MEDICAL SCIENCE MONITOR

CLINICAL RESEARCH

e-ISSN 1643-3750
© Med Sci Monit, 2021; 27: e933082
DOI: 10.12659/MSM.933082

Received: 2021.05.10
Accepted: 2021.08.31
Available online: 2021.09.13
Published: 2021.12.23

Postoperative Complications Associated with Moderate Sedation in Endoscopic Procedures Among Patients with Cirrhosis

Authors' Contribution:
Study Design A
Data Collection B
Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
Literature Search F
Funds Collection G

B 1 Yan Wang*
C 1,2 Huisheng Xu*
E 1 Hui Li
B 3 Lingyang Chen
C 4 Ye Xin
D 5 Hongtan Chen
E 1 Xiangming Fang
A 1 Baoli Cheng

1 Department of Anesthesiology, The First Affiliated Hospital, Zhejiang University School of Medicine, Hangzhou, Zhejiang, PR China
2 Department of Anesthesiology, Quzhou People's Hospital, Quzhou, Zhejiang, PR China
3 Department of Anesthesiology, Taizhou Hospital of Zhejiang Province, Hangzhou, Zhejiang, PR China
4 Department of Anesthesiology, Ningbo Medical Center Lihuili Eastern Hospital, Ningbo, Zhejiang, PR China
5 Department of Digestive Medicine, The First Affiliated Hospital, Zhejiang University School of Medicine, Hangzhou, Zhejiang, PR China

* Yan Wang and Huisheng Xu contributed equally to this work

Corresponding Authors: Xiangming Fang, e-mail: xmfang@zju.edu.cn, Baoli Cheng, e-mail: chengbaoli1979@zju.edu.cn
Financial support: None declared
Conflict of interest: None declared

Background: Moderate sedation for endoscopic intervention has become common and offers increased safety and comfort. Patients with cirrhosis are sicker and at increased risk for complications related to sedation. However, postoperative complications associated with moderate sedation and their risk factors have not been adequately studied in this population.

Material/Methods: This retrospective study included cirrhotic patients who underwent endoscopic procedures with moderate sedation and were admitted to the First Affiliated Hospital, Zhejiang University School of Medicine, between January 1, 2015, and December 31, 2019. A mixed-effects multivariate logistic regression model determined odds ratios between variables and complications, adjusting for potential confounders. The model was validated with 51 patients admitted from August 28, 2020, to October 12, 2020, at 3 hospitals.

Results: Among 232 cirrhotic patients, complications were recorded for 40 patients (17.2%). These patients had a significantly longer hospital length of stay ($P<0.05$), and postprocedural complications (35/40; 87.5%) were the most common type of complication. Moderate sedation-associated postoperative complications were significantly associated with portal hypertension history (odds ratio [OR] 2.201; 95% confidence interval [CI] 0.903, 5.364) and the procedure being performed in the evening (OR 1.971; 95% CI 0.946, 4.106). The area under the receiver-operating characteristic curve was 0.627 (95% CI, 0.534 to 0.719, $P=0.012$) in the validated subgroup, and the predicted accordance rate was 70%.

Conclusions: Moderate sedation-associated postoperative complications were relatively high among cirrhotic patients undergoing endoscopic procedures. Complications were associated with sicker patients who underwent endoscopic procedures in the evening, suggesting the potential need for more intensive care of perioperative management in this population, including anesthesia monitoring.

Trial registration: This study was registered on the Chinese Clinical Trial Registry (ChiCTR2000034799)

Keywords: Anesthesia, Intravenous • Liver Cirrhosis • Postoperative Complications

Full-text PDF: https://www.medscimonit.com/abstract/index/idArt/933082

Indexed in: [Current Contents/Clinical Medicine] [SCI Expanded] [ISI Alerting System] [ISI Journals Master List] [Index Medicus/MEDLINE] [EMBASE/Excerpta Medica] [Chemical Abstracts/CAS]

