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ORIGINAL ARTICLE

Retrospective Study

Influence of night duty on endoscopic therapy for bile duct stones

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Abstract

AIM

To examine the influence of night duty (ND) on endoscopic therapy for biliary duct stones.

METHODS

The subjects consisted of 133 patients who received initial endoscopic therapy for biliary duct stones performed by eight endoscopists after they had been on (ND group, *n* = 34 patients) or not [day duty (DD) group, *n* = 99 patients]. Patient characteristics (age, gender, history of abdominal surgery, transverse diameter of the largest stone, number of stones), years of experience of the endoscopists, endoscopic procedures [sphincterotomy, papillary balloon dilation (EPBD), papillary large balloon dilation (EPLBD)], and outcomes of initial endoscopy (procedure time; rate of stone removal by the first endoscopist; procedure

success rate by the first endoscopist: removal of stones or endoscopic retrograde biliary drainage; rate of final stone removal; final procedure success rate; complications; hospitalization after the procedure) were compared retrospectively between the two groups. History of abdominal surgery and treatment outcomes were also compared between the groups for each of the four endoscopists who performed most of the procedures in the ND group.

RESULTS

There were no significant differences regarding the number of treatments performed by each endoscopist or the years of experience between the ND and DD groups. The frequency of endoscopic retrograde cholangiopancreatography procedures did not differ significantly between the groups. There were also no significant differences regarding patient characteristics: age, gender, history of abdominal surgery (ND 7: Billroth II 4, R-Y 3; DD 18: double tract reconstruction 1, Billroth I 3, Billroth II 6, R-Y 7, duodenoduodenostomy for annular pancreas 1), transverse diameter of largest stone, and number of stones between the two groups. Among the treatment procedures, the endoscopic sphincterotomy and EPBD rates did not differ significantly between the groups. However, EPLBD was performed more frequently in the ND group [47.1% (16/34) *vs* 19.2% (19/99)]. Regarding outcomes, there were no significant differences in the rate of stone removal, procedure success rate, complications (ND: pancreatitis 1; DD: pancreatitis 6, duodenal bleeding 1, decreased blood pressure 1, hypoxia 2), or hospitalization after the procedure. However, the procedure time was significantly longer in the ND group (71.5 ± 44.7 *vs* 54.2 ± 28.8). Among the four endoscopists, there were no significant differences in patient history of abdominal surgery, removal of stones, or procedure success rate. However, the procedure time for one endoscopist was significantly longer in the ND group.

CONCLUSION

The time required for endoscopic therapy for bile duct stones might be influenced by ND.

Key words: Night duty; Endoscopic therap; Bile duct stone; Removal of stones; Procedure time

Core tip: Sleep deprivation affects brain activation, and therefore disturbs cognitive ability and reduces work efficiency. In the clinical field, night duty (ND) might affect surgical outcomes and the number of medical errors. In this study, we examined the influence of ND on endoscopic therapy for biliary duct stones. The procedure was significantly longer when performed by endoscopists after they had been on ND. The time required for endoscopic therapy for bile duct stones might be influenced by ND.

Sugimoto M, Takagi T, Suzuki R, Konno N, Asama H, Watanabe K, Nakamura J, Kikuchi H, Waragai Y, Takasumi M, Hikichi T, Ohira H. Influence of night duty on endoscopic therapy for bile duct stones. *World J Gastroenterol* 2016; 22(42): 9387-9393 Available from: URL: http://www.wjgnet.com/1007-9327/full/v22/i42/9387.htm DOI: http://dx.doi.org/10.3748/wjg.v22.i42.9387

INTRODUCTION

Sleep deprivation disturbs cognitive ability, and sleep is important to maintain concentration[1]. Sleep deprivation also reduces work efficiency and changes brain activation[2-7]. However, most reports in the clinical field indicate that sleeping hours or night duty (ND) do not influence surgery. In Ellman *et al*[8] and Chu *et al*[9], sleeping hours did not affect outcomes after cardiac surgery. In Sharpe *et al*[10] complications and re-hospitalization 30 d after abdominal surgery (hernia repair, cholecystectomy, intestinal operations) did not differ significantly between doctors who were and were not on ND on the previous day. Most recently, Govindarajan *et al*[11] reported that prior night work did not affect outcomes for gastroenterology surgeries, hysterectomy, orthopedic surgeries, lung resection, craniotomy, or angioplasty. However, in Rothschild *et al*[12], complications were more frequent after surgery performed by surgeons with a prior sleep time of less than 6 h, and serious medical errors have been associated with interns working for more than 24 h[13].

