL for Group I patients, 430 mL for Group II patients, and 327 mL for Group III patients. ANOVA showed no significant difference among groups regarding cell saver volumes (P = .44).

Postoperative Hemovac Output. Postoperative Hemovac output was recorded and analyzed for postoperative days 1, 2, and 3 in each of the three groups. Postoperative Hemovac output averaged 336 mL, 156 mL, and 14 mL for Group I patients for the first, second, and third postoperative 24-hour periods, respectively. Postoperative Hemovac output averaged 414 mL, 213 mL, and 30 mL for Group II patients for these same intervals, respectively. Postoperative Hemovac output averaged 397 mL, 169 mL, and 20 mL for Group III patients for these same intervals, respectively. ANOVA showed significant differences in postoperative Hemovac output for the first 24-hour period among groups (P = .05). Similarly, ANOVA showed significant differences in postoperative Hemovac output over the second 24-hour period among groups (P = 0.005), with Group II patients again having significantly more postoperative Hemovac output than Group I patients (P < .05). No statistically significant difference was observed among groups regarding postoperative Hemovac output over the third 24-hour period (P = .28).

An analysis of total Hemovac output over the entire 72-hour postoperative period showed Hemovac outputs of 506 mL for Group I patients, 657 mL for Group II patients, and 586 mL for Group III patients. ANOVA showed a significant difference in the average total Hemovac output (over the 72-hour postoperative interval) (P = .002), with Group II having significantly greater postoperative Hemovac output than Group I (P < .05).

Intraoperative Complications (Table 2). In Group I, 10 patients (9%) required a 1 unit transfusion of blood intraoperatively, 12 (11%) required 2 units, and 1 required 3 units. Overall, 23 patients in Group I required an intraoperative blood transfusion. In Group II, 10 patients (14%) required 1 intraoperative unit of blood, 6 (9%) required 2 units, and none required more than 2 units. The total number of patients in Group II requiring transfusion was 16 (23%). Only 4 patients in Group III required an intraoperative transfusion (1 unit in 1 patient and 2 units in 3 patients). No significant difference among groups was noted in the proportion of patients requiring an intra-
operative blood transfusion \( (P = .87) \).

An intraoperative femur fracture was noted in 3 cases in Group I, 5 cases in Group II, and 1 case in Group III. No significant difference among anesthesia groups was noted regarding the prevalence of intraoperative femur fracture \( (P = .35) \). Two neurologic deficits were noted postoperatively in Group I patients. These were two palsies of the common peroneal nerve, and both subsequently resolved. Two patients in Group I had intraoperative episodes of hypotension, one secondary to a femoral artery laceration and the second because of volume depletion and prolonged surgical time. No other intraoperative complications were observed. There were no intraoperative deaths, pulmonary, gas, or fat emboli, or myocardial infarctions.

**Postoperative Complications (Tables 2-3).** Only one clinically symptomatic deep venous thrombosis was observed in a Group III patient. There was one postoperative death in Group I believed to be attributable to a pulmonary embolus, although a postmortem examination was not performed. There were five deep infections requiring additional surgery. Two deep infections occurred in Group I patients, two were in Group II, and one was in Group III.

Nineteen (10%) postoperative urinary tract infections were documented by urine cultures in the 195 cases. Eleven of these occurred in Group I patients, and eight occurred in Group II patients. No patient in Group III had a postoperative urinary tract infection. No significant difference among groups was seen regarding the prevalence of postoperative urinary tract infections \( (P = .44) \).

The average duration of Foley catheterization was 2.3 days in Group I, 3.4 days in Group II, and 3.9 days in Group III. ANOVA showed a statistically significant difference among anesthesia groups \( (P = .004) \) with Group I patients having a significantly shorter duration of Foley catheterization than Group II and III patients \( (P < .05) \). Five of 107 patients (5%) who had the Foley catheter in place for 2 days or less developed a postoperative urinary tract infection. By contrast, 14 of 88 patients (16%) who had the Foley in place for 3 days or more developed a urinary tract infection. This difference was statistically significant at \( P = .03 \). When we investigated the prevalence of postoperative urinary tract infection by anesthesia group and controlled for the duration of Foley catheterization, no significant difference in the prevalence of urinary tract infection was observed among the three anesthesia groups \( (P = .21) \) (Table 3).

