Clinical Case Report

Medicine®

OPEN

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

Jianbo Li, MD[a], Chengdi Wang, MD[b], Nan Chen, MD[c], Jiulin Song, MD[a], Yan Sun, MD[c], Qin Yao, MD[d], Lunan Yan, MD[a,*], Jiayin Yang, MD[a,*]

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.[2–4] 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.

Editor: N A.

JL and CW contributed equally to this work.

Funding/support: This study is supported by the National Science and Technology Major Project of China (Grant number 81470037 to JY).

The authors have no conflicts of interest to disclose.

[a] Department of Liver Surgery and State Key Laboratory of Biotherapy, West China Hospital, Sichuan University, [b] Department of Respiratory and Critical Care Medicine, West China Medical School/West China Hospital, [c] West China School of Medicine/West China Hospital, Sichuan University, [d] Department of Anesthesiology, West China Hospital of Sichuan University, Chengdu, Sichuan, P.R. China.

[*] Correspondence: Jiayin Yang, and Lunan Yan, Department of Liver Surgery, West China Hospital, Sichuan University, Chengdu, 610041, P.R. China (e-mails: doctoryjy@163.com, yanlunan8060@163.com).

Copyright © 2017 the Author(s). Published by Wolters Kluwer Health, Inc. This is an open access article distributed under the Creative Commons Attribution License 4.0 (CCBY), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Medicine (2017) 96:47(e8467)

Received: 14 January 2017 / Received in final form: 27 August 2017 / Accepted: 9 October 2017

http://dx.doi.org/10.1097/MD.0000000000008467

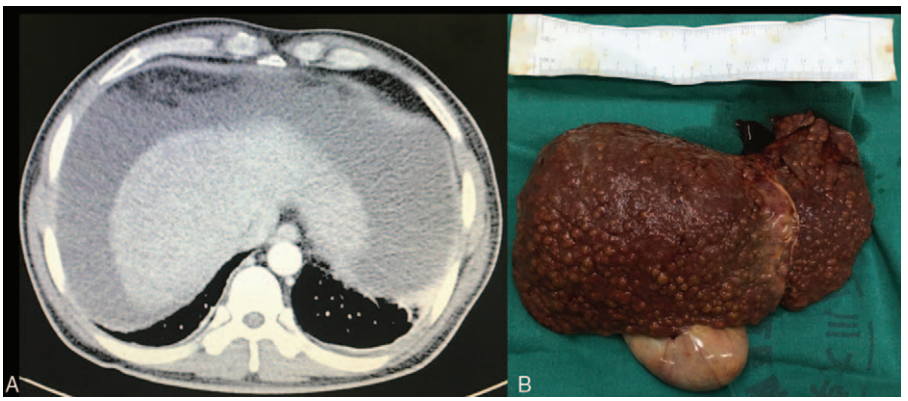

Figure 1. Preoperative contrast-enhanced abdominal computed tomography scan and the resected liver of recipient. (A) Computed tomography enhanced scan of the upper abdomen showed massive ascites and atrophic liver, (B) the gross multinodular cirrhosis appearance of the explanted liver.

Written informed consent was obtained from each patient and the study application was approved by the ethics committee of West China Hospital.

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 1.15), blood ammonia of 81.0 μmol/L (upper limit of normal reference range 33.0 μmol/L), hepatitis B virus DNA of 1.65E+03 IU/mL (upper limit of normal reference range 1.00E+02 IU/mL), sodium of 142.6 mmol/L, potassium of 3.96 mmol/L, white cell count of 7.3×10^9/L, lymphocyte count of 1.0×10^9/L, hemoglobin of 99 g/L (lower limit of normal reference range 130 g/L), and platelet count of 39×10^9/L (lower limit of normal reference range 100 g/L). Computed tomography enhanced scan of the upper abdomen demonstrated evidence of liver cirrhosis, splenomegaly, esophageal varices, massive ascites, and gallstone (Fig. 1A). The preoperative Child–Pugh score and MELD score were respectively calculated at 13 and 41 (Table 1).