Endoscopic therapy requires considerable concentration, but the dependence of outcomes on sleep time or ND has not been examined. Therefore, in this study, we investigated the influence of ND on endoscopic therapy for bile duct stones.

MATERIALS AND METHODS

Study design

This study was performed as a retrospective analysis of clinical data. Written consent for endoscopic therapy was obtained from the patients. Informed consent for this study was not required. The ethics committee of Fukushima Medical University approved the study, and the details of the study are published on the homepage of Fukushima Medical University (authorization No. 2453).

Patients

Among 335 patients treated with endoscopic therapy for bile duct stones from January 2011 to December 2015 at Fukushima Medical University Hospital, 167 underwent initial endoscopic therapy and had stones confirmed *via* computed tomography or endoscopic retrograde cholangiography (Figure 1). Among these patients, data from 133 patients treated by eight endoscopists (A-H) were evaluated in this study. In

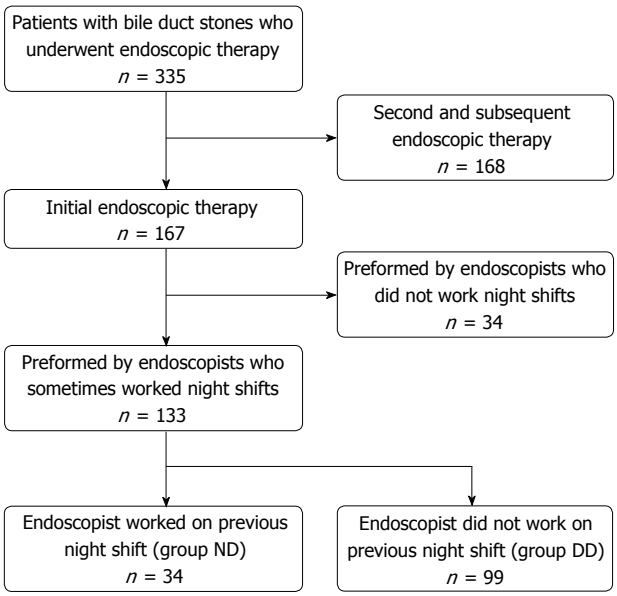

Figure 1 Disposition of patients in the study. Among 335 patients treated by endoscopic therapy for bile duct stones in five years at our hospital, 167 underwent initial endoscopic therapy. The data from 133 patients treated by eight endoscopists who sometimes worked night shifts were evaluated in this study. These 133 cases included 34 patients treated by endoscopists after they had been on night duty the previous day (ND group) and 99 treated by the same endoscopists when they had not been on night duty the previous day (DD group). ND: Night duty; DD: Day duty.

Table 1 Profile of endoscopists

Item	ND Group (*n* = 34)	DD Group (*n* = 99)	*P* value
Endoscopists (years of experience)			0.527
A (14-19)	5	11	
B (6-9)	7	17	
C (6-8)	8	21	
D (6-11)	5	16	
E (7-12)	2	22	
F (10-15)	3	7	
G (5-8)	3	4	
H (3-7)	1	1	
Years of experience, mean ± SD	9.3 ± 3.9	9.4 ± 3.4	0.830

ND: Night duty; DD: Day duty.

total, 34 patients were treated by an endoscopist after they had been on ND the previous day (ND group), and 99 patients were treated by the same endoscopists when they had not been on ND the previous day (day duty, DD group) (Table 1). ND was defined as performing normal ward duties in the hospital overnight and sometimes examining emergency patients.

Methods

The following items were compared between the ND and DD groups: years of experience of the endoscopists, patient characteristics (age, gender, history of abdominal surgery, transverse diameter of the largest stone, number of stones), endoscopic procedure [sphincterotomy (EST), papillary balloon dilation (EPBD), papillary large balloon dilation (EPLBD)], treatment outcomes (procedure time; removal of stones by the first endoscopist; procedure success rate by the first endoscopist: removal of stones or endoscopic retrograde biliary drainage; final rate of stone removal; final procedure success rate; complications; and hospitalization after procedure). The outcomes related to the second (or more) endoscopist were included in the study: rate of final stone removal and final procedure success rate. History of abdominal surgery and treatment outcomes (procedure time, removal of stones, procedure success rate) were also compared between the two groups for each of the four endoscopists (A-D) who treated many of the patients in the ND group. The main outcome was a comparison of treatment results to evaluate the work efficiency in the ND and DD groups.

