Immediate postoperative tracheal extubation in a liver transplant recipient with encephalopathy and the Mayo end-stage liver disease score of 41

A CARE-compliant case report revealed meaningful challenge in recovery after surgery (ERAS) for liver transplantation

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Abstract

Rationale: Immediate postoperative tracheal extubation (IPTE) is one of the most important subject in recovery after surgery (ERAS) for liver transplantation. However, the criteria for IPTE is not uniform at present.

Patient concerns: We reported a successful IPTE in a liver transplant recipient with encephalopathy and a high Mayo end-stage liver disease (MELD) score of 41, which beyond the so-called criteria reported in the literature. The patient was 48-year-old man, admitted in September 2016 for end-stage liver cirrhosis secondary to hepatitis B.

Diagnoses: End-stage liver cirrhosis secondary to hepatitis B with encephalopathy and a high MELD score of 41.

Interventions: He was involved in our ERAS project and was extubated at the end of the liver transplantation in the operating room.

Outcomes: As a result, the patient was not reintubated and had an excellent postoperative recovery, staying in intensive care unit (ICU) for just 2 days and discharged home on day 10.

Lessons: We believed IPTE in liver transplant recipients with severe liver dysfunction is a meaningful challenge in ERAS for liver transplantation. Our case and literature review suggest 3 things: IPTE in liver transplantation is generally feasible and safe; the encephalopathy or high MELD score should not be the only limiting factor; and a more systematic predicting system for IPTE in liver transplantation should be addressed in future studies.

Abbreviations: ERAS = enhanced recovery after surgery, ICU = intensive care unit, IPTE = immediate postoperative tracheal extubation, MELD = Mayo end-stage liver disease.

Keywords: enhanced recovery after surgery, immediate postoperative tracheal extubation, liver transplantation, Mayo end-stage liver disease

1. Introduction

Immediate postoperative tracheal extubation (IPTE) as a potential subtopic of the up-to-date concept of enhanced recovery after surgery (ERAS) has been identified as an excellent tool to achieve rapid recovery for selective patients undergoing liver transplantation. However, the criteria for IPTE have not yet been determined. The Mayo end-stage liver disease (MELD) score of <11 is the earliest proposed criteria[1] and the encephalopathy is usually regarded as exclude status for IPTE. In this report, we present a successful IPTE in a liver transplant recipient with encephalopathy and a high MELD score up to 41. We also reviewed the relevant literature with a view to the criteria for IPTE and investigated another 6 liver transplantations in the same month in our center with the purpose of identifying potential factors of IPTE in our cases.

2. Case report

A 48-year-old man was admitted in September 2016 for end-stage liver cirrhosis secondary to hepatitis B. The patient’s decompensated features included marked ascites, esophageal varices, and hepatic encephalopathy. His medical history included an artificial liver support for 10 times in the past month, and type 2 diabetes with bad blood glucose control for 8 years. The full-size liver transplant from a voluntary deceased donor who died of stroke was performed on the day of admission. IPTE was carried out at the end of surgery in the operating room and no complication occurred during the postoperative period.
Platelet count of 39 × 10^9/L (lower limit of normal reference range 130 × 10^9/L), and upper abdomen demonstrated evidence of liver cirrhosis, (Fig. 1A). The preoperative Child–Pugh score and MELD score were respectively calculated at 13 and 41 (Table 1).

Preoperative laboratory investigation showed a bilirubin of 31.2 mg/dL (upper limit of normal reference range 1.6 mg/dL), albumin of 35.6 g/L (lower limit of normal reference range 40 g/L), creatinine of 1.41 mg/dL, prothrombin time of 64.1 seconds (upper limit of normal reference range 12.8 seconds), international standardized ratio of 5.01 (upper limit of normal reference range 1.1 5), blood ammonia of 81.0 μ mol/L (upper limit of normal reference range 33.0 μ mol/L), sodium of 142.6 mmol/L (upper limit of normal reference range 135 mmol/L), potassium of 3.96 mmol/L, white cell count of 1.00E+02 IU/mL, sodium of 35.6 g/L (lower limit of normal reference range 31.2 mg/dL), and plasma 850 mL, went smoothly and lasted a total of 6.3 hours. The gross appearance of the explanted liver confirmed the computed tomography scan findings of multinodular cirrhosis (Fig. 1B and Table 2).