Procurement of the piggyback liver transplantation was performed using standard techniques.[5,6] The operation, with a blood loss of 1000 mL and total blood transfusion of 2950 mL (autologous blood of 500 mL, red blood cell suspension of 8 U, 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% sevoflorane 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)				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*
Age, y	36	50	17	34.3±16.6	44	67	48	45	51.0±10.8	−1.6	.17
History of chronic hepatitis B	Yes	Yes	No	–	No	Yes	Yes	Yes			
History of other chronic diseases	No	No	No		No	No	Type 2 diabetes mellitus	No			
History of surgery	Surgery for pneumothorax 4 y ago	Splenectomy 10 y and radiofrequency ablation of liver cancer 1 y ago	No		Choledochojejunostomy 18 y ago	Radiofrequency ablation of liver cancer 2 y ago	Artificial liver support for ten times in the last year	Surgery for left hand index finger trauma	—	—	
History of smoking	Smoking for 10 y	Smoking for 30 y	No		No	No	No	No			
History of drinking	No	Drinking for 20 y	No		No	No	Drinking for 4 y	No			
Weight, kg	70.0	67.5	46.0	61.2±13.2	51.0	72.0	72.0	62.0	64.3±10.0	−0.4	.74
Height, cm	173.0	168.0	161.0	167.3±6.0	160.0	172.0	168.0	171.0	167.8±5.4	−0.1	.93
BMI	23.4	23.9	17.7	21.7±3.4	19.9	24.3	25.5	21.2	22.7±2.6	−0.5	.66
Main diagnosis	Hepatocellular carcinoma	Hepatocellular carcinoma	Wilson's disease	—	Secondary cholestatic cirrhosis	Hepatocellular carcinoma	Chronic liver failure	Chronic liver failure	—		
Creatinine, mg/dL	1.0	1.2	0.6	0.9±0.3	0.4	0.8	1.4	0.7	0.8±0.4	0.4	.72
Total bilirubin, mg/dL	0.8	0.9	0.9	0.9±0.1	11.0	0.5	31.2	10.0	13.2±12.9	−1.6	.17
INR	1.0	1.2	5.0	2.4±2.3	1.9	1.1	5.0	1.8	2.5±1.7	0.0	.98
MELDs	6	10	20	12±7	8	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.

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	Surgeon A	Surgeon B	Surgeon C		Surgeon C	Surgeon B	Surgeon A	Surgeon B			
Anesthesiologists	Anesthesiologist A	Anesthesiologist A	Anesthesiologist B	—	Anesthesiologist C	Anesthesiologist D	Anesthesiologist E	Anesthesiologist A	—	—	
ASA Classification	3	3	2		3	2	3	2			
Operation time, h	9.0	7.2	7.9	8.0 ± 0.9	9.5	4.6	6.3	5.2	6.4 ± 2.2	1.2	.28
Postoperative mechanical ventilation time, h	7.9	17.8	23.5	16.4 ± 7.9	1.7	0.4	0.5	0.0	0.7 ± 0.7	4.1	<.01
Anhepatic phase, h	2.0	1.4	1.0	1.5 ± 0.5	1.2	0.8	1.4	0.9	1.1 ± 0.3	1.3	.24
Liver implantation method	Living donor	Orthotopic	Piggyback		Piggyback	Orthotopic	Piggyback	Orthotopic			
Dopamine, μg/kg	0	0	705	235.0 ± 407.0	0	0	550	0	135.0 ± 275.0	0.4	.72
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	.09
Epinephrine hydrochloride, 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	.22
Urine volume, mL	—	—	800	800.0 ± 0.0	—	1750	60	950	920.0 ± 845.4	−0.1	.91
Blood loss, mL	2300	5000	400	2566.7 ± 2311.6	1000	1000	1000	—	1000.0 ± 0.0	1.2	.31
Autologous blood transfusion, mL	0	0	200	66.7 ± 115.5	200	0	500	0	175.0 ± 236.3	−0.7	.50
Allogeneic red blood cells, μm	8	29	4	13.7 ± 13.4	14	0	8	0	5.5 ± 6.8	1.1	.33
Allogeneic plasma, mL	550	2650	0	1066.7 ± 1398.5	1600	0	850	400	712.5 ± 686.0	0.4	.67
Allogeneic cryoprecipitate, μm	10	0	0	3.3 ± 5.8	0	0	0	0	0.0 ± 0.0	1.2	.29
Allogeneic platelets, μm	0	10.25	0	3.4 ± 5.9	0	0	0	0	0.0 ± 0.0	1.2	.29
Human serum albumin, g	100	165	100	121.7 ± 37.5	75	50	75	125	81.3 ± 31.5	1.6	.18
Lyophilized human fibrinogen, g	0	6	0	2.0 ± 3.4	5	0	0	0	1.3 ± 2.5	0.3	.75
Prothrombin complex concentrate, IU	0	3000	0	1000.0 ± 1732.1	3000	0	0	0	750.0 ± 1500.0	0.2	.85
5% Sodium bicarbonate, mL	775	1625	260	886.7 ± 689.3	0	0	0	0	0.0 ± 0.0	2.7	<.05
Total colloid input, mL	3000	4800	3000	3600.0 ± 1.39.2	2500	1000	1500	2500	1875.0 ± 750.0	2.6	.05
Total crystal input, mL	7575	11,925	4360	7953.3 ± 3796.7	5150	2600	6600	6000	5087.5 ± 1761.8	1.4	.23
Total liquid input, mL	10,575	16,725	7360	11,553.3 ± 4758.5	7650	3600	8100	8500	6962.5 ± 2268.4	1.4	.15
Total blood transfusion, mL	2150	8450	1000	3866.7 ± 4010.7	4600	0	2950	400	1987.5 ± 2177.3	0.8	.46
Postoperative complications	No	Active abdominal bleeding	No	—	No	No	No	Pulmonary infection	—	—	
Perioperative death	No	Yes	No	—	No	No	No	No			