Background

Over the past decade, anesthesia-directed sedation for gastrointestinal endoscopic procedures has risen dramatically owing to the promise of rapid sedation and recovery, increased patient comfort, and enhanced satisfaction with operations compared with endoscopist-directed sedation [1-5]. Liver cirrhosis is the end stage of chronic liver disease and is characterized by the accumulation of fibrotic tissue and abnormal regenerative nodules [6,7]. Portal hypersensitive gastropathy and its devastating complication, variceal hemorrhage, are common in cirrhotic patients [8]. Variceal hemorrhage poses the most life-threatening complication of liver cirrhosis, and it is associated with increased mortality, particularly in patients with hepatic decompensation [9]. Patients with cirrhosis should routinely undergo upper endoscopy for variceal screening and for diagnostic and therapeutic purposes [10,11]. Due to delayed gastric emptying, poor nutritional status, and altered drug metabolism, cirrhotic patients are considered to be at higher risk for sedation-associated complications. Therefore, cirrhotic patients undergoing endoscopy often need the assistance of anesthesia-directed sedation [12]. Moderate sedation, predominantly achieved using propofol, is the most commonly used anesthesia-directed sedation for gastrointestinal endoscopic procedures. The pharmacokinetic profile of propofol, which has a short duration of action and is quickly metabolized, is particularly appealing in patients with liver disease including cirrhosis [13,14]. However, there are limited data describing characteristics of moderate sedation-associated postoperative complications in cirrhotic patients. Moreover, it is imperative to understand the risks for the development of moderate sedation-associated complications in this population. Therefore, in this study, we aimed to investigate the prevalence of postoperative complications associated with moderate sedation among cirrhotic patients undergoing endoscopic procedures and these patients' risk factors.

Material and Methods

Patient and Public Involvement

This retrospective study collected data on patients with cirrhosis admitted at the Department of Digestive Medicine, the First Affiliated Hospital, Zhejiang University School of Medicine from January 1, 2015, to December 31, 2019. The population included individuals with cirrhosis undergoing endoscopic procedures using moderate sedation. Moderate sedation was performed with propofol 2-4 mg/kg per hour by anesthesiologists. The electronic medical system used for the study included an electronic record for storing data about basic characteristics (eg, age, sex, American Society of Anesthesiologists [ASA] classification, Child-Pugh classification, portal hypertension history, cardiac commodities, diabetes mellitus), intraoperative variables (procedure type, day/night shift) and postoperative complications. Complications were available only if reported by the physician in the ward and recorded in electronic medical system. Endoscopic procedures referred to esophagogastroduodenoscopy with or without endoscopic ultrasound and enteroscopy. Moderate sedation-associated postoperative complications were grouped into 7 categories: (1) postprocedure complications including nausea, vomiting, pain, or other symptoms; (2) respiratory complications including airway obstruction aspiration, difficult airway, pneumothorax, pulmonary embolus, reintubation, and respiratory arrest; (3) cardiovascular complications including myocardial ischemia and transfusion, arrhythmia, cardiac arrest, myocardial infarction, hemodynamic instability, and hypotension; (4) drug-related complications including adverse reaction, anaphylaxis, malignant hyperthermia, and medication error; (5) neurologic complications including awareness, emergence, neurologic deficit, seizure, stroke, and vision loss; (6) patient injury including eye injury, infection, and other bodily injury; and (7) death [15]. Respiratory, cardiovascular, drug-related, and neurologic complications; patient injury; and death were identified as serious complications. Our primary measurement was the incidence and type of postoperative complications associated with moderate sedation. An important secondary aim of the study was to determine the risk factors associated with complications. The logistic regression model was further validated in a subgroup with 51 patients admitted from August 28, 2020, to October 12, 2020, at 3 university hospitals located in Zhejiang province (the First Affiliated Hospital, Zhejiang University School of Medicine, Quzhou People's Hospital, Taizhou Hospital of Zhejiang Province). This study was registered on Chinese Clinical Trial Registry (ChiCTR2000034799) and approved by the Ethics Committee of the First Affiliated Hospital, Zhejiang University School of Medicine (IIT20200328A).

Statistical Analysis

PASS statistical software was used to calculate sample size. With a 2-tailed α=0.05, assumed odds ratio of 4, confidence level of 0.95, and a power of 80% to guarantee results, a minimum sample size of 196 participants was required. We examined frequencies for each categorical variable (patient characteristics, procedural characteristics, and complications). We performed bivariate comparisons of each variable with the dichotomous outcome of a postoperative complication using Pearson's chi-square tests for categorical predictors. We fit a logistic regression model to determine risk factors that best predicted the probability of developing moderate anesthesia-associated complications reported as odds ratios, and further to calculate the accordance rate. Mixed-effects modeling was used to account for variability in practice and provider reporting of complications. Our final multivariable logistic regression analysis was restricted to observations that had no missing data. The final mixed-effects model consisted of

Indexed in: [Current Contents/Clinical Medicine] [SCI Expanded] [ISI Alerting System] [ISI Journals Master List] [Index Medicus/MEDLINE] [EMBASE/Excerpta Medica] [Chemical Abstracts/CAS]

Table 1. Patient characteristics of endoscopic procedures performed in cirrhosis.

