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Manuscript NO: 74052**Manuscript Type:** ORIGINAL ARTICLE***Retrospective Cohort Study*****Effect of overtime pancreaticoduodenectomy on the short-term prognosis of patients**Zhang JZ *et al.* Effect of overtime pancreaticoduodenectomy

Jin-Zhu Zhang, Shu Li, Wei-Hua Zhu, Xi-Sheng Leng, Da-Fang Zhang

Abstract**BACKGROUND**

Due to the large number of operations, surgeons sometimes need to work overtime or even stay up late to perform pancreaticoduodenectomy. Fatigue and sleep deprivation can result in an increased error rate at work. There have been numerous studies about the effect of overtime surgery on the prognosis of patients. However, the effect of overtime work for pancreaticoduodenectomy on the prognosis of patients is unclear. This study explores the impact of overtime work for pancreaticoduodenectomy on the prognosis of patients.

6**AIM**

To explore the impact of overtime work for pancreaticoduodenectomy on the short-term prognosis of patients.

METHODS

This was a single-center, retrospective cohort study. The patients who underwent pancreaticoduodenectomy between January 2017 and December 2019 were included. Patients were stratified by operative start time into the control group (surgery that

started between 8:00 and 16:49) and the overtime group (surgery that started between 17:00 and 22:00) and compared intraoperative and postoperative parameters. The following parameters were compared between the overtime group and the control group: Operative time, blood loss, number of lymph nodes removed, duration of treatment in the Intensive Care Unit (ICU), and incidence of complications.

RESULTS

From January 2017 to December 2019, a total of 239 patients underwent pancreaticoduodenectomy in the Department of Hepatobiliary Surgery of our institution. Four patients were excluded from this study due to lack of clinical data. A total of 235 patients were included, with 177 in the control group and 58 in the overtime group. There was no difference between the two groups in operative time, blood loss, number of lymph nodes removed, ICU length of stay, hospital length of stay, mortality during hospitalization. Compared with the control group, the overtime group had a higher incidence of pancreatic fistula (32.8% vs 15.8%, $P < 0.05$). Multivariate analysis showed that overtime work, higher Body Mass Index were independent risk factors for pancreatic fistula ($P < 0.05$).

CONCLUSION

Overtime work for pancreaticoduodenectomy increases the incidence of pancreatic fistula. The effect of overtime surgery on the long-term prognosis of patients' needs to be further studied.

Key Words: Pancreaticoduodenectomy; Fatigue; Surgery; Pancreatic fistula; General surgery; Overtime surgery

Zhang JZ, Li S, Zhu WH, Leng XS, Zhang DF. Effect of overtime pancreaticoduodenectomy on the short-term prognosis of patients. *World J Gastrointest Surg* 2022; In press

Core Tip: The effect of overtime work for pancreaticoduodenectomy on the prognosis of patients is unclear. We explore the impact¹⁷ of overtime work for pancreaticoduodenectomy on the prognosis of patients. A total of 235 patients were included, with 177 in the control group and 58 in the overtime group. Overtime work for pancreaticoduodenectomy increases⁶ the incidence of pancreatic fistula. The effect of overtime surgery² on the long-term prognosis of patients' needs to be further studied.

INTRODUCTION

Due to the large number of operations, surgeons sometimes need to work overtime to perform elective surgery. When this occurs, surgeons performing the operation are faced with fatigue or even sleep deprivation. Fatigue and sleep deprivation affect cognitive function, leading to an increased error rate at work^[1-3]. There have been numerous studies about the effect of overtime surgery on the prognosis of patients. However, the impact of surgery on patients due to surgeon fatigue and sleep deprivation is still controversial. Halvachizadeh *et al*^[4] observed higher complication and mortality rates for after-hour orthopedic trauma surgery. Boscà *et al*^[5] suggest that the prognosis of patients undergoing liver transplantation by fatigued surgeons is not poor. Brunschot *et al*^[6] reported that nighttime kidney transplantation is associated with less pure technical graft failure.

Pancreaticoduodenectomy is widely used to treat pancreatic cancer, bile duct carcinoma, duodenal carcinoma, and ampullary carcinoma^[7]. The operation is complicated^[8], and usually lasts more than 5 h. Postoperative complications such as pancreatic fistula, delayed gastric emptying, abdominal infection, and postoperative hemorrhage are prone to occur^[9]. Extensive literature has clarified the risk factors related to complications after pancreaticoduodenectomy^[10,11]. At present, there is no report on the effect of pancreaticoduodenectomy over time on the prognosis of patients. Therefore, the study explores the impact of overtime work for pancreaticoduodenectomy on the prognosis of patients.

