

Impact of liver disease severity on outcomes of patients undergoing endourological procedures for urolithiasis

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Abstract

Objectives: This study is aimed to determine the impact of liver disease severity on the outcome of patients undergoing endourological procedures for urolithiasis, and to understand the factors that are helpful in improving the outcome.

Materials and methods: We retrospectively analyzed the records of patients with chronic liver disease who underwent endourological procedures between January 2014 and February 2020. Inpatient records and charts were assessed for age, sex, height, weight, body mass index, model for end-stage liver disease (MELD) score, Child–Turcotte–Pugh score, type of procedure and anesthesia, intensive care unit (ICU) stay, duration of hospitalization, number, size, and position of stones, and postoperative complications such as hematuria, sepsis, and secondary procedures. Data are presented as mean ± standard deviation or frequency. The chi-square test was applied to determine the exact association between categorical data and Student t-test or Mann–Whitney U test as appropriate for continuous data. Statistical significance was set at $p < 0.05$.

Results: Hospital and ICU stay as well as administration of different blood products were significantly longer in the Child C than in the Child A and B categories ($p < 0.001$). Two patients in the Child C category died, while 3 left the hospital against medical advice. The duration of ICU stay and blood products administered increased with augmenting MELD scores. The durations of hospitalization and blood product administration were significantly higher in patients with an MELD score ≥ 20 than in the group with MELD score < 20 .

Conclusions: Hospital and ICU stay and blood product administration were significantly higher in Child C than in Child A and B class patients. Hospitalization duration and blood product administration were significantly higher in patients with an MELD score ≥ 20 .

Keywords: Chronic liver disease; Coagulopathy; Endourology; Obstructive uropathy; Urolithiasis

1. Introduction

The prevalence of nephrolithiasis in patients with chronic liver disease (CLD) is 2-fold higher than that in the general population.^[1] Various mechanisms, such as lipid peroxidation, oxidative stress, and changes in urinary constituents have been suggested to be responsible for this high incidence.^[2] Hemostasis is altered as these patients have thrombocytopenia, platelet dysfunction, clotting factor deficiencies, hyperfibrinolysis, and dysfibrinogenemia. Moreover, most patients have chronic anemia, which can further complicate the outcome.^[3] The preoperative optimization includes the administration of fresh frozen plasma (FFP), cryoprecipitates, desmopressin, and vitamin K. However, all these modalities have serious side effects, such as volume overload, worsening of portal pressure, and disseminated

intravascular coagulation.^[4] The combination of hypoalbuminemia, bleeding diathesis, need for transfusions, and immunocompromised state can complicate even a minimally invasive endourological procedure. Hence, this study was conducted to determine the impact of liver disease severity on the outcome of patients undergoing endourological procedures for urolithiasis and to understand the factors that contribute to improving this outcome.

2. Materials and methods

After obtaining approval from the institutional ethics committee (IEC/2019/68/MA03), this trial was registered with the Clinical Trial Registry of India (CTRI/2020/06/026233). Written informed consent for publication was obtained from the study participants. We retrospectively analyzed the records of patients with CLD who underwent endourological procedures between January 2014 and February 2020. Patients with CLD proven either by biopsy or ultrasound and who had undergone endourological management for urinary calculi were included in the study. However, patients with a history of liver transplantation and adequate graft function were excluded. Inpatient records and charts were assessed for age, sex, height, weight, body mass index, model for end-stage liver disease (MELD) score, Child–Turcotte–Pugh (CTP) score, type of procedure and anesthesia, intensive care unit (ICU) stay, duration

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of hospitalization, number, size, and position of stones, and postoperative complications such as hematuria, sepsis, and secondary procedures. The patients were classified based on their CTP score (Child class A, B, and C; score 5–6, 7–9, and 10–15, respectively). Moreover, the MELD score was calculated as follows: MELD score = $[9.57 \times \log_e \text{creatinine mg/dL} + 3.78 \times \log_e \text{bilirubin mg/dL} + 11.20 \times \log_e \text{international normalized ratio} + 6.43]$.^[5,6] Data are presented as mean \pm standard deviation (SD) or frequencies. The chi-square test was applied to determine the exact fissure association between categorical data and Student t-test or Mann–Whitney U test as appropriate for continuous data. Univariate and multivariate logistic regression analyses were applied to determine risk factors. Statistical significance was set at $p < 0.05$.