Variable	Frequency, n (%)
Age	
18-49	62 (26.7)
50-64	113 (48.7)
65-79	53 (22.8)
≥80	4 (1.8)
Sex	
Female	70 (30.2)
Male	162 (69.8)
American Society of Anesthesiologists score	
1/2	42 (18.1)
≥3	190 (81.9)
Child-Pugh	
A	199 (85.8)
B	30 (12.9)
C	3 (1.3)
History portal hypertension complication	
Yes	158 (68.1)
No	74 (31.9)
Cardiac comorbidities*	
Yes	42 (18.0)
No	190 (82.0)
Diabetes mellitus	
Yes	24 (10.3)
No	208 (89.7)

* Cardiac comorbidities including coronary artery disease, heart failure, and other cardiovascular diseases.

variables that were reported to be associated with complications in the literature (eg, ASA, portal hypertension) and potential predictors of complications that could be clinically relevant (eg, age, sex, Child-Pugh scores, diabetes, and cardiac comorbidities), as well as variables that were statistically significant on bivariate analysis (eg, shift). The area under the receiver-operating characteristic curve was displayed (c-statistic). *P* value of <0.05 was considered significant.

Results

Patient Characteristics

Our sample consisted of a total of 232 patients with cirrhosis who underwent endoscopic procedures. In a univariate analysis, the population was 30.2% female, with a median age of 57 years (**Table 1**). A majority of cases (81.9%) were ASA class 3 or greater (ie, ASA 3, a patient with severe systemic disease; ASA 4, severe systemic disease that is a constant threat to life; ASA 5, a moribund patient who is not expected to survive without the procedure). A majority of cases were assessed as Child-Pugh A (85.8%). Over half (68.1%) had a history of portal hypertension. Out of the total population, 24 patients (10.3%) had diabetes mellitus and 42 (18%) had a cardiac comorbidity, 38 of whom had a diagnosis of hypertension.

Table 2. Procedure characteristics of endoscopic procedures performed in cirrhosis.

Variable	Frequency, n (%)
Procedure type	
Esophagogastroduodenoscopy	221 (95.3)
Enteroscopy	11 (4.7)
Shift	
Daytime (7: 00 AM to 5: 00 PM)	161 (69.4)
Evening (5: 01 PM to 6: 59 AM)	71 (30.6)

Table 3. Prevalence of moderate sedation-associated postoperative complications among endoscopic procedures.

Complication type	Frequency, n (%)
Any complication	40 (17.2)
Postprocedure	35 (15.1)
Cardiovascular	7 (3.0)
Patient injury	1 (0.4)

Procedural Characteristics

As shown in **Table 2**, esophagogastroduodenoscopy composed the vast majority of procedures (95.3%). A majority of cases were performed using endoscopy during daytime hours (69.4%).

Prevalence of Moderate Sedation-Associated Postoperative Complications

Among a total of 40 complications (17.2%) recorded from 2015 to 2019, the most common type of complication was postprocedural (35/40; 87.5%) including postprocedural pain, nausea, or vomiting (**Table 3**). A total of 8 serious complications (3.4%) occurred, a majority of which were cardiovascular complications (7/8, 87.5%) including 6 episodes of transfusion and 1 episode of clinically significant hypotension. We examined the relationship between cardiovascular complications and cardiac

Indexed in: [Current Contents/Clinical Medicine] [SCI Expanded] [ISI Alerting System] [ISI Journals Master List] [Index Medicus/MEDLINE] [EMBASE/Excerpta Medica] [Chemical Abstracts/CAS]

Table 4. Predictors of moderate sedation-associated postoperative complications: unadjusted bivariate analysis.