ASA = American Society of Anesthesiologists.
* 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 transferred to the surgical ward 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 which emphasizes efficient use of resources[7] is now one potential subtopic of currently the most popular surgical theme called ERAS[8] which our liver transplantation center is committed to practice at present.

Although the early extubation was introduced to fast tracking in patients after coronary artery bypass grafting in 1980,[9] the similar practice in liver transplant recipients was conducted by Mandell et al[2] 17 years later. Theoretically, positive pressure ventilation and positive end expiratory pressure can reduce liver blood flow and are especially maligned in the context of compromised immune and high cardiac indices during liver transplantation. In the last 15 years, a series of studies has been demonstrated that IPTE in the operating room could be successfully performed in a large fraction of patients (60%–80%) without an increased risk of subsequent reintubation.[10–12]

According to the available literature,[1,7,10] benefits of such an approach include: higher quality of care, shorter ICU and hospital length of stay, and less total treatment costs. In line with these reports, our patient's postoperative course was uneventful, and he was discharged home on day 10. Also his hospital cost was below average level for liver transplantation.

Immediate extubation following liver transplantation has been 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, Biancofiore et al's study[1] 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[13] 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.[3] 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 3 independent predictors of IPTE.[12] 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 postoperative mechanical ventilation and 4 underwent IPTE with