Endoscopic retrograde cholangiopancreatography (ERCP)-related procedures were performed for patients with stable breathing and hemodynamics. Before ERCP, patients were sedated with midazolam under observation of blood pressure and oxygen saturation. However, patients in septic shock were not sedated. Most procedures were performed with a JF 260V endoscope (Olympus, Tokyo, Japan). A Q260J (Olympus) was used for double tract reconstruction in proximal gastrectomy, a PCF-Q260AI or Q260J (Olympus) was used for Billroth II (B-II) procedures, and a PCF-Q260AL (Olympus) was used for Roux-en-Y (R-Y). For R-Y after choledocojejunostomy, the bile duct-jejunum anastomosis was accessed with a SIF-Q260 (Olympus) and a sliding tube. The balloon of the sliding tube was expanded, fixed and placed, and endoscopy with a PCF-PQ260AI (Olympus) was then performed through the sliding tube.

EST was performed using Clever Cut (Olympus). In cases in which it was difficult to cannulate the biliary duct, or for patients with a history of abdominal surgery, an RX needle knife XL (Boston Scientific, Tokyo, Japan) was used. EPBD was performed if the transverse diameter of the largest stone was > 8 mm and bile duct stones were difficult to remove only by EST or if a perivaterian diverticulum was present. A Hurricane RX Biliary Balloon Dilation Catheter (Boston Scientific) was used for EPBD. EPLBD was performed if the transverse diameter of the largest stone was > 12 mm, if many bile duct stones were difficult to remove only by EST or if sufficient EST was difficult because of a parapapillary diverticulum or history of abdominal surgery. A CRE Biliary Balloon Dilation Catheter (Boston Scientific) or a Giga (Century Medical, Tokyo, Japan) was used for EPLBD. A Trapezoid RX basket catheter (Boston Scientific) and a LithoCrush V, FG-V435P (Olympus) were used as tools to crush stones.

Statistical analysis

Years of experience of endoscopists, patient age,

Table 2 Comparison of patient characteristics

	ND Group (*n* = 34)	DD Group (*n* = 99)	*P* value
Age (yr), mean ± SD	73.1 ± 13.0	72.4 ± 14.3	0.801
Gender (M/W)	21/13	59/40	0.824
History of abdominal surgery, *n* (%)	7 (20.6)	18 (18.2)	0.757
Double tract reconstruction, *n*		1	
Billroth Ⅰ		3	
Billroth Ⅱ	4	6	
Roux-en-Y	3	7	
Duodenoduodenostomy		1	
Transverse diameter of the largest stone (mm), mean ± SD	10.6 ± 4.6	10.3 ± 4.9	0.735
Number of stones, mean ± SD	2.8 ± 4.0	2.8 ± 3.6	1.0

ND: Night duty; DD: Day duty; Double tract reconstruction: Double tract reconstruction for proximal gastrectomy; Duodenoduodenostomy: Duodenoduodenostomy for annular pancreas.

Table 3 Comparison of endoscopic procedures, *n* (%)

	ND Group (*n* = 34)	DD Group (*n* = 99)	*P* value
EST	32 (94.1)	83 (83.8)	0.107
EPBD	0 (0)	6 (6.1)	0.163
EPLBD	16 (47.1)	19 (19.2)	0.001

ND: Night duty; DD: Day duty; EST: Endoscopic sphincterotomy; EPBD: Endoscopic papillary balloon dilation; EPLBD: Endoscopic papillary large balloon dilation.

transverse diameter of the largest stone, number of stones, and hospitalization after the procedure were compared by Student's *t* tests. The number of procedures performed by each endoscopist in the ND and DD groups, patient gender, history of abdominal surgery, EPLBD, rate of stone removal by the first endoscopist, rate of final stone removal and procedure success rate by the first endoscopist were compared by the χ^2 test. Procedure time was compared with the Welch *t* test. EST, EPBD, complications, final procedure success rate and items for each endoscopist (history of abdominal surgery, removal of stones rate, procedure success rate) were compared by the Fisher exact probability test. The procedure time for each endoscopist was compared by the Mann-Whitney *U* test. $P < 0.05$ was considered to be significant. All analyses were performed using Statcel 3 (OMS Edition, Saitama, Japan).