3. Results

A total of 47 patients who underwent 51 endourological procedures during 51 hospital admissions were included. Two patients with a history of liver transplantation were excluded from the study because they had an adequately functioning graft and were not hepatically compromised. Demographic variables are shown in Table 1. Decompensation in the form of ascites was present in 26 (51%) patients and jaundice was present in 13 (25.49%) patients. Stones were located in the renal pelvis, upper ureter, mid ureter, and lower ureter (39.2%, 41.2%, 5.9%, and 13.7%, respectively). Double J (DJ) stent placement, ureteroscopic lithotripsy (URSL), and retrograde intrarenal surgery (RIRS) were performed in 15 (29.4%), 22 (43.1%), and 14 (27.5%) cases, respectively. Perioperative administration of transfusions was required in 35.29% of cases. Packed red blood cells, FFP, cryoprecipitates, and platelets were administered in 23.5%, 23.5%, 13.7%, and 21.6% of patients, respectively. Hospital and ICU stay, and blood products administered were not statistically different in CTP A and B categories ($p = 0.7$ and 0.87 , respectively). Two patients in the CTP C category died and 3 patients left the hospital against medical advice after a prolonged ICU stay. The various patient's parameters according to their CTP class are presented in Table 2.

Table 1

Demographic variables.

Characteristics	Total patients (n=51)
Age, yr	51.53
Male sex, n (%)	41 (80.4)
BMI, kg/m ²	27.24
CTP score	7.98
MELD score	16.14
MELD Na score	18.90
DM, n (%)	16 (31.4)
Hypertension, n (%)	8 (17)
Right sided procedure	38
Left sided procedure	11
Bilateral procedures	2
Cause of cirrhosis	Percentage
NASH	21.3
Ethanol	17
Hepatitis C	14.9
Hepatitis B	10.6
Idiopathic	12.8
Cryptogenic	10.6
Ethanol and hepatitis B combined	4.3
Primary biliary cirrhosis	1.96
Combined ethanol and NASH	1.96
Cholestasis	1.96
DM	16 (34)
Hypertension	8 (17)
Hypothyroidism	2
Tuberculosis	2

BMI = body mass index; CTP = Child–Turcotte–Pugh classification; DM = diabetes mellitus; MELD = model for end-stage liver disease; NASH = non-alcoholic steatohepatitis.

The duration of ICU stay increased with the rise in MELD score ($p < 0.001$, $r = 0.7$) (Fig. 1). Similarly, administration of blood products also increased with rising MELD scores ($p < 0.001$, $r = 0.7$) (Fig. 2 and Table 3). None of the patients required readmission from postoperative complications.

Table 2

Parameters based on Child–Pugh classification.

Parameters	Child A (n=16)	Child B (n=22)	Child C (n=13)	p
Age, yr	49.71	51.85	53	0.720
BMI, kg/m ²	28.91	25.89	27.45	0.135
MELD score	11	14.55	25.15	0.000
MELD Na score	13.14	17.50	28	0.000
DM, n (%)	3 (21.4)	8 (40)	5 (38.5)	0.491
Hypertension, n (%)	4 (28.6)	2 (10)	2 (15.4)	0.360
DJ stent placement, n (%)	3 (18.8)	5 (22.7)	7 (53.8)	
URSL, n (%)	4 (25)	14 (63.6)	4 (38.8)	
RIRS, n (%)	9 (56.3)	3 (13.6)	2 (15.4)	
Total blood products	0.06 (mean)	1.73 (mean)	9.23 (mean)	0.000
Cryoprecipitates	0	0.5	1.46	0.036
FFP	0	0.4	4.33	0.000
Platelets	0.06	0.66	2.38	0.016
ICU stay, d	0	0.5	5.92	0.000
Duration of hospitalization, d	2	3.5	12.15	0.000
Mortality, n	0	0	2	

BMI = body mass index; DJ = double J stent; DM = diabetes mellitus; FFP = fresh frozen plasma; MELD = model for end-stage liver disease; RIRS = retrograde intrarenal surgery; URSL = ureteroscopic lithotripsy; ICU = intensive care unit.