Independent variable	Patients, n	Cardiac, n (%)	Patient Injury, n (%)	Procedure, n (%)	Serious, n (%)	Any, n (%)
Age, y						
18-49	62	0 (0)	0 (0)	9 (14.5)	0 (0)	9 (14.5)
≥50	170	7 (4.1)	1 (0.6)	26 (15.3)	8 (4.7)	31 (18.2)
P value		0.235	1.000	0.884	0.183	0.507
Sex						
Female	70	2 (2.9)	1 (1.4)	8 (11.4)	3 (4.3)	11 (15.7)
Male	162	5 (3.1)	0 (0)	27 (16.7)	5 (3.1)	29 (11.7)
P value		1.000	0.302	0.306	0.946	0.686
ASA						
1/2	42	2 (4.8)	0 (0)	5 (11.9)	2 (4.8)	6 (14.3)
≥3	190	5 (2.6)	1 (0.5)	30 (15.8)	6 (3.2)	34 (17.9)
P value		0.817	1.000	0.524	0.961	0.575
Child-Pugh						
A	199	5 (2.5)	1 (0.5)	31 (15.6)	6 (3.0)	35 (17.6)
B+C	33	2 (6.1)	0 (0)	4 (12.1)	2 (6.1)	5 (15.2)
P value		0.270	0.683	0.607	0.375	0.731
Procedure						
EGD	221	7 (3.2)	1 (0.5)	34 (15.4)	8 (3.6)	39 (17.6)
Enteroscopy	11	0 (0)	0 (0)	1 (9.1)	0 (0)	1 (9.1)
P value		0.549	0.823	0.159	0.521	0.463
Portal hypertension history						
Yes	158	7 (4.4)	1 (0.6)	27 (17.1)	8 (5.1)	32 (20.3)
No	74	1 (1.4)	0 (0)	8 (10.8)	1 (1.4)	8 (10.8)
P value		0.417	1.000	0.213	0.317	0.076
Cardiac comorbidities						
Yes	42	1 (2.4)	0 (0)	4 (9.5)	1 (2.4)	4 (9.5)
No	190	7 (3.7)	1 (0.5)	31 (16.3)	8 (4.2)	36 (18.9)
P value		1.000	1.000	0.266	0.909	0.143
Diabetes mellitus						
Yes	24	1 (4.2)	0 (0)	5 (20.8)	1 (4.2)	5 (20.8)
No	208	7 (3.4)	1 (0.5)	30 (14.4)	8 (3.8)	35 (16.8)
P value		1.000	1.000	0.596	1.000	0.836
Shift						
Daytime	161	3 (1.9)	1 (0.6)	21 (13.0)	3 (1.9)	17 (10.6)
Evening	71	4 (5.6)	0 (0)	14 (19.7)	5 (7.0)	23 (32.4)
P value		0.205	1.000	0.191	0.109	<0.001

ASA – American Society of Anesthesiologists; EGD – esophagogastroduodenoscopy.

Indexed in: [Current Contents/Clinical Medicine] [SCI Expanded] [ISI Alerting System] [ISI Journals Master List] [Index Medicus/MEDLINE] [EMBASE/Excerpta Medica] [Chemical Abstracts/CAS]

Table 5. Associations between patient and procedure characteristics, and moderate sedation-associated complications – multivariable mixed-effects logistic regression model.

Variable	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Age, years		
18-49	1 (referent)	1 (referent)
≥50	1.313 (0.586-2.943)	1.535 (0.642-3.671)
Sex		
Male	1 (referent)	1 (referent)
Female	0.855 (0.400-1.826)	0.798 (0.356-1.788)
ASA		
1/2	1 (referent)	1 (referent)
≥3	1.308 (0.511-3.349)	0.977 (0.348-2.740)
Child-Pugh		
A	1 (referent)	1 (referent)
B/C	0.837 (0.312-2.318)	0.760 (0.260-2.228)
History portal hypertension complication		
No	1 (referent)	1 (referent)
Yes	2.095 (0.914-4.805)	2.201 (0.903-5.364)
Diabetes mellitus		
No	1 (referent)	1 (referent)
Yes	1.301 (0.455-3.717)	1.458 (0.482-4.410)
Cardiac comorbidities		
No	1 (referent)	1 (referent)
Yes	0.450 (0.151-1.342)	0.388 (0.125-1.209)
Shift		
Daytime	1 (referent)	1 (referent)
Evening	1.889 (0.937-3.809)	1.971 (0.946-4.106)

ASA, – American Society of Anesthesiologists; CI – confidence interval; OR – odds ratio.

comorbidities, and only 1 cardiovascular complication was identified among those with a cardiac comorbidity. The postoperative length of stay was longer in patients with moderate sedation-associated complications than in those without complications (7.78±0.74 vs 5.73±0.34, $P<0.05$).