A total of 74 of 195 patients had postoperative epidural anesthesia. No patient in Group I had a postoperative epidural, 60 patients in Group II had a postoperative epidural, and 14 in Group III had a postoperative epidural. The average duration of the postoperative epidural was 3.1 days for Group II and 2.9 days for Group III \( (P = .74) \). Two of 26 patients (8%) who had the epidural catheter in place for 2 days or less developed a urinary tract infection. The comparison, 5 of 48 patients (10%) who had the epidural catheter in place for 3 days or more developed a urinary tract infection. No significant difference in the prevalence of urinary tract infection was observed based on the duration of postoperative epidural anesthesia \( (P = .53) \).

We used correlation analysis to investigate the relationship between duration of epidural catheterization and Foley catheterization. We did observe a significant correlation \( (r = .43, P < .00001) \) between these two variables for the 74 patients who had a postoperative epidural catheter.

Two patients in Group II developed skin breakdown (decubiti) of the foot believed to be secondary to a prolonged block. The average duration of epidural placement in the 74 patients who had a postoperative epidural was 3.0 days. By contrast, in the two patients who developed decubiti, the duration of epidural catheterization was greater than 6 days.

**Discussion**

Little information exists in the literature comparing the relative safety of regional and general anesthesia in patients undergoing THR. The reported advantages of epidural anesthesia include the reduction in thromboembolic complications, reduction and need for general anesthesia, and the potential for use in postoperative pain management. By contrast, some authors have expressed concern regarding hemodynamic compromise in patients undergoing epidural anesthesia. Because little information exists, we undertook a study to assess the perioperative outcomes of patients undergoing primary unilateral THR as a function of type of anesthesia used. To the best of our knowledge such a study has not previously been reported.

Comparison of the demographic profiles among Group I patients (general anesthesia alone), Group II patients (general anesthesia with epidural augmentation), and Group III patients (epidural anesthesia alone) demonstrated no significant differences in age, gender, number of preexisting medical conditions, ASA Physical Status Class, primary diagnosis leading to total hip replacement surgery, smoking history, and type of prosthesis fixation used. No other medical factors entered into the decision or the choice of anesthetic. This finding made it possible to compare the effects of the anesthetic type on the perioperative outcomes of patients in each group.

Results of the current investigation show that the estimated intraoperative blood loss was significantly lower in Group III patients (who underwent epidural anesthesia alone) than in Group I patients (who had general endotracheal anesthesia). These results are in agreement with previous studies. Of the four independent variables studied (anesthetic group, surgeon, type of prosthesis fixation [cemented or cementless], and surgical time) the variable that correlated most strongly with estimated intraoperative blood loss (the dependent variable) was
surgical time. From our data we are unable to draw definite conclusions regarding the effect of type of anesthesia on intraoperative blood loss. Although the effect of anesthesia on perioperative blood loss is clearly multifactorial, it is possible that the decreased intraoperative blood loss seen in patients having epidural anesthesia is due to sympathetic blockade, vasodilation of arterioles, arteries and veins, and intraoperative hypotension.7,8

Postoperative Hemovac output was higher in patients receiving epidural anesthesia. Specifically, the difference in postoperative Hemovac output among groups reached statistical significance when comparing the Hemovac output of the general (Group I) and general with epidural (Group II) patients for each of the first and second postoperative days as well as over the entire 72-hour postoperative period. An increase in postoperative Hemovac output in patients receiving epidural anesthesia for total hip arthroplasty has similarly been reported by Flordal and Neander.7 By contrast, several authors have reported decreased Hemovac output in patients having regional anesthesia.4,6,8 The hemodynamic changes in the lower limbs that result from regional anesthesia include increased large vessel blood flow, decreased small vessel flow, and decreased venous pressure.4 One may only speculate as to the explanation for the divergent results of postoperative Hemovac output reported in clinical series of patients undergoing total hip arthroplasty.