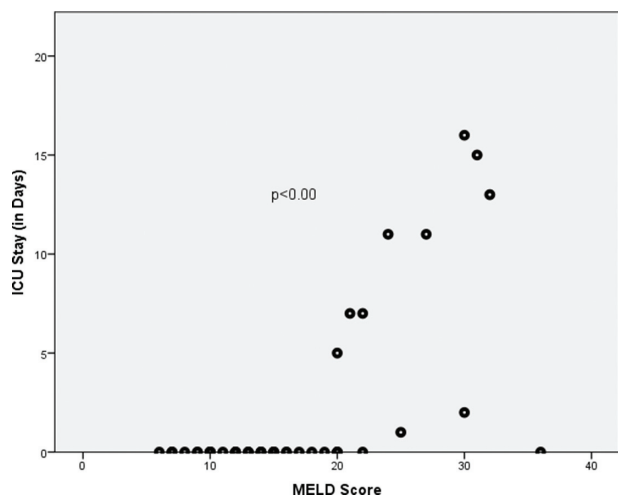


Figure 1. Correlation of MELD score with ICU stay. ICU = intensive care unit; MELD = model for end-stage liver disease.

Stone clearance was complete in all patients who underwent URSL. Residual calculi of 7–8 mm were encountered in 3 patients who underwent RIRS. Re-look RIRS was performed in 2 patients. One CTP A category patient underwent extracorporeal shock wave lithotripsy successfully, without any complications for a residual calculus of 8 mm.

4. Discussion

CLD patients pose a great challenge to physicians due to associated complications and comorbidities. They can present with hepatic encephalopathy, bleeding diathesis, ascites, hepatic hydrothorax, and hepatorenal syndrome. Therefore, it is of utmost importance to optimize these parameters before planning surgery. Traditionally, correctable parameters have been normalized before surgical intervention. Moreover, these maneuvers usually require hospitalization, which can significantly increase

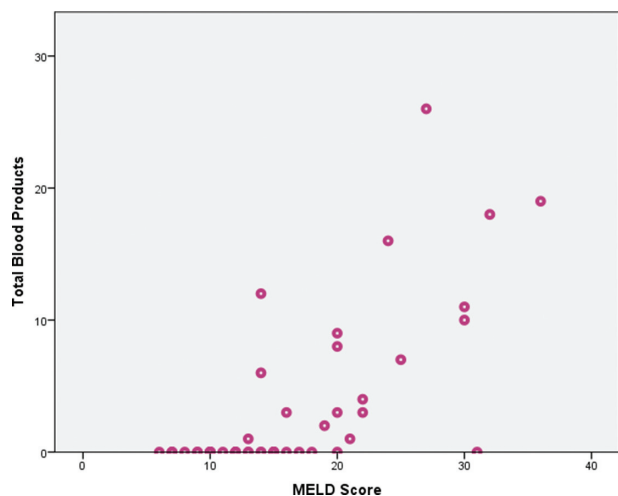


Figure 2. Correlation of MELD score with total amount of blood products transfused. MELD = model for end-stage liver disease.

Table 3

Parameters based on MELD score.

Parameters	MELD <20	MELD ≥20	<i>p</i>
Total hospital stay	2.56 ± 1.46 *2 (2,3)	11.67 ± 6.53 *14 (6,16)	0.002
Total blood products	0.0 ± 2.26 *0 (0,0)	9 ± 7.80 *2 (2,3)	0.001

MELD = model for end-stage liver disease.

* Median (interquartile range).

the cost of treatment. In our series, all patients who underwent endourological procedures were evaluated using plain computerized tomography before the procedure to determine stone number, location, and diameter. The treatment of choice for ureteric stones in patients with liver disease is URSL.^[7,8] RIRS is the procedure of choice in CLD patients with upper ureteric, renal pelvic, and renal calculi. Other options, such as shock wave lithotripsy and percutaneous nephrolithotomy (PCNL), are not suitable for CLD patients because of coagulopathies. RIRS is not ideal for renal stones >2 cm. However, in this group of patients, staged RIRS is a better modality for larger stones than PCNL, and is associated with high morbidity in patients with coagulopathies.^[9–11]

Pattaras et al. presented a series of 16 CLD patients who underwent 24 procedures. The most common cause of cirrhosis in their series was hepatitis C, compared with nonalcoholic steatohepatitis in our series. Twelve out of the 22 procedures in their series were preceded by the use of FFP, platelets, vitamin K, desmopressin, or recombinant factor VIIa to reverse severe coagulopathy. Their series included 18 ureteroscopies, 5 PCNLs, and 1 cystoscopic stone manipulation.^[11] They recommended a team approach and the application of protocols for the successful endoscopic management of urolithiasis in patients with CLD. Owing to the dynamic coagulation status, these patients remain at a high risk of delayed bleeding even after perioperative correction of coagulopathy.^[12]

Various scoring systems have been used to assess the severity of liver disease and to predict prognosis after surgery. The MELD, MELD Na, and CTP scores are commonly used. In our study, we also used the MELD and CTP scores to predict outcomes after the endourological procedure. These scores have been used to prognosticate patients with CLD undergoing various other surgeries, such as abdominal and cardiothoracic surgeries. Prognostication based on these scoring systems for other surgeries may not apply to our subset of patients, as we expect a better outcome after endourological procedures compared to abdominal and cardiothoracic surgery. Our study did not involve the validation of MELD and CTP scores in patients with CLD undergoing endourological management of urolithiasis, but it could be interesting to use CTP and MELD scores in these patients.