The anesthesia program included induction with intravenous propofol 2 to 3 mg/kg, fentanyl 0.4 μg/kg, midazolam 2 mg, penehyclidine hydrochloride 0.1 mg/kg and rocuronium 1 mg/kg, and maintenance with 2% sevoflurane in a 50% air/oxygen low-flow respiratory mixture, remifentanil (0.1–0.2 μg/kg/min), and cisatracurium (10 mg/hour). Hemodynamic monitoring included invasive systemic arterial pressure and the use of a central venous catheter. The 1% ropivacaine was subcutaneously injected along the incision when suturing the skin.

At the end of the operation, the patient’s hemodynamic stability was determined by the attending anesthetist in the

**Table 1**

Preoperative variables of patients undergoing liver transplantation in the same month.

| Conservative tracheal extubation (CTE) | Mean ± SD | Immediate postoperative tracheal extubation (IPTE) | Mean ± SD | t | P |
|---------------------------------------|-----------|----------------------------------------------------|-----------|---|---|
| Age, y                                | 36 ± 15   | 44 ± 17                                            | 51.0 ± 10.8 | 1.6 | .17 |
| History of chronic hepatitis B        | Yes       | Yes                                                | No        | No | No |
| History of other chronic diseases     | No        | No                                                 | No        | No | No |
| History of surgery                    | Surgery for pneumothorax 4 y ago | Splenectomy 10 y and radiofrequency ablation of liver cancer 1 y ago | No | No | No |
| History of smoking                    | No        | No                                                 | No        | No | No |
| History of drinking                   | No        | No                                                 | No        | No | No |
| Weight, kg                           | 70 ± 6.0  | 67 ± 5.0                                           | 64.3 ± 10.0 | 0.4 | .74 |
| Height, cm                           | 173.0 ± 6.0 | 168.0 ± 5.0                                       | 167 ± 5.4 | 0.1 | .93 |
| BMI                                   | 23.4 ± 2.3 | 23.9 ± 2.3                                        | 22.7 ± 2.6 | 0.5 | .66 |
| Main diagnosis                        | Hepatocellular carcinoma | Hepatocellular carcinoma | Wilson’s disease | Secondary cholestasis | Cirrhosis | Hepatocellular carcinoma | Chronic liver | Chronic liver |
| Creatinine, mg/dL                     | 1.0 ± 0.2 | 1.2 ± 0.2                                         | 0.6 ± 0.3 | 0.9 ± 0.3 | 0.4 | 0.8 | 1.4 | 0.7 |
| Total bilirubin, mg/dL                | 0.8 ± 0.1 | 0.9 ± 0.1                                         | 0.9 ± 0.1 | 11.0 | 0.5 | 31.2 | 10.0 | 13.2 ± 12.9 | 1.6 | .17 |
| INR                                   | 1.0 ± 0.2 | 1.2 ± 0.2                                         | 0.9 ± 0.1 | 11.0 | 0.5 | 31.2 | 10.0 | 13.2 ± 12.9 | 1.6 | .17 |
| MELDs                                 | 6 ± 3 | 10 ± 2 | 20 ± 12 | 7 ± 3 | 61 | 3 | 41 | 19 | 18 ± 17 | 0.5 | .61 |

BMI = body mass index, INR = international normalized ratio, MELD = Mayo end-stage liver disease score, SD = standard deviation.

*The patient who is reported in this article.*
operating room and then tracheal extubation was carried out according to the standardized and the universally accepted criteria (patient awake, ability to lift the head and swallow, and good oxygenation). Subsequently, the patient was admitted to the intensive care unit (ICU).

The patient made an excellent postoperative recovery and was discharged from the ICU 2 days later. He was discharged on the day 10, with a lower hospital cost compared to the average for liver transplantation.