MATERIALS AND METHODS

Study design and population

Approval of the Ethics Committee of the Peking University People's Hospital was obtained. Patients who underwent pancreaticoduodenectomy at the Department of Hepatobiliary Surgery, Peking University People's Hospital from January 2017 to December 2019 were reviewed. Patients with missing clinical data were excluded. All patients were scheduled to undergo elective surgery. The center stipulates that the

working hours of surgeons are 8:00-17:00 from Monday to Friday. The definition of overtime surgery in this study is that the surgeon starts the operation after 17:00. So Patients were stratified by operative start time into the control group (surgery that started between 8:00 and 16:49) and the overtime group (surgery that started between 17:00 and 22:00). Since the off-hours in our institution begin at 17:00, five o'clock was set as the cutoff point. The operating room did not accept new elective surgery after 22:00.

The following parameters were included as possible confounders: patient age, sex, body mass index (BMI), American Society of Anesthesiologists grade, preoperative comorbidities, preoperative total bilirubin, site of lesion, surgeon, technique of reconstruction, and technique of pancreaticojejunostomy. The following parameters were compared between the overtime group and the control group: operative time, blood loss, number of lymph nodes removed, duration of treatment in the Intensive Care Unit (ICU), incidence of complications and number of hospital death.

Surgery and surgeons

A total of 6 surgeons performed pancreaticoduodenectomy at the institution. All surgeons had more than 10 years of experience in performing pancreaticoduodenectomy. Each surgeon performed operations two days a week. Karolinska Sleepiness Scale (KSS)^[12] was used to assess surgeon sleepiness. The surgeons involved in this study self-assessed their level of sleepiness for each surgery, and expressed with KSS.

Pancreaticoduodenectomy was used to treat pancreatic cancer, cholangiocarcinoma, duodenal cancer, ampullary cancer, and a small number of benign diseases. All pancreaticoduodenectomy were performed by laparotomy. Roux-en-y or child surgery was used to reconstruct the digestive tract, and pancreaticojejunostomy was performed by duct-mucosa or invagination.

Definition of postoperative pancreatic fistula and delayed gastric emptying

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A clinically relevant postoperative pancreatic fistula is defined as a drain output of any measurable volume of fluid with an amylase level > 3 times the upper limit of institutional normal serum amylase activity^[13]. 11
Delayed gastric emptying was defined as the patient not removing the gastric tube or needing to have the tube reinserted for more than 3 d after the operation^[14]. Delayed gastric emptying can be classified as grade A (3-7 d), B (8-14 d), and C (more than 14 d) according to the duration of retention of the gastric tube. In this study, only grades B and C of delayed gastric emptying were included in the postoperative complication analysis.

Statistical analysis

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Continuous variables were tested with the Shapiro-Wilk test to determine whether they were normally distributed. Continuous variables that were proven to have a normal distribution are reported as the mean and standard deviation. Otherwise, continuous variables are reported by medians. Categorical variables are reported as frequencies or percentages. Continuous, normally distributed variables were compared with the t-test and non-normally distributed variables were compared with the Mann-Whitney test. The chi-square test was used to compare categorical variables. Reverse stepwise multivariable logistic regression was performed to assess the effects of the potential covariates on outcome. Variables with p-values less than 0.2 in univariate logistic regression models will be included in the multivariable logistic regression analysis. P values less than 0.05 were considered significant. Data were analyzed in Statistical Package for the Social Sciences version 21.0 (SPSS 21.0). The study was reviewed by our expert Biostatistic Da-Fang Zhang.

RESULTS

Preoperative clinical characteristic

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From January 2017 to December 2019, a total of 239 patients underwent pancreaticoduodenectomy in the Department of Hepatobiliary Surgery of our institution. Four patients were excluded from this study due to lack of clinical data. A

total of 235 patients were included in this study. A total of 177 (75.3%) patients underwent surgery before 16:59. In addition, 58 (24.7%) patients underwent surgery after 17:00. The median age of the patients was 64 (range 14-89) years. There were 153 (65.1%) males and 82 (34.9%) females. The preoperative clinical characteristic of all patients were shown in Table 1. There was no significant difference in any baseline characteristic between the two groups of patients (Table 2).

Outcome

The intraoperative and postoperative clinical characteristic of all patients were shown in Table 3. Ten patients (4.3%) died during postoperative hospitalization. Of the ten patients who died, 2 died of gastrointestinal bleeding, 4 died of pancreatic fistula, 3 died of pneumonia, and 1 died of abdominal infection. Compared with the control group, the overtime group had a higher incidence of pancreatic fistula (32.8% vs 15.8%, $P = 0.005$). There was no difference between the two groups in operative time, blood loss, number of lymph nodes removed, ICU length of stay, hospital length of stay, mortality during hospitalization or complications except pancreatic fistula (Table 4).