Predictors of Moderate Sedation-Associated Postoperative Complications: Unadjusted Bivariate Analysis

On unadjusted bivariate analysis, shift time was associated with moderate sedation-associated postoperative complications (**Table 4**). An endoscopic procedure performed in the evening was associated with an increased proportion of moderate sedation-associated complications. There were no associations between variables including age, sex, ASA, Child-Pugh, procedure type, portal hypertension complication, cardiac comorbidities, diabetes mellitus, and specific types of complications (eg, cardiovascular, patient injury).

Predictors of Moderate Sedation-Associated Postoperative Complications: Mixed-Effects Multivariable Model

Table 5 depicts the unadjusted and adjusted odds ratios for moderate sedation-associated postoperative complications associated with the variables age, sex, ASA status, Child-Pugh, history of portal hypertensive complication, cardiac comorbidities, diabetes mellitus, and shift time. On multivariable analysis, moderate sedation complications were significantly associated with portal hypertensive complication (OR 2.201; 95% CI 0.903, 5.364) and procedure in evening (OR 1.971; 95% CI 0.946, 4.106) adjusting for age, sex, ASA status, Child-Pugh, history of portal hypertensive complication, cardiac comorbidities,

Indexed in: [Current Contents/Clinical Medicine] [SCI Expanded] [ISI Alerting System] [ISI Journals Master List] [Index Medicus/MEDLINE] [EMBASE/Excerpta Medica] [Chemical Abstracts/CAS]

Table 6. Predicted accordance rate in validated subgroups using logistic regression model.

	Actual complication		
	0.00	1.00	**Total**
Predicted complication			
0.00	33	4	**37**
1.00	11	3	**14**
Total	**44**	**7**	**51**

diabetes mellitus, and shift time. The c-statistic for the validation subsamples was 0.627 (95% CI, 0.534 to 0.719, *P*=0.012). In addition, we used this logistic regression model to predict incidence of complications in 51 patients. We found that the accordance rate was 70% (**Table 6**).

Discussion

This study of endoscopic procedures is the first to report the prevalence of moderate sedation-associated postoperative complications among individuals with cirrhosis. Overall, the complication rate was 17.2%, and the presence of a complication was associated with an increased hospital length of stay. The majority of complications were postprocedural complications. Furthermore, we explored novel risk factors for moderate sedation complications that were not investigated previously, including portal hypertension history and the procedure occurring in the evening among cirrhotic patients. Our study suggests that the complexity of liver disease and endoscopic procedures being performed in evening may drive the risk of complications.

Our study may offer opportunities for earlier identification of cirrhotic patients who are at a high risk of moderate sedation complications and for whom early preventions and/or treatments can be initiated. In this study, we identified 2 independent risk factors associated with moderate sedation complications, including portal hypertension history and the procedure occurring in the evening. Interventions should be considered to offset these risk factors to optimize the patient's condition before endoscopy. Indeed, procedure time can be arranged by operators and anesthesiologists. Our study suggests that in routine clinical practice, operators and anesthesiologists should consider endoscopic procedure for cirrhotic patients in the daytime rather than in the evening. In addition, cirrhotic patients with portal hypertension history may warrant more intensive care during anesthesia for endoscopic procedure. Therefore, our findings may be useful for clinicians to guide routine clinical care in patients with cirrhosis and ultimately reduce the risk of moderate sedation complications and improve clinical outcomes.

Moderate sedation is widely employed for upper endoscopy, and propofol is the dominant drug used owing to its short duration of action, quick metabolism, and no dose adjustments [16]. The pharmacokinetic profile of propofol is particularly appealing in patients with liver disease, including cirrhosis [14]. In cirrhotic patients undergoing endoscopic sclerotherapy, moderate sedation with propofol was associated with shorter recovery periods, lower frequency of body movements, and higher operator satisfaction than midazolam [17,18]. Sharma et al [13] found that propofol sedation was safe in 108 patients with cirrhosis during endoscopy. Riphaus et al [19] reported that propofol sedation was associated with improved clinical outcomes in patients with cirrhosis. Patients with liver cirrhosis are at a potentially increased risk for complications related to sedation, but few studies have quantified the risk in this population. Our study showed that the rate of postoperative complications associated with moderate sedation with propofol was 17.2%, with 87.5% of complications occurring after the procedure, including postprocedural pain, nausea, and vomiting. Moreover, we calculated an overall frequency of serious complications to be 3.4%, which was higher than in other reported studies [20]. In a large retrospective observational cohort study, the overall frequency of serious complications was found to be 0.39% for a general population undergoing endoscopies [4]. The lower estimate of 0.39% for serious complications was voluntarily reported by anesthesia providers, which may have led to significant underreporting [21]. Our higher estimate of the prevalence of complications can be explained by the disease complexity in patients with cirrhosis. In addition, our study may indeed reflect the actual risk of moderate sedation-related complications, which are reported by physicians in wards, not by anesthesiologists. Interestingly, we found serious complications were predominantly cardiac in nature. There is evidence to suggest that hemodynamic changes related to vasodilation and hyperdynamic circulation in cirrhosis can lead to cardiac dysfunction and cardiomyopathy [22]. Moreover, cardiovascular disease has been shown to be more prevalent among the population with cirrhosis owing to unique features of chronic liver disease, including insulin resistance and lipid dysregulation [23].

