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SURGICAL ENDOSCOPY
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Laparoscopic cholecystectomy in cirrhotic patients

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Abstract
Background: Due to unacceptable increases in intra- and postoperative complications and associated morbidity, cirrhosis of the liver is often considered to be a contraindication for laparoscopic cholecystectomy (LC). However, recent advances have now made it increasingly possible for experienced surgeons to perform LC on this high-risk population. The aim of this study was to evaluate the impact of the coagulopathy associated with cirrhosis on the performance and results of LC. We hypothesized that the factors leading to hemorrhage, rather than Child's classification, would drive operating time and resource utilization.
Methods: Between 1 July 1996 and 30 June 2003, 1,285 cholecystectomies were performed. Thirty one of these patients had evidence of cirrhosis at the time of operation. The 31 patients were divided into high, (low platelets, prolonged International Normalized Ratio) ($n = 18$), intermediate, (abnormal liver function tests, normal clotting) ($n = 5$), and low, (normal platelets, normal clotting, and normal liver function tests) ($n = 8$) surgical risk categories for further analysis. Based on the Child-Turcotte-Pugh (CTP) classification of cirrhosis, there were three grade C and 28 grade A or grade B patients.
Results: There were 24 LC, three of which were started laparoscopically and then converted to open, and four open cholecystectomies. Operating room time ranged from 79 to 450 min, with the extent of coagulopathy correlating with the length of time needed to achieve satisfactory hemostasis. Median length of stay postoperatively in the high-risk group was 2 days (range, 0–20). Nine of the cholecystectomies were performed on an outpatient basis. One patient received a liver transplantation 5 months post-LC. There were no operative deaths, bile duct injuries, or returns to the operating room for bleeding. Blood product usage correlated with preexisting coagulopathy.
Conclusions: Currently, the classification of cirrhotic patients is normally done using the CTP score. However, preoperative platelet levels and INR more accurately predict the difficulty of cholecystectomy than CTP score, because intraoperative hemorrhage is the primary concern in these patients. This study demonstrates that preoperative degree of coagulopathy, and not Child's class, should guide the surgeon's approach and expectations when LC is performed in a cirrhotic patient.

Key words: Laparoscopic cholecystectomy — Cirrhosis — Coagulopathy — Surgical risk — Child's classification

Open cholecystectomy in cirrhotic patients is a serious surgical challenge associated with high rates of morbidity and mortality. Since the introduction of laparoscopic cholecystectomy (LC) into the United States in 1988, it has become the treatment of choice, due to the substantially lower postoperative morbidity and mortality rates when compared to the open procedure. The same benefits found for LC could theoretically extend to the treatment of symptomatic gallbladder disease in cirrhotic patients. However, in 1992, the National Institutes of Health (NIH) issued a consensus statement on LC that included the following caveat: ''Patients who are usually not candidates for laparoscopic cholecystectomy include those with generalized peritonitis, septic shock from cholangitis, severe acute pancreatitis, end-stage cirrhosis of the liver with portal hypertension, severe coagulopathy unresponsive to treatment, known cancer of the gallbladder, and cholecysto-enteric fistulas'' [g].

But there is abundant evidence in the literature to show that LC has been improved and refined such that it is now safe for patients with symptomatic gallbladder disease and Child's class A or Child's class B cirrhosis [1, 12–12]. Reporting in 2000 on their experience with this procedure, Fernandes et al. stated: ''LC in patients with Child's class A and B cirrhosis is reasonably safe and shows no increase in morbidity or mortality or

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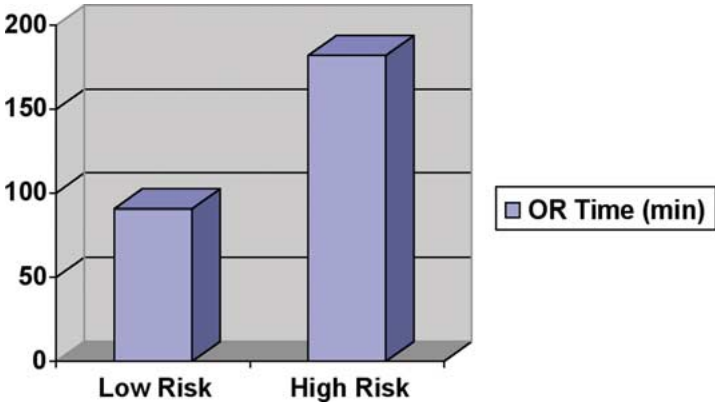