Univariate and multivariate logistic regression analysis of the risk factors for pancreatic fistula

To identify the prognostic factors of pancreatic fistula, we performed univariate and multivariate logistic regression analyses. In the multivariate logistic regression, parameters that significantly increased the risk of pancreatic fistula were high BMI and overtime surgery (Tables 5 and 6).

KSS of surgeons during overtime and non-overtime operations

The average values of KSS in the control group and overtime group were 1.95 ± 0.6 and 6.4 ± 1.0 , respectively. The statistical analysis demonstrates differences between groups regarding KSS ($P < 0.001$), with increased mean KSS in overtime group (Table 7).

DISCUSSION

Due to the large demand for surgery, surgeons often need to work overtime or even stay up late to complete a surgery. In a state of fatigue and sleep deprivation, surgeons may make more mistakes during the operation, which may result in a worse prognosis for the patient after surgery. McCormick *et al*^[15] reported that residents' fatigue levels were predicted to increase the risk of medical error by 22% compared with well-rested historical control subjects. Taffinder *et al*^[16] found that surgeons who were sleep deprived made 20% more mistakes in laparoscopic procedures and had an increase in operating time of 14%. Because of pancreaticoduodenectomy is complicated operation with long operation time, its requirements for the surgeon's physical and mental stamina are higher. Although a large number of studies on pancreaticoduodenectomy have been reported. To the best of our knowledge, our study is the first to explore the relationship between the overtime surgery and the short-term prognosis of pancreaticoduodenectomy. All surgeons at our center perceive a decrease in alertness during overtime surgery. Therefore, the KSS of the overtime group were higher than control group. This means that surgeons tend to be fatigued when they work overtime.

There was no significant difference in the preoperative and intraoperative results of patients between the overtime group and the control group. However, the postoperative results showed that the overtime group had a higher incidence of pancreatic fistula. In the multivariate regression analysis, operation time was still the influencing factor on pancreatic fistula. The incidence of pancreatic fistula in the night shift group was approximately twice that in the day shift group (32.8% vs 15.8%). In addition, elevated BMI was risk factors for pancreatic fistula. Relevant studies have confirmed that high BMI is a risk factor for pancreatic fistula^[17,18]. High BMI causes abdominal fat to increase, which in turn leads to increased difficulty in surgery, thereby increasing the incidence of pancreatic fistula.

Pancreatico-enteric anastomosis in pancreaticoduodenectomy places stricter requirements on the operation of the surgeon. Due to more than 8 h of work during the day, the surgeon is physically and mentally exhausted, which may lead to a decline in

surgical proficiency. Therefore, overtime surgery may cause a significant increase in the incidence of pancreatic fistula. This study confirmed that overtime pancreaticoduodenectomy increased the incidence of postoperative pancreatic fistula in patients. According to previous literature^[19-21], about 16.3%-23.9% of patients who underwent pancreaticoduodenectomy developed pancreatic fistula after surgery. The result was consistent with the report in our center. Postoperative pancreatic fistula can prolong the patients' hospital stay, increase the patient's medical expenses, and even lead to the patient's death. So avoiding pancreatic fistula as much as possible is crucial for surgeons.

The institution stipulates that surgeons cannot start new elective operations after ten o'clock in the evening. However, clinicians need to complete a large number of surgical tasks on their own surgery days. To extend working hours, surgeons will schedule short-term operations such as cholecystectomy to be completed during the day and long-term operations such as pancreaticoduodenectomy to be performed near ten o'clock in the evening. Therefore, a large number of pancreaticoduodenectomies are performed after hours in our institution. Working overtime to perform pancreaticoduodenectomy reduces the safety of the operation and increases the incidence of postoperative pancreatic fistula. In addition, overtime work has an adverse effect on doctors' health. Studies have confirmed that overtime work will lead to an increase in the incidence of cardiovascular diseases^[22,23].

The government and hospital administrators may need to take measures to change the situation where surgeons frequently work overtime or even stay up late for surgery. At the government level, investment in medical care should be increased to alleviate the shortage of medical resources. In addition, the government can legislate to limit the working hours of medical staff. At the hospital level, the clinical workload of surgeons should be appropriately reduced to ensure medical safety. Surgeons should try to avoid working overtime to perform pancreaticoduodenectomy. For patients undergoing overtime