Table 3

Intraoperative arterial blood gas analysis results 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*
PH											
Start of surgery	7.36	7.43	7.47	7.43 ± 0.06	7.47	7.40	7.50	7.44	7.45 ± 0.06	−0.4	.72
End of surgery	7.41	7.28	7.25	7.33 ± 0.06	7.36	7.34	7.46	7.38	7.40 ± 0.08	−1.2	.29
Average value	7.31	7.27	7.36	7.33 ± 0.06	7.35	7.35	7.45	7.37	7.43 ± 0.05	−2.3	.07
PCO_2, mm Hg											
Start of surgery	39.9	26.6	30.1	32.2 ± 6.9	27.5	44.3	45.7	30.6	37.0 ± 9.3	−0.7	.49
End of surgery	41.4	41.0	40.3	40.9 ± 0.6	31.4	47.8	40.4	42.7	40.6 ± 6.9	0.1	.94
Average value	41.5	38.8	37.9	39.4 ± 1.9	32.2	43.7	40.1	35.5	37.9 ± 5.1	0.5	.65
PO_2, mm Hg											
Start of surgery	375.4	273.5	220.8	289.9 ± 78.6	94.1	212.3	100.7	322,3	907.5 ± 1544.6	−0.7	.53
End of surgery	286.4	276.3	257.0	2732 ± 14.9	239.4	236.7	246.2	261.3	245.9 ± 11.0	2.8	.04
Average value	287.9	262.0	250.3	266.7 ± 19.2	211.6	240.1	247.4	276.7	244.0 ± 26.7	1.2	.27
Na^+, mmol/L											
Start of surgery	138.7	139.4	132.1	136.7 ± 4.0	135.4	136.6	133.0	133.9	134.7 ± 1.6	0.9	.40
End of surgery	143.0	150.3	139.5	144.2 ± 5.5	140.0	139.0	134.6	138.4	138.0 ± 2.4	2.1	.09
Average value	141.1	128.9	136.3	135.4 ± 6.1	136.7	137.2	134.8	136.5	136.3 ± 1.0	−0.3	.79
K^+, mmol/L											
Start of surgery	3.0	2.7	3.1	2.9 ± 0.2	2.9	3.5	3.8	3.9	3.5 ± 0.45	−2.1	.09
End of surgery	4.3	3.6	3.5	3.8 ± 0.4	3.5	4.0	4.5	3.8	4.0 ± 0.4	−0.5	.67
Average value	3.3	3.8	3.2	3.4 ± 0.3	3.3	3.6	3.8	3.3	3.5 ± 0.2	−0.3	.77
Ca^+, mmol/L											
Start of surgery	1.1	1.0	1.0	1.0 ± 0.1	1.0	1.1	1.0	0.954	0.78 ± 0.5	0.8	.44
End of surgery	1.0	0.6	1.0	0.9 ± 0.3	1.2	1.1	1.2	1.0	1.1 ± 0.1	−2.1	.09
Average value	1.0	0.8	1.0	0.9 ± 0.1	1.0	1.0	1.0	1.0	1.0 ± 0.0	−1.2	.29
Glu, mmol/L											
Start of surgery	4.8	4.4	5.6	4.9 ± 0.6	5.1	4.3	15.8	3.8	7.3 ± 5.7	−0.7	.53
End of surgery	10.8	7.0	8.6	8.8 ± 1.9	11.9	7.9	16.0	13.1	12.2 ± 3.4	−1.6	.18
Average value	7.1	5.6	6.5	6.4 ± 0.8	8.3	6.2	13.8	6.9	8.8 ± 3.4	−1.2	.30
Lac, mmol/L											
Start of surgery	1.8	2.3	1.9	2.0 ± 0.3	2.4	1.7	7.9	2.6	3.7 ± 2.9	−1.0	.38
End of surgery	10.3	20.0	9.4	13.2 ± 5.9	10.8	1.6	7.6	3.8	6.0 ± 4.1	2.0	.11
Average value	9.6	12.7	5.2	9.2 ± 3.7	6.0	2.3	7.4	3.7	4.9 ± 2.3	1.9	.12
Hct, %											
Start of surgery	40.5	40.5	27.5	36.2 ± 7.5	32.2	38.6	28.4	27.3	31.6 ± 5.1	1.0	.38
End of surgery	23.0	14.6	34.8	24.1 ± 10.1	23.1	29.4	24.2	27.1	26.0 ± 2.9	−0.4	.74
Average value	27.0	15.3	30.2	24.2 ± 7.8	26.2	32.6	27.4	25.6	28.0 ± 3.2	−0.9	.41
HCO_3, mmol/L											
Start of surgery	21.9	17.3	21.3	20.2 ± 2.5	19.5	26.5	33.1	20.5	24.9 ± 6.3	−1.2	.28
End of surgery	25.7	18.7	17.4	20.6 ± 4.5	17.1	25.3	27.8	24.7	23.8 ± 4.6	−0.9	.41
Average value	20.7	18.6	20.8	20.0 ± 1.2	17.6	23.6	29.7	21.6	23.1 ± 5.0	−1.0	.36
BE, mmol/L											
Start of surgery	−3.3	−6.9	−1.9	−4.0 ± 2.6	−3.4	1.3	10.3	−3.0	1.3 ± 6.4	−1.3	.24
End of surgery	1.0	−7.5	−9.3	−5.3 ± 5.5	−7.6	−0.8	3.6	−0.5	−1.3 ± 4.6	−1.0	.35
Average value	−5.2	−8.0	−4.3	−5.8 ± 1.9	−7.1	−2.1	6.1	−4.5	−1.9 ± 5.7	−1.1	.31
Thb, g/L											
Start of surgery	131.3	131.8	85.5	116.2 ± 26.6	95.3	127.7	88.4	87.4	99.7 ± 19.0	1.0	.38
End of surgery	82.2	64.0	121.9	89.4 ± 29.6	79.8	102.4	77.2	88.1	86.9 ± 11.3	0.2	.88
Average value	91.9	61.2	96.7	83.3 ± 19.3	85.3	110.3	87.5	81.8	91.3 ± 12.9	−0.7	.54
SaO_2, %											
Start of surgery	100.0	100.0	100.0	100.0 ± 0.0	98.5	100.0	98.5	100.0	99.3 ± 0.9	1.5	.20
End of surgery	100.0	100.0	100.0	100.0 ± 0.0	100.0	100.0	100.0	100.0	100.0 ± .0.0	0.0	1.00
Average value	99.6	66.5	100.0	88.7 ± 19.2	99.5	100.0	98.3	100.0	99.5 ± 0.8	−1.2	.30
Cl^-, mmol/L											
Start of surgery	110.6	118.2	110.4	113.1 ± 4.4	111.4	108.8	97.6	112.3	107.5 ± 6.8	1.2	.28
End of surgery	112.1	109.4	111.8	111.1 ± 1.5	114.5	111.5	104.0	111.1	110.3 ± 4.5	0.3	.78
Average value	112.5	115.1	109.7	112.4 ± 2.7	113.0	110.8	101.3	99.4	106.1 ± 6.8	1.5	.20