### 3. Discussion

To the best of our knowledge, this case is the first to report IPTE in a liver transplant recipient with encephalopathy and so high MELD score up to 41. In fact, IPTE once relating to fast tracking existed for decades, however, considering possible failure of IPTE, which patients are more suitable for IPTE or what predict IPTE is still a question. In Europe, Bianco et al.'s study showed that only an MELD score <11 could predict the successful IPTE with a receiver operator characteristic area under the curve of 0.61, but the pretransplant Child–Pugh score did not. Perkins et al. did not think this criterion would be suitable for liver transplantation in the United States, which were performed mainly for patients with a MELD score >16. A further statistical analysis in a similar patient population demonstrated that the only factors associated with the failure to IPTE were encephalopathy and increased body mass index >34. Different from the above studies, a recent study showed the patient’s initial hemoglobin concentration, the number of packed red blood cells and fresh frozen plasma transfused during surgery, and pain control by application of a thoracic epidural catheter were only independent predictors of IPTE. Interestingly, our case with an MELD score of 41, encephalopathy and massive intraoperative blood transfusion failed to meet the above criteria for IPTE does show a good recovery result.

In order to explore decisive factors of IPTE in this case, we did a retrospective analysis which involved another 6 cases in our center during the same period. We did a total of 9 liver transplantations in September including 7 adult and 2 pediatric cases. Of the 7 adult cases, 3 underwent conservative tracheal extubation (CTE) with an average value of 16.4 hours for extubation (CTE) with an average value of 16.4 hours for immediate postoperative mechanical ventilation and 4 underwent IPTE with average value of 16.4 hours for extubation (IPTE).

