INTRODUCTION

Although previously published studies have documented a high perioperative risk in patients with liver failure undergoing general surgery, such as, elective abdominal surgery (1-4), thoracotomy (5), and trauma operations (6, 7), little information is available on clinical outcomes following orthopedic surgery in this group of patients. Ziser et al. (8), in their retrospective review of 733 cirrhotic patients undergoing any type of surgical procedure, reported that patients undergoing major orthopedic procedures including hip surgery, spine fusions, and operations for long bone fractures had a substantially higher perioperative complication rate than patients undergoing non-orthopedic surgery. Whilst elective total hip arthroplasty (THA) is generally regarded as safe, with an associated perioperative mortality rate of less than 1% in the general population (9-11), data are extremely limited on the safety and outcome of hip arthroplasty in patients with advanced liver disease. Only two recent studies (12, 13), to the best of our knowledge, have evaluated the perioperative risks of hip arthroplasty in cirrhotic patients. The purpose of this study was to document perioperative morbidity and mortality in patients with liver cirrhosis undergoing hip arthroplasty.
cations searched for were as follows: postoperative bleeding (gastrointestinal or surgical site), coagulopathy, wound (dehiscence or infection), encephalopathy, cardiovascular (congestive heart failure, myocardial infarction, or arrhythmia), pulmonary (pneumonia, pulmonary embolism, or ventilatory dependence), renal (acute tubular necrosis, hepatorenal syndrome, or ascites), and infection (bacteremia or fungemia). Postoperative bleeding was defined as hemorrhage requiring transfusion, and gastrointestinal and surgical site bleedings were distinguished from each other based on a review of the medical records. Coagulopathy (whether on the basis of reduced hepatic synthesis, disseminated intravascular coagulation, normal consumption, or dilutional mechanisms) was noted in those patients with a decreased platelet count, fibrinogen concentration, and increased activated partial thromboplastin time. New onset or worsening of ascites or encephalopathy was also registered as a postoperative complication within 30 days of hip arthroplasty. Mortality was defined as death within 30 days of index arthroplasty. We chose this 30-day perioperative time limit because a shorter period may have missed complications and deaths directly related to events that had begun during hip surgery or hospitalization.

Twelve variables were investigated to determine risk factors in liver cirrhosis patients who underwent hip arthroplasty: age, gender, the presence of ascites or varices, prothrombin time, the levels of albumin, bilirubin, and creatinine, the type of surgery (primary THA, bipolar hemiarthroplasty, or revision THA), the type of anesthesia (general or spinal), operation time, and estimated operative blood loss. As none had a preoperative encephalopathy, it was excluded from the investigation.

Statistical analysis was performed using the SAS statistical software package (SAS Institute, Cary, NC, U.S.A.). Multivariate logistic regression models were used to identify factors differentiating complicated and uncomplicated hip arthroplasties in cirrhotic patients. Generalized estimating equations were used to control for the clustering of complications within patients. Variables deemed significant by multivariate analysis at \( p < 0.05 \) were considered risk factors associated with perioperative morbidity and mortality in liver cirrhosis patients who underwent hip arthroplasty.

### RESULTS

According to assessments of liver cirrhosis severity using the Child-Pugh scoring system, 19 patients (63.3%) were class A, 9 (30.0%) class B, and 2 (6.7%) were class C.

Eight (26.7%) of the 30 patients had one or more perioperative complications. Of these, a superficial wound infection was the most common, with a rate of 10% (3 of 30 hips). Other postoperative complications included 2 surgical site bleedings, 2 coagulopathies, 2 encephalopathies, 1 gastrointestinal bleeding, 1 pneumonia, and 1 arrhythmia. In the analysis of the cirrhotic patients by individual Child-Pugh's class, perioperative complications occurred in 1 (5.3%) of 19 class A cirrhotics, 5 (55.6%) of 9 class B, and 2 (100%) of 2 class C (Table 1). Two patients with class C died from aspiration pneumonia and disseminated intravascular coagulation, respectively, during the first postoperative month. Thus, the perioperative mortality rate was 6.7% (2 of 30 patients).

Of the twelve variables that were investigated to identify risk factors for complicated hip arthroplasty in patients with liver cirrhosis, a high level of creatinine was solely associated with increased perioperative mortality \( (p = 0.0499) \). No statistically significant associations were found in the other variables including age, gender, the presence of ascites or varices, prothrombin time, the levels of albumin and bilirubin, the type of surgery, the type of anesthesia, operation time, and

### Table 1. Perioperative complications following hip arthroplasty in 30 patients with liver cirrhosis

| Complications (no. of occurrences)* | Child-Pugh classification |
|------------------------------------|---------------------------|
| Total number of patients            | A | B | C |
| Wound infection                     | 0 | 3 | 0 |
| Operative site bleeding             | 0 | 1 | 1 |
| Coagulopathy                        | 1 | 0 | 1 |
| Encephalopathy                      | 0 | 1 | 0 |
| GI bleeding                         | 0 | 1 | 0 |
| Pneumonia                           | 0 | 0 | 1 |
| Anythmia                            | 0 | 1 | 0 |
| Total number (%) of patients with any complications | 1 (5.3) | 5 (55.6) | 2 (100) |

*Some patients were associated with more than one complications.