Fig. 1. Preoperative surgical risk as a function of average operating room (OR) time ($p = 0.0072$).

worsening of outcome'' [2]. However, the most recent meta-analysis of LC in Child's class C cirrhosis is inconclusive due to a lack of data on such cases, most likely because surgeons continue to consider the risks of morbidity and mortality to be unacceptably high: ''This study does not include adequate data about the patients with Child's class C cirrhosis and does not allow us to determine whether or not the procedure should be recommended for these patients'' [10]. It is our contention that it is misleading to relate the surgical risk in cirrhotic patients to the Child's class. Instead, we believe that the degree of operative difficulty is related to preoperative coagulopathy (International Normalized Ratio and platelet count).

There are several reasons why surgeons have considered patients with cirrhosis to be poor candidates for surgery or have tended to refer them to tertiary care centers. Historically, their reluctance was due to concern about the development of end-stage liver disease associated with anesthesia and laparotomy. However, less hepatotoxic regimens are currently being used. Nevertheless, intraoperative hemorrhage remains a real concern due to three factors: thrombocytopenia, coagulopathy, and portal hypertension. These problems are further exacerbated by the fact that cirrhotics are often operated on late in the course of their disease, so the gallbladder tissue is already stiff, woody, and friable.

Extrapolating from these factors, we hypothesized that the forces leading to hemorrhage would drive intraoperative conditions, resource utilization, and operating time. We prospectively divided our cirrhotic population into groups according to Child's classification but also categorized them by preoperative bleeding risk.

Methods

Approval was obtained from the Tufts–New England Medical Center Institutional Review Board and Privacy Board for a retrospective analysis of patient records between July 1996 and June 2003. A total of 1,285 consecutive patients who had been treated with cholecystectomy for symptomatic gallbladder disease were identified on the hospital's computerized database. Details of these patients relating to indications for surgery, comorbidities, preoperative laboratory tests, transfusion requirements, operating room times, and both short and long-term complications were entered into a hand-held device using Pendragon Forms database software (ver. 3.2; Pendragon Software, Libertyville, IL, USA). The data were subsequently transferred to Microsoft Access 2002 (Microsoft, Seattle, WA, USA) for further analysis [7].

To test our hypothesis that intraoperative transfusion requirement was directly related to preoperative coagulopathy, we stratified our patients into high, (low platelets, prolonged INR, abnormal liver function tests [LFT]) ($n = 18$), (normal clotting, abnormal LFT) ($n = 5$), and low (normal platelets, normal clotting, and normal LFT) ($n = 8$) surgical risk subsets. Statistical comparisons between risk subsets were made with the unpaired t-test for continuous variables. Statistical significance was accepted at $p < 0.05$.

The Child-Turcotte-Pugh classification system was used to assess the severity of cirrhosis. Twenty eight patients were classified as Child's class A or B, and three were classified as Child's class C.

Results

Of the 1,285 patients who had undergone cholecystectomy in this 7-year time frame, 954 operations were completed laparoscopically and 331 were performed via an open approach. Thirty-one of them also had biopsy-proven liver cirrhosis at the time of operation. The etiology of the each patient's cirrhosis defined as follows: 11 patients had a viral form, three had alcoholic cirrhosis, two had viral and alcoholic, 12 had cryptogenic, one had autoimmune, one had hemochromatosis, and one had nonalcoholic steatohepatitis. Nonalcoholic steatohepatitis is described as inflammation of the liver associated with the accumulation of fat in the liver. It differs from the simple accumulation of fat in the liver (fatty liver, or hepatic steatosis) in that the inflammation causes damage to the liver cells, whereas simple fatty liver probably does not. There were 17 men and 14 women in this study population subset, and the mean age was 54 years (range, 39–83).

All of our patients had stable liver disease without imminent transplant (Model for End-Stage Liver Disease [MELD] scores ranged from 6 to 15). However, one of our patients (Child's B/high surgical risk based on our classification system) later developed hepatic failure and received a liver transplant 5 months postoperatively.

The mean operating time for the 31 cholecystectomies was 156 min (range, 79–450). However, when we compared the mean operating times by surgical risk subset, we found that the average operating room time in the low risk group was 91 min, whereas in the high-risk group, it was 182 min ($p = 0.0072$) (Fig. 1).