Indexed in: [Current Contents/Clinical Medicine] [SCI Expanded] [ISI Alerting System] [ISI Journals Master List] [Index Medicus/MEDLINE] [EMBASE/Excerpta Medica] [Chemical Abstracts/CAS]

Furthermore, we used mixed-effects modeling and adjusted our analysis by patient characteristics and procedural characteristics to distinguish a true association with increased complications. We uncovered significant independent risk factors for moderate sedation-associated postoperative complications, namely portal hypertension and the procedure occurring in the evening. This study explored novel predictors of complications for cirrhotic patients including procedure shift time and portal hypertension that have not been investigated previously. The increased risk of moderate sedation-associated complications with portal hypertension and an evening procedure can be explained by individuals with worse liver disease and endoscopy performed in evening having a higher risk for complications. Portal hypertension often accompanies liver cirrhosis and can lead to esophageal varices, ascites, and hepatorenal syndrome [24]. Patients with portal hypertension have increased perioperative morbidity and mortality following surgery caused by the systemic pathophysiology of liver disease [25,26]. Our study identified that portal hypertension is a risk factor for moderate sedation-associated postoperative complications in patients with cirrhosis, suggesting that anesthesiologists should also consider the liver disease severity during preoperative assessment. Moreover, this focus is clinically important because cirrhotic patients require frequent endoscopy procedures under sedation during follow-up. This finding provides evidence of the importance of early intervention and individualized perioperative care for cirrhotic patients with portal hypertension.

The timing of surgery has been extensively studied in surgical setting with regard to its impact on patients' outcomes. Previous studies have found that intraoperative adverse events and postoperative complications occur more often in patients undergoing nighttime surgery [27]. In addition, surgery performed during the night was found to be associated with a higher risk of mortality than surgery performed during the day [28]. Fewer health care workers, mental or physical fatigue, more frequent provider handovers, and worse early postoperative care might all compromise quality with nighttime surgeries [29-31]. Health care workers' fatigue is considered to be a potential contributing factor for these increased risks [32-35]. Fatigue in anesthesiologists with sleep deprivation was found to be associated with worse reactions times and greater deterioration in performance [35]. Working at night seems to be the most common cause of fatigue. Strategies are needed to optimize perioperative risk. The implementation of several strategies applied at both personal and organizational levels, including enforcement of strategic breaks and improving nutrition intake during night shifts, has been suggested to ameliorate fatigue [36]. Not unexpectedly, but shown for the first time in cirrhotic patients, a substantial increase in risk of moderate sedation-associated complications was observed in endoscopy procedures performed in the evening in our study. This information is crucial for planning endoscopy procedures, especially longer and complex procedures. At night, fewer health care workers with worse mood and task performance and worse early postoperative care might compromise the quality of nighttime endoscopy procedures. This finding carries important implications for both scheduling of endoscopy and perioperative care management, including anesthesia monitoring.

This retrospective study has several factors that could influence the outcome of the study. Our cases were selected among patients with cirrhosis who were admitted to the Department of Digestive Medicine; hence, cases among patients who were admitted in other departments may not be included. For this reason, there are some missing data that could influence the calculation of the prevalence of complications among individuals with cirrhosis. Although we tried to assess disease severity and case complexity by including variables such as ASA classification and Child-Pugh score, more specific measurements such as case duration, laboratory values, and facility volume were not characterized in this study. Therefore, further study is needed to amplify the volume of endoscopic cases and number of predictors of complications investigated.