### Table 2. Variables associated with perioperative complications and death following hip arthroplasty in cirrhotic patients

| Variables                  | Complications (p value) | Death (p value) |
|----------------------------|-------------------------|-----------------|
| Age                        | 0.9932                  | 0.82            |
| Gender                     | 0.0892                  | 0.12            |
| Child-Pugh class           |                         | N/A             |
| A:B                        | <0.0001                 |                 |
| B:C                        | <0.0001                 |                 |
| Presence of ascites        | 0.0513                  | 0.0574          |
| Presence of varices        | 0.6536                  | 0.119           |
| Prothrombin time           | 0.3564                  | 0.0979          |
| Albumin level              | 0.0921                  | 0.0947          |
| Bilirubin level            | 0.9736                  | 0.095           |
| Creatinine level           | 0.1313                  | 0.0499          |
| Type of surgery            |                         |                 |
| Primary THA vs. BHA        | 0.7723                  | 0.5546          |
| Primary THA vs. revision THA| 0.8127                  | 0.2823          |
| Operation time             | 0.2734                  | 0.5794          |
| Estimated operative blood loss| 0.7123               | 0.4              |
| Type of anesthesia         | 0.9672                  | 0.627           |

THA, total hip arthroplasty; BHA, bipolar hemiarthroplasty.
estimated operative blood loss. However, combining all of the categories included in the Child-Pugh scoring system, a significantly increased risk of perioperative complications was noted in cirrhotic patients who had a higher Child-Pugh score \( (p=0.0001) \) (Table 2).

**DISCUSSION**

Previous studies (1-7, 15-18) have well documented high rates of perioperative complications in patients with liver failure undergoing anesthesia and surgery, especially those undergoing major orthopedic procedures (8). However, data are extremely limited on the safety and outcome of hip or knee arthroplasty in patients with advanced liver disease (12, 13, 19). Ziser et al. (8) evaluated 733 patients with a diagnosis of liver cirrhosis who had undergone some type of surgical procedure, and reported a perioperative complication rate of 30.1% and a mortality rate of 11.6% within 30 days of surgery. Of these, 26 procedures were hip and pelvic surgery, arthroplasty, or fractures, and this subgroup showed a substantially increased perioperative complication rate of 53.8%. Recently, Hsieh et al. (13) reported on the outcomes of 45 hip arthroplasties that had been performed over a period of 20 yr in 38 patients with liver cirrhosis, with a perioperative 30-day complication rate of 26.7%. They found that advanced cirrhosis (Child-Pugh’s B and C patients) had a higher risk of complications than Child-Pugh’s A cirrhetics \( (p=0.004) \). Cohen et al. (12) also reported a 20.7% major complication rate for cirrhotic patients who received either total hip or knee arthroplasty. In accordance with these previous studies, we observed a high perioperative complication rate \( (26.7\%, 8 \text{ of } 30) \) in cirrhotic patients that had undergone hip arthroplasty. Of the twelve variables evaluated in our series, a high level of creatinine was found to be the only risk factor associated with perioperative mortality. However, combining all of the categories included in the Child-Pugh scoring system, a higher Child-Pugh score was another important risk factor of perioperative morbidity. Our findings were also consistent with the previous observations that there was a trend toward an increased perioperative risk for hip arthroplasty in cirrhotic patients with more advanced liver disease.

Rice et al. (16) reported a mortality rate within 30 days of surgery of 28% for patients with chronic liver failure who had undergone non-hepatic surgery, and that 2 of 5 patients who underwent unspecified orthopedic surgery died. Hsieh et al. (13) reported that 18 of 38 cirrhotic patients undergoing hip arthroplasty died during the protracted study period of 20 yr. Of these, 8 patients died from complications of liver cirrhosis. Cohen et al. (12) reported a 10.3% perioperative mortality rate for cirrhotic patients who received either total hip or knee arthroplasty, and this mortality rate increased to 15.8% \( (3 \text{ of } 19) \) in cirrhotic THA patients. However, a relatively lower rate of perioperative mortality \( (6.7\%, 2 \text{ of } 30) \) was noted in the present study as compared with previous series that enrolled patients with liver cirrhosis undergoing orthopedic surgery over a long time span. Although it may be attributed to the small number of patients with severe liver cirrhosis (Child-Pugh’s class C) in our series, we believe that the improvement of medical care of cirrhotic patients and refinement in surgical techniques that have occurred during past decade may contribute to the lower mortality rate. Cohen et al. (12) also suggested that less extensive operative procedures, such as bipolar hemiarthroplasty, would be associated with more favorable outcomes than those of primary or revision THAs, but our findings showed no statistically significant difference among the different surgical procedures, which we attribute to the small sample size.