RESULTS

There were no significant differences regarding the number of treatments performed by each endoscopist or in the years of experience between the ND and DD groups (Table 1). The frequency of ERCP did not differ significantly between the groups. There were also no significant differences in patient characteristics regarding age, gender, history of abdominal surgery (ND 7: Billroth II 4, R-Y 3; DD 18: double tract reconstruction 1, Billroth I 3, Billroth II 6, R-Y 7, duodenoduodenostomy for annular pancreas 1), transverse diameter of the largest stone, and number of stones between the two groups (Table 2).

Among the treatment procedures, the rates of EST and EPBD did not differ significantly between the groups, but EPLBD was performed more frequently in the ND group [47.1% (16/34) *vs* 19.2% (19/99)] (Table 3). Regarding outcomes, there were no significant differences in the rate of stone removal and procedure success rate, complications (ND: pancreatitis 1; DD: pancreatitis 6, duodenal bleeding 1, decreased blood pressure 1, hypoxia 2), or hospitalization after the procedure (Table 4). However, the procedure time was significantly longer in the ND group (71.5 ± 44.7 *vs* 54.2 ± 28.8).

For each of the four endoscopists A-D, there were no significant differences in patient history of abdominal surgery, rate of stone removal, and procedure success rate. However, the procedure time for endoscopist D was significantly longer in the ND group (Table 5).

Table 4 Comparison of treatment outcomes *n* (%)

	ND Group (*n* = 34)	DD Group (*n* = 99)	*P* value
Procedure time (min), mean ± SD	71.5 ± 44.7	54.2 ± 28.8	0.043
Rate of stone removal by first endoscopist	13 (38.2)	52 (52.5)	0.150
Procedure success rate by first endoscopist	18 (52.9)	57 (57.6)	0.638
Rate of final stone removal	24 (70.6)	66 (66.7)	0.67
Final procedure success rate	33 (97.1)	90 (90.9)	0.22
Complications	1 (2.9)	11 (11.1)	0.136
Pancreatitis	1	6	
Duodenal bleeding		2	
Decreased blood pressure		1	
Hypoxia		2	
Hospitalization after procedure (d), mean ± SD	7.1 ± 7.6	6.6 ± 6.6	0.715

ND: Night duty; DD: Day duty; Procedure success rate: Removal of stones or biliary stenting.

DISCUSSION

In this report, we examined the influence of ND on endoscopic therapy for bile duct stones. The rate of EPLBD and the procedure time were significantly greater for endoscopists after ND. The procedure time was also longer in the ND group for one endoscopist.

Although more EPLBD procedures were performed in the ND group, the patients who met the criteria for EPLBD described in the Materials and Methods were not significantly different between the ND group and the DD group according to the results of χ^2 tests (Table

Table 5 Comparison of treatment outcomes for each endoscopist *n* (%)

	ND Group	DD Group	*P* value
Endoscopist A			
n	5	11	
Procedure time (min), median ± SD	90.0 ± 80.8	90.0 ± 39.7	0.910
Rate of stone removal	3 (60.0)	6 (54.5)	0.635
Procedure success rate	5 (100)	9 (81.8)	0.458
Endoscopist B			
n	7	17	
Procedure time (min), median ± SD	40.0 ± 20.4	50.0 ± 26.0	0.589
Rate of stone removal	5 (71.4)	11 (64.7)	0.572
Procedure success rate	5 (71.4)	12 (70.6)	0.607
Endoscopist C			
n	8	21	
Procedure time (min), median ± SD	75.0 ± 39.6	50.0 ± 27.1	0.113
Rate of stone removal	3 (37.5)	7 (33.3)	0.745
Procedure success rate	4 (50.0)	10 (47.6)	0.617
Endoscopist D			
n	5	16	
Procedure time (min), median ± SD	60 ± 31.5	40 ± 14.7	0.017
Rate of stone removal	1 (20)	8 (50)	0.258
Procedure success rate	1 (20)	10 (62.5)	0.126

ND: Night duty; DD: Day duty; Procedure success rate: Removal of stones or biliary stenting.