Limitations of the present study should also be noted. In this study, we used Child-Pugh scores to precisely assess the degree to which severity of liver disease contributed to the risk of complications. However, we found no association between Child-Pugh score and moderate sedation-associated complications. We speculate that this may be due to the fact that there were limited numbers of patients with Child-Pugh C undergoing procedures in our study. Further data are needed for Child-Pugh C patients, which could potentially identify this association. Another limitation is that delayed complications that developed after discharge were not documented in the present study. In addition, the predicted accordance rate was not high, indicating that larger numbers of patients and more related factors should be involved in further research.

Conclusions

In conclusion, this study investigated moderate sedation-associated postoperative complications among cirrhotic patients undergoing endoscopic procedures. The prevalence of complications in cirrhosis was 17.2%, which was associated with sicker patients (portal hypertensive complication) undergoing procedures performed in the evening. This finding suggests a potential need for a higher level of more intensive care including anesthesia monitoring for these patients. Our analysis of risk factors will likely help to avoid and further reduce moderate sedation-associated complications in cirrhotic patients during endoscopy.

Indexed in: [Current Contents/Clinical Medicine] [SCI Expanded] [ISI Alerting System] [ISI Journals Master List] [Index Medicus/MEDLINE] [EMBASE/Excerpta Medica] [Chemical Abstracts/CAS]

References:

1. Liu H, Waxman DA, Main R, Mattke S. Utilization of anesthesia services during outpatient endoscopies and colonoscopies and associated spending in 2003-2009. JAMA. 2012;307:1178-84
2. Predmore Z, Nie X, Main R, et al. Anesthesia service use during outpatient gastroenterology procedures continued to increase from 2010 to 2013 and potentially discretionary spending remained high. Am J Gastroenterol. 2017;112:297-302
3. Lin OS. Sedation for routine gastrointestinal endoscopic procedures: A review on efficacy, safety, efficiency, cost and satisfaction. Intest Res. 2017;15:456-66
4. Vargo JJ, Niklewski PJ, Williams JL, et al. Patient safety during sedation by anesthesia professionals during routine upper endoscopy and colonoscopy: An analysis of 1.38 million procedures. Gastrointest Endosc. 2017;85:101-8
5. Wadhwa V, Issa D, Garg S, et al. Similar risk of cardiopulmonary adverse events between propofol and traditional anesthesia for gastrointestinal endoscopy: A systematic review and meta-analysis. Clin Gastroenterol Hepatol. 2017;15:194-206
6. Ibrahim M, El-Mikkawy A, Hamid MA, et al. Early application of haemostatic powder added to standard management for oesophagogastric variceal bleeding: A randomised trial. Gut. 2019;68:844-53
7. Tsochatzis EA, Bosch J, Burroughs AK. Liver cirrhosis. Lancet. 2014;383:1749-61
8. Tripathi D, Stanley AJ, Hayes PC, et al. UK guidelines on the management of variceal haemorrhage in cirrhotic patients. Gut. 2015;64:1680-704
9. Sarin SK, Kumar A, Angus PW, et al. Diagnosis and management of acute variceal bleeding: Asian Pacific Association for Study of the Liver recommendations. Hepatol Int. 2011;5:607-24
10. Kircheis G, Knoche A, Hilger N, et al. Hepatic encephalopathy and fitness to drive. Gastroenterology. 2009;137:1706-15
11. Garcia-Tsao G, Abraldes JG, et al. Portal hypertensive bleeding in cirrhosis: Risk stratification, diagnosis, and management: 2016 practice guidance by the American Association for the Study of Liver Diseases. Hepatology. 2016;65:310-35
12. Thuluvath PJ. Toward safer sedation in patients with cirrhosis: Have we done enough? Gastrointest Endosc. 2009;70:269-71
13. Sharma P, Singh S, Sharma BC, et al. Propofol sedation during endoscopy in patients with cirrhosis, and utility of psychometric tests and critical flicker frequency in assessment of recovery from sedation. Endoscopy. 2011;43:400-5
14. Tsai HC, Lin YC, Ko CL, et al. Propofol versus midazolam for upper gastrointestinal endoscopy in cirrhotic patients: a meta- analysis of randomized controlled trials. PLoS One. 2015;10:e0117585
15. Lieber SR, Heller BJ, Howard CW, et al. Complications associated with anesthesia services in endoscopic procedures among patients with cirrhosis. Hepatology. 2020;72(6):2109-18
16. Gasparović S, Rustemović N, Opacić M, et al. Clinical analysis of propofol deep sedation for 1104 patients undergoing gastrointestinal endoscopic procedures; A three-year prospective study. World J Gastroenterol. 2006;12:327-30
17. Watanabe K, Hikichi T, Takagi T, et al. Propofol is a more effective and safer sedative agent than midazolam in endoscopic injection sclerotherapy for esophageal varices in patients with liver cirrhosis: A randomized controlled trial. Fukushima J Med Sci. 2018;64:133-41
18. Wang D, Chen C, Chen J, et al. The use of propofol as a sedative agent in gastrointestinal endoscopy: A meta-analysis. PLoS One. 2013;8(1):e53311
19. Riphaus A, Lechowicz I, Frenz MB, et al. Propofol sedation for upper gastrointestinal endoscopy in patients with liver cirrhosis as an alternative to midazolam to avoid acute deterioration of minimal encephalopathy: A randomized, controlled study. Scand J Gastroenterol. 2009;44:1244-51
20. Lieber SR, Heller BJ, Martin CF, et al. Complications of anesthesia services in gastrointestinal endoscopic procedures. Clin Gastroenterol Hepatol. 2020;18(9):2118-27.e4
21. Dutton RP, Dukatz A. Quality improvement using automated data sources: The anesthesia quality institute. Anesthesiol Clin. 2011;29:439-54
22. Loria P, Marchesini G, Nascimbeni F, et al. Cardiovascular risk, lipidemic phenotype and steatosis. A comparative analysis of cirrhotic and non-cirrhotic liver disease due to varying etiology. Atherosclerosis. 2014;232:99-109
23. Moller S, Henriksen JH. Cardiovascular complications of cirrhosis. Gut. 2008;57:268-78
24. Riphaus A, Wehrmann T, Weber B, et al. S3 Guideline: Sedation for gastrointestinal endoscopy 2008. Endoscopy. 2009;41:787-815
25. Wong M, Busuttil RW. Surgery in patients with portal hypertension. Clin Liver Dis. 2019;23(4):755-80
26. Nguyen GC, Correia AJ, Thuluvath PJ. The impact of cirrhosis and portal hypertension on mortality following colorectal surgery: A nationwide, population-based study. Dis Colon Rectum. 2009;52(8):1367-74
27. Cortegiani A, Gregoretti C, Neto AS, et al. Association between night-time surgery and occurrence of intraoperative adverse events and postoperative pulmonary complications. Br J Anaesth. 2019;122(3):361-69
28. Cortegiani A, Ippolito M, Misseri G, et al. Association between night/after-hours surgery and mortality: A systematic review and meta-analysis. Br J Anaesth. 2020;124(5):623-37
29. Althoff FC, Wachtendorf LJ, Rostin P, et al. Effects of night surgery on postoperative mortality and morbidity: a multicenter cohort study. BMJ Qual Saf. 2021;30(8):678-88
30. Linzey JR, Burke JF, Sabbagh MA, et al. The effect of surgical start time on complications associated with neurological surgeries. Neurosurgery. 2018;83:501-7
31. Dalton MK, McDonald E, Bhatia P, et al. Outcomes of acute care surgical cases performed at night. Am J Surg. 2016;212:831-36
32. Farquhar M. For nature cannot be fooled. Why we need to talk about fatigue. Anaesthesia. 2017;72:1055-58
33. McClelland L, Holland J, Lomas JP, et al. A national survey of the effects of fatigue on trainees in anaesthesia in the UK. Anaesthesia. 2017;72:1069-77
34. Bernstrøm VH, Alves DE, Ellingsen D, Ingelsrud MH. Healthy working time arrangements for healthcare personnel and patients: A systematic literature review. BMC Health Serv Res. 2019;19:193
35. Saadat H, Bissonnette B, Tumin D, et al. Effects of partial sleep deprivation on reaction time in anesthesiologists. Paediatr Anaesth. 2017;27:358-62
36. Cortegiani A, Misseri G, Gregoretti C, Giarratano A. Outcome of after-hours surgery: Setting, skill and timing may explain the outcome. J Orthop Surg (Hong Kong). 2019;27:2309499019861264

Indexed in: [Current Contents/Clinical Medicine] [SCI Expanded] [ISI Alerting System] [ISI Journals Master List] [Index Medicus/MEDLINE] [EMBASE/Excerpta Medica] [Chemical Abstracts/CAS]