**Table 2**

| Table 2 | Intraoperative variables and postoperative complications of patients undergoing liver transplantation in the same month. |
|---------|---------------------------------------------------------------|
| **Conservative tracheal extubation (CTE)** | **Immediate postoperative tracheal extubation (IPTE)** |
| **Patient 1** | **Patient 2** | **Patient 3** | **Mean ± SD** | **Patient 4** | **Patient 5** | **Patient 6** | **Patient 7** | **Mean ± SD** | **t** | **P** |
| Surgeon | Anesthesiologists | | | | | | | | | | |
| Surgeon A | Surgeon B | Surgeon C | | | | | | | | | |
| ASA Classification | | | | | | | | | | | |
| 3 | 3 | 2 | 2 | 3 | 3 | 3 | | | | | |
| Operation time, h | 9.0 | 7.2 | 7.9 | 8.0 ± 0.9 | 9.5 | 9.6 | 6.3 | 5.2 | 6.4 ± 2.2 | 1.2 | 0.28 |
| Postoperative mechanical ventilation time, h | 7.9 | 17.8 | 23.5 | 16.4 ± 7.8 | 1.7 | 0.4 | 0.5 | 0.0 | 0.7 ± 0.7 | 4.1 | <0.01 |
| Antihypertensive agents | | | | | | | | | | | |
| Norepinephrine, μg/kg | 51.2 | 178.4 | 41.6 | 90.4 ± 76.4 | 33.8 | 4.9 | 0.0 | 4.0 | 10.7 ± 15.6 | 2.1 | 0.08 |
| Epinephrine, μg/kg | 11.3 | 155.5 | 8.8 | 58.5 ± 83.9 | 0.0 | 3.4 | 0.0 | 0.1 | 0.9 ± 1.7 | 1.4 | 0.22 |
| Urine volume, ml | — | — | 800.0 | 800.0 ± 0.0 | — | 1750.0 | 60 | 850 | 920.0 ± 845.4 | 0.1 | 0.91 |
| Blood loss, ml | 2300 | 5000 | 400 | 2566.7 ± 2311.6 | 1000 | 1000 | 1000 | — | 1000 ± 0.0 | 1.2 | 0.31 |
| Autologous blood transfusion, ml | 0 | 0 | 200 | 66.7 ± 115.5 | 200 | 0 | 500 | 0 | 175.0 ± 230.3 | 0.7 | 0.50 |
| Allogeneic red blood cells, μm | 8 | 29 | 4 | 13.7 ± 13.4 | 14 | 0 | 8 | 0 | 5.5 ± 6.8 | 1.1 | 0.33 |
| Allogeneic plasma, ml | 550 | 2850 | 0 | 1066.7 ± 1398.5 | 1600 | 0 | 850 | 400 | 712.5 ± 686.0 | 0.4 | 0.67 |
| Allogeneic cryoprecipitate, μm | 10 | 0 | 0 | 3.3 ± 5.8 | 0 | 0 | 0 | 0 | 0.0 ± 0.0 | 1.2 | 0.29 |
| Allogeneic platelets, μm | 0 | 10 | 0 | 3.4 ± 5.9 | 0 | 0 | 0 | 0 | 0.0 ± 0.0 | 1.2 | 0.28 |
| Human serum albumin, g | 100 | 165 | 100 | 121.7 ± 37.5 | 75 | 50 | 75 | 125 | 81.3 ± 31.5 | 1.6 | 0.18 |
| Lymphohematopoietic growth factors, g | 0 | 6 | 0 | 2.0 ± 3.4 | 5 | 0 | 0 | 0 | 1.3 ± 2.5 | 0.3 | 0.75 |
| Prothrombin complex concentrate, IU | 0 | 3000 | 0 | 1000 ± 1723.1 | 3000 | 0 | 0 | 0 | 750 ± 1500.0 | 0.2 | 0.85 |
| 5% Sodium bicarbonate, ml | 775 | 1625 | 260 | 886.7 ± 689.3 | 0 | 0 | 0 | 0 | 0.0 ± 0.0 | 2.7 | <0.05 |
| Total colloid input, ml | 3000 | 4800 | 3000 | 3600.0 ± 1393.2 | 2500 | 1000 | 1500 | 2500 | 1875.0 ± 750.0 | 2.6 | 0.05 |
| Total crystal input, ml | 7575 | 11,925 | 4360 | 7953.3 ± 3796.7 | 5150 | 2600 | 6600 | 6000 | 5087.5 ± 1761.8 | 1.4 | 0.23 |
| Total liquid input, ml | 10,575 | 16,725 | 7360 | 11,553.3 ± 4758.5 | 7650 | 3600 | 8100 | 8500 | 6962.5 ± 2298.4 | 1.4 | 0.15 |
| Total blood transfusion, ml | 2150 | 8450 | 1000 | 3860.0 ± 4010.7 | 4600 | 0 | 2950 | 400 | 1967.5 ± 2177.3 | 0.8 | 0.46 |
| Postoperative complications | No | Yes | No | — | No | No | No | No | Pulmonary infection | — | — |
| Perioperative death | No | Yes | No | — | No | No | No | No | No | No | No |

ASA = American Society of Anesthesiologists.

1. The patient who is reported in this article.

[8] ERAS is a practice at present.

[9] Successful IPTE with a receiver operator characteristic area under the curve of 0.61, but the pretransplant Child–Pugh score did not.

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an average time of 0.7 hours (Table 2). We compared the 2 groups of patients from preoperative variables, intraoperative variables and postoperative complications, together with the intraoperative intraoperative arterial blood gas analysis results (Tables 1–3). We found there was no significant difference between the 2 groups for most of the variables; however, the intraoperative transfusion volume of 5% sodium bicarbonate and PO₂ at the end of surgery differed in the 2 groups (Tables 2, 3). In addition, the intraoperative total colloid input volume also showed a marginal difference between CTE and IPTE. It is also noteworthy that our evidence is not definitive due to the limited number of cases included in our analysis and more large sample studies are required in the future. Nevertheless, a more detailed analysis revealed that all the patients in the IPTE had no smoking history and this case we reported in the above did not use any vasoconstrictor including norepinephrine and epinephrine.
hydrochloride, which indicated a good lung function and a stable intraoperative hemodynamic should be important for this challenging practice.

Our case suggests even for recipients with encephalopathy and a high MELD score, successful IPTE in liver transplantation still exists in certain cases. Furthermore, a larger series that provides who to select for early extubation and the pros/cons would be useful in the practice of ERAS for liver transplantation.

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