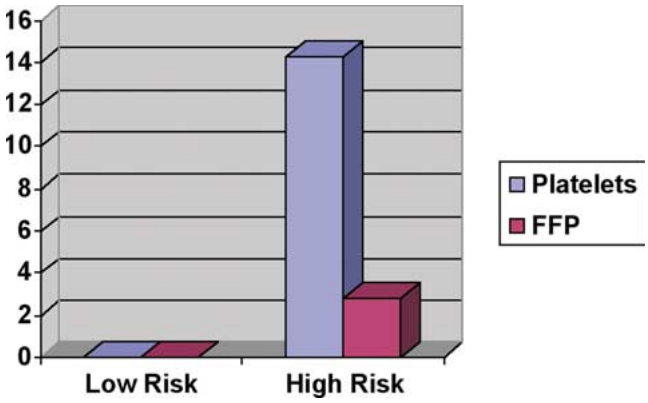

Fig. 2. Preoperative surgical risk as a function of the average intraoperative requirements for transfusion of platelets ($p = 0.0261$) and fresh frozen plasma (FFP) ($p = 0.0132$).

Of the 31 cholecystectomies, 27 were attempted laparoscopically and 24 (89%) were completed laparoscopically. Three of the patients were converted to an open procedure, two due to surgeon inexperience and one to an immobile liver. There were no returns to the operating room, no retained stones, and no bile duct injuries.

Intraoperatively, transfusion requirements varied widely, from 0 to 88 units of platelets and 0 to 10 units of fresh frozen plasma. Postoperatively, transfusion requirements were 0 to 40 units of platelets and 0 to 12 units of fresh frozen plasma. Further analysis of the intraoperative requirements showed that the low-risk group needed no transfusions, whereas the high-risk group received an average of 14.3 units of platelets ($p = 0.0261$) and 2.83 units of fresh frozen plasma ($p = 0.0132$) (Fig. 2)

Seven of the 31 patients required packed red blood cells (pRBCs). Three of the patients received pRBC intraoperatively, with a maximum requirement of 4 units. Four patients received pRBC postoperatively, with a maximum of 6 units. All three of the patients who received pRBC intraoperatively were in the high-risk group.

In terms of the gallbladder pathology identified in our cirrhotic population, there were two patients with gallbladder adenocarcinoma, one with acute hemorrhagic cholecystitis, two with acute and chronic cholecystitis, and one with idiopathic disease. The remaining 25—the majority of our patients—had evidence of chronic cholecystitis.

Discussion

Because cirrohotic patients are operated on late in the course of their gallbladder disease, they present with severe chronic cholecystitis. Therefore, the gallbladder tissue is often woody and friable. We believe that a more extensive surgical dissection is one of primary keys to surgical success in these patients.

Perfect hemostasis is time-consuming in this coagulopathic group. Preoperatively, when appropriate, correction of coagulopathy was attempted with fresh frozen plasma and vitamin K preinduction, and platelets were given postinduction, as needed. Additional modalities to control oozing can be used, including hemostatic agents such as oxidized cellulose (Gelfoam [Pfizer, New York, NY, USA]; Surgicel [Johnson & Johnson, New Brunswick, NJ, USA]), a topical hemostatic agent like FloSeal (Baxter International, Deerfield, IL, USA), and the application of ultrasonic energy via a Harmonic Scalpel. All of these modalities, in conjunction with mechanical compression from introduced surgical sponges, are critical to surgical success in these patients. Finally, a tremendous amount of patience is necessary, because conversion does not help to control the coagulopathy.

In conclusion, this study has shown that preoperative degree of coagulopathy, and not the Child's class, should guide the surgeon's approach, expectations, and education of the patient/family when LC is performed in a cirrhotic patient. Therefore, we believe that LC can be performed in Child's class A and B patients.

One of the limitations of this study is that we did not have enough Child's class C patients to make a similar definitive statement. For example, more Child's class C patients may have resulted in a high incidence of liver failure postoperatively. However, although the numbers are small, it appears viable to consider LC in Child's class C—or, in the NIH's words, "end-stage cirrhosis of the liver"—by an experienced surgeon when all attempts are made to correct any coagulopathy preoperatively and the full arsenal of available surgical modalities is used to control oozing intraoperatively.

Excellent results can be obtained with LC in high surgical risk patients with elevated INR and severely decreased platelets when a full range of hemostatic modalities is used. It can be performed safely in Child's class A and B, and although our numbers are small, LC appears to be viable in Child's class C as well.

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