No significant differences in length of hospitalization were observed among groups. Initially, we anticipated that the use of postoperative epidural anesthesia would prolong hospitalization due to a high incidence of motor block during the immediate postoperative period of epidural adjustment; however, this was not found. The fact that the length of hospitalization was not increased was most likely related to an ability to mobilize patients earlier with an epidural, since their pain was well controlled without systemic narcotics and with minimal effect on motor function. However, confounding variables include the fact that some surgeons preferred one type of anesthesia and may also favor earlier mobilization and discharge. A second confounding variable relates to the fact that surgeons have come under increased pressure to discharge patients earlier; therefore, patients who appeared later in the study may have been discharged earlier.

A common concern among orthopedic surgeons is the impact of non-orthopedic factors on time utilization in the operating room. A review of the literature2,4,7,8 fails to show a consistent pattern of parameters measured as well as time effects produced by choice of anesthesia. In response to these inconsistencies and the concerns of orthopedic surgeons, we endeavored to evaluate the total operating room time, surgical time, and nonsurgical operating room time as a function of type of anesthesia. Our results suggest that the total operating room time and surgical time are a function of the operating surgeon and not the choice of anesthesia. It is clear from our results that type of anesthetic has no effect on non-surgical operating room time, even when the epidural catheter is placed after the patient is brought into the operating room (as in our study). Therefore, concerns related to time utilization in the operating room for patients undergoing primary unilateral THR as a function of the choice of anesthesia appear to be unwarranted. Two neurologic complications were observed in the general anesthetic group only. These were common peroneal palsies which have subsequently resolved. It is worthy to note that no such palsies occurred in the epidural group, as our initial concern was that the peripheral anesthesia might predispose to such nerve lesions.

Postoperative complications were infrequent in all groups. Clinically apparent thromboembolic complications were extremely rare. There was only one presumed pulmonary embolus which resulted in death; however, a postmortem autopsy could not be performed. This occurred in a patient who had general anesthesia. Only one clinically symptomatic deep venous thrombosis was found (in a patient in Group III) which required anticoagulation therapy. We recognize that our study is retrospective and that no special diagnostic modalities were employed to identify clinically silent thromboembolic complications. Previous studies employing such modalities have identified a lower prevalence of deep venous thrombosis in patients having regional anesthesia (as compared to general) during THR.2,4,6 Despite the limitations of our study, it is interesting to note that no differences in the prevalence of clinically apparent deep venous thrombosis were observed among the anesthetic groups.

It is our impression that there is a prejudice among some practitioners regarding a correlation between the use of epidural (or spinal) anesthesia and the occurrence of urinary tract infection. The literature suggests that the duration of Foley catheterization, retention associated with the operation, retention associated with the type of anesthesia, or intrinsic genitourinary disease may be associated with postoperative urinary tract infection.12,13 Our retrospective review shows that postoperative urinary tract infection is a function of the duration of Foley catheterization, but not the type of anesthesia used (or the duration of postoperative epidural anesthesia). More specifically, a significant increase in the prevalence of postoperative urinary tract infection was seen in patients whose urinary catheter was left in situ for 3 or more days.

Five operations (3%) resulted in deep infection requiring additional surgery. No significant differences in the prevalence of deep infection were found among the three anesthetic groups. In four of the five cases with an infection, operative blood loss was in excess of 2 L and surgical time was in excess of 170 minutes. This finding corroborates the findings of earlier
studies.14,15

There were two patients (in Group II) without other neurologic complications who developed decubiti of the foot believed to be secondary to prolonged retention of the epidural catheter. Duration of epidural catheterization in both of these patients was in excess of 6 days. By contrast, the average duration for a postoperative epidural catheter (in those patients who had a catheter) was 3 days. We speculate that this complication was related to prolonged depression of peripheral sensation.

CONCLUSION

Epidural anesthesia was a safe form of anesthesia in this study. It allows for early mobilization postoperatively and does not appear to increase intraoperative or postoperative complication rates. The use of epidural anesthesia does not appear to increase the incidence of cardiac or hemodynamic-related complications, and can be used in the majority of patients undergoing primary unilateral THR.

REFERENCES