In a systematic review of 100 cirrhotic patients undergoing abdominal surgery, perioperative mortality rates of 10%, 31%, and 76% were found in Child class A, B, and C, respectively. In this review, Child classification was found to be the best predictor of surgical mortality and morbidity. They also found that MELD and MELD-Na scores were independent predictors of mortality at days 30, days 90, and 1 year.^[13] Our study observed that a high CTP score was associated with a statistically significant increase in the duration of hospital and ICU stay, and in the need for transfusions (*p* < 0.001).

Another analysis involving 140 cirrhotic patients undergoing non-transplant surgeries compared the mean MELD score of survivors with that of nonsurvivors (16.2% vs. 24.8%, respectively). Moreover, they observed a similar difference in the mean MELD score of survivors 1 year after surgery. The average MELD score at 1 year was 15.4 for survivors and 23.5 for nonsurvivors.^[14] In our study, patients with an MELD score of ≥ 20 had a significantly longer hospital stay ($p=0.002$) and required a significantly higher number of transfusions ($p < 0.001$).

Surgery should be performed in carefully selected patients and the risk of decompensation should be explained. If required, patients should be optimized by doing tapping of ascitic fluid along with infusion of albumin.

Coagulation remains a challenge in these patients, as both anticoagulants and procoagulants are affected.^[15] Thrombopoietin analogues and receptor agonists (eltrombopag, avatrombopag, and lusutrombopag) have been used to increase the platelet count to more than $50,000 \text{ mm}^3$ before elective surgery to avoid unnecessary transfusions.^[16] It is also desirable to have a fibrinogen level of $>100 \text{ mg/dL}$ before surgery. This can be achieved by administering low-volume cryoprecipitates. International normalized ratio is commonly used as a guide for FFP transfusion. However, this ratio only measures the activity of procoagulants, whereas point-of-care tests (thromboelastography and rotational thromboelastometry) provide a holistic status of coagulation by measuring the activity of both procoagulants and anticoagulants. Hence, it is better to use point-of-care testing as a guide for transfusing blood products.^[17]

Patients with advanced liver disease often do not undergo any major surgeries, including endourological procedures. DJ stent placement is a minimally invasive procedure that can be life saving in patients with sepsis or obstructive uropathy. It also avoids a prolonged anesthesia, which can further decompensate the liver. DJ stent placement can serve as a bridge to definitive surgery at later stages.^[13,14] In our study, 1 patient with obstructive uropathy underwent successful liver transplant after DJ stent placement. According to the literature search, this is the largest series of patients with CLD undergoing endourological management of urolithiasis. Most previous studies and guidelines included patients with coagulopathies from other causes. However, combining these patients with those suffering from other coagulopathies is not justified because the challenges imposed by liver disease are unique and multifactorial.^[6,17] Large multicentric studies are required to formulate guidelines for the management of patients with liver diseases and urinary calculi.

We recommend that patients with moderate-to-severe liver disease should be managed using a multidisciplinary approach. The correction of coagulopathy in these patients should be based on a point-of-care test to avoid both over- and under-correction. DJ stent placement should be considered in high-risk patients with severe liver disease, as it can serve as a bridge to the definitive procedure.

The lack of long-term follow-up was the main limitation of this study. In addition, the retrospective nature of the study and the small number of patients enrolled are other limitations.

5. Conclusions

Hospital and ICU stay, as well as blood product administration were significantly higher in Child C than in Child A and B class patients. Hospitalization duration and blood product adminis-

tration were significantly higher in patients with an MELD score ≥ 20 .

Acknowledgments

None.

Statement of ethics

This study was approved by institutional ethics committee (IEC/2019/68/MA03), this trial was registered with the Clinical Trial Registry of India (CTRI/2020/06/026233). Written informed consent for publication was obtained from the study participants. All procedures performed in study involving human participants were in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Conflict of interest statement

No conflict of interest has been declared by the author.

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Author contributions

All authors contributed equally in this study.

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