Table 6 Reasons for not performing endoscopic papillary large balloon dilation

	ND Group (*n* = 34)	DD Group (*n* = 99)	*P* value
Patients with EPLBD indication, *n* (%)	20 (58.8)	44 (44.4)	0.15
Patients in whom EPLBD was performed (shown in Table 3)	16	19	
Reasons for not performing EPLBD			
AOSC	1	5	
Narrow lower bile duct	1	1	
Biliary stricture	1	0	
Minor bleeding of Vater's papilla	1	0	
No insurance coverage for EPLBD	0	5	
96 years old and performance status 3	0	1	
Gallstone pancreatitis	0	3	
Antithrombotic drug therapy	0	4	
Difficulty identifying the biliary anastomotic region	0	2	
Smaller stones on visual inspection	0	2	
Difficulty identifying the Vater papilla	0	1	
Double tract reconstruction	0	1	

EPLBD: Endoscopic papillary large balloon dilation; AOSC: Acute obstructive suppurative cholangitis.

6). Fewer EPLBD procedures were performed in the DD group for several reasons. However, it has been shown that EPLBD shortens the procedure by allowing easier removal of stones or at least does not extend the procedure time[14,15]. Based on these earlier reports, we suggest that EPLBD did not contribute to the longer procedure time in the ND group.

The cause of the longer procedure time for endoscopists after ND might be the influence of sleep deprivation or lower sleep quality on work efficiency. The attention, vigilance, and driving tasks of residents during heavy night call rotations were equivalent to those for residents with a 0.04 to 0.05 g % blood alcohol concentration during a light call rotation[16]. Sanches *et al*[17] also found that the psychomotor performance of young doctors on night shifts was lower than that of young doctors who were not assigned night work. Thus, ND may influence the procedure time of endoscopic therapy for bile duct stones.

In this study, there was no significant difference in complications between procedures performed by endoscopists who had and had not been on prior ND, but an extended procedure time has been reported to be a risk factor for post-ERCP pancreatitis[18,19]. In addition, Pan *et al*[20] found that a cannulation challenge to the common bile duct within 10 min gave the best results in trials by trainees. Therefore, if a procedure is slow by an endoscopist working after ND, it might be advisable to change the endoscopist.

There are several limitations to this study, including its retrospective design and the small number of cases of ERCP for bile duct stones at a single institution. We perform 400 ERCP procedures each year. However, in this study, we only included patients treated by endoscopists who had been on ND and performed the initial endoscopic therapy for bile duct stones. This resulted in a small number of eligible subjects. However, restricting the endoscopic procedures to the treatment of bile duct stones allowed for a more precise evaluation of the influence of ND compared to previous studies that considered the effect of ND on multiple types of surgery[8-12]. Secondly, we did not measure the exact sleep time of the endoscopists. However, night shifts and on-call duty have been found to influence circadian rhythm and worsen quality of sleep[21,22]. A difference in bedding also influences quality of sleep[23-26], and, therefore, ND itself is likely to influence quality of sleep. Thirdly, we were unable to compare the number of biliary duct cannulation challenges between the two groups to evaluate the direct influence of ND on the endoscopic procedure due to a lack of precise records. A further study of the number of biliary duct cannulations is desirable.

Within these limitations, we conclude that the procedure time for endoscopic therapy for bile duct stones is increased by the influence of ND. Substitution of an endoscopist after ND might be advisable to shorten the procedure.

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COMMENTS

Background

Concentration was affected by sleep deprivation. Recently, sleep deprivation or night duty (ND) was reported to influence several medical activities. However, the relationship between endoscopic therapy and sleep deprivation or ND was uncertain.

Research frontiers

Endoscopic therapy for bile duct stones requires much concentration. In Japan, many endoscopists perform endoscopic therapy after ND. This study clarified the influence of ND on endoscopic therapy for bile duct stones.

Innovations and breakthroughs

There have been no reports about the influence of ND on endoscopic therapy. In this report, ND the previous day influenced the procedure time for endoscopic therapy for bile duct stones.

Applications

This study suggested that ND the previous day influenced the procedure time of endoscopic therapy for bile duct stones. According to this result, if the first endoscopist who was on ND the previous day experiences difficulty in the endoscopic procedure, it is advisable to change endoscopists earlier.

Terminology

ERCP: endoscopic procedure that contrasts biliary duct and pancreatic duct using X-ray equipment; EST: endoscopic procedure that incises the papilla of Vater; EPBD: endoscopic procedure that dilates the biliary exit to remove the stones; EPLBD: endoscopic procedure that dilates the biliary exit using a large balloon catheter to remove large stones or many stones.

Peer-review

This study is innovative, and the conclusion is instructive and practical for endoscopic management of bile duct stones.

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