In conclusion, we continue to perform hip arthroplasty in patients with cirrhotic liver disease, but we should warn patients with a higher Child–Pugh score and those with an increased creatinine level about their increased perioperative risk of complications or death. Cirrhotic patients should be aware that they are at increased risk for surgical complications because of their disease, albeit the mortality rates are relatively low in less severe cirrhotics.

**REFERENCES**

1. Aranha GV, Sontag SJ, Greenlee HB. Cholecystectomy in cirrhotic patients: a formidable operation. Am J Surg 1982; 143: 55-60.
2. Garrison RN, Cryer HM, Howard DA, Polk HC Jr. Clarification of risk factors for abdominal operations in patients with hepatic cirrhosis. Ann Surg 1984; 219: 648-55.
3. Lehnert T, Herfarth C. Peptic ulcer surgery in patients with liver cirrhosis. Ann Surg 1993; 217: 335-46.
4. Mansour A, Watson W, Shayan V, Pickleman J. Abdominal operations in patients with cirrhosis: still a major surgical challenge. Surg 1997; 122: 730-6.
5. Ueda H, Iwasaki A, Kusano T, Shirakusa T. Thoracotomy in patients with liver cirrhosis. Scand J Thorac Cardiovasc Surg 1994; 28: 37-41.
6. Demetriades D, Constantinou C, Salim A, Velmahos G, Rhee P, Chan L. Liver cirrhosis in patients undergoing laparotomy for trauma: effect on outcomes. J Am Coll Surg 2004; 199: 538-42.
7. Tinkoff G, Rhodes M, Diamond D, Lucke J. Cirrhosis in the trauma victim. Effect on mortality rates. Ann Surg 1990; 211: 172-7.
8. Ziser A, Plevak DJ, Wisner RH, Rakela J, Offord KP, Brown DL. Mortality and morbidity in cirrhotic patients undergoing anesthesia and surgery. Anesthesiology 1999; 90: 42-53.
9. Barrett J, Losina E, Baron JA, Mahomed NN, Wright J, Katz JN. Survival following total hip replacement. J Bone Joint Surg Am 2005; 87: 1965-71.
10. Dearborn JT, Harris WH. Postoperative mortality after total hip arthroplasty. An analysis of deaths after two thousand seven hundred and thirty-six procedures. J Bone Joint Surg Am 1998; 80: 1291-4.
11. Parvizi J, Johnson BG, Rowland C, Ereh MH, Lewallen DG. Thirty-day mortality after elective total hip arthroplasty. J Bone Joint...
Surg Am 2001; 83: 1524-8.

12. Cohen SM, Te HS, Levitsky J. Operative risk of total hip and knee arthroplasty in cirrhotic patients. J Arthroplasty 2005; 20: 460-6.

13. Hsieh PH, Chen LH, Lee MS, Chen CH, Yang WE, Shih CH. Hip arthroplasty in patients with cirrhosis of the liver. J Bone Joint Surg Br 2003; 85: 818-21.

14. Pugh RN, Murray-Lyon IM, Dawson JL, Pietroni MC, Williams R. Transection of oesophagus for bleeding oesophageal varices. Br J Surg 1973; 60: 646-9.

15. Patel T. Surgery in the patient with liver disease. Mayo Clin Proc 1999; 74: 593-9.

16. Rice HE, O’Keefe GE, Helton WS, Johansen K. Morbid prognostic features in patients with chronic liver failure undergoing nonhepatic surgery. Arch Surg 1997; 132: 880-5.

17. del Olmo JA, Flor-Lorente B, Flor-Civera B, Rodriguez F, Serra MA, Escudero A, Lledo S, Rodrigo JM. Risk factors for nonhepatic surgery in patients with cirrhosis. World J Surg 2003; 27: 647-52.

18. Farnsworth N, Fagan SP, Berger DH, Awad SS. Child-Turcotte-Pugh versus MELD score as a predictor of outcome after elective and emergent surgery in cirrhotic patients. Am J Surg 2004; 188: 580-3.

19. Shih LY, Cheng CY, Chang CH, Hsu KY, Hsu RW, Shih HN. Total knee arthroplasty in patients with liver cirrhosis. J Bone Joint Surg Am 2004; 86: 335-41.