SD = standard deviation.

* The patient who is reported in this article.

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 PO_2 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.

Acknowledgments

The authors thank the National Science and Technology Major Project of China for providing funds for this project (Grant number 81470037 to JY).

References

[1] Biancofiore G, Bindi ML, Romanelli AM, et al. Fast track in liver transplantation: 5 years' experience. Eur J Anaesthesiol 2005;22: 584–90.
[2] Mandell MS, Lockrem J, Kelley SD. Immediate tracheal extubation after liver transplantation: experience of two transplant centers. Anesth Analg 1997;84:249–53.
[3] Mandell MS, Lezotte D, Kam I, et al. Reduced use of intensive care after liver transplantation: patient attributes that determine early transfer to surgical wards. Liver Transpl 2002;8:682–7.
[4] Skurzak S, Stratta C, Schellino MM, et al. Extubation score in the operating room after liver transplantation. Acta Anaesthesiol Scand 2010;54:970–8.
[5] Starzl TE, Marchioro TL, Vonkaulla KN, et al. Homotransplantation of the liver in humans. Surg Gynecol Obstet 1963;117:659–76.
[6] Gerber DA, Passannante A, Zacks S, et al. Modified piggyback technique for adult orthotopic liver transplantation. J Am Coll Surg 2000; 191:585–9.
[7] Plevak DJ, Torsher LC. Fast tracking in liver transplantation. Liver Transpl Surg 1997;3:447–8.
[8] Steenhagen E. Enhanced recovery after surgery: it's time to change practice!. Nutr Clin Pract 2016;31:18–29.
[9] Quasha AL, Loeber N, Feeley TW, et al. Postoperative respiratory care: a controlled trial of early and late extubation following coronary-artery bypass grafting. Anesthesiology 1980;52:135–41.
[10] Glanemann M, Busch T, Neuhaus P, et al. Fast tracking in liver transplantation. Immediate postoperative tracheal extubation: feasibility and clinical impact. Swiss Med Wkly 2007;137:187–91.
[11] Aniskevich S, Pai SL. Fast track anesthesia for liver transplantation: review of the current practice. World J Hepatol 2015;7:2303–8.
[12] Blaszczyk B, Wronska B, Klukowski M, et al. Factors affecting breathing capacity and early tracheal extubation after liver transplantation: analysis of 506 cases. Transplant Proc 2016;48:1692–6.
[13] Perkins JD. Immediate tracheal extubation following liver transplantation. Liver Transpl 2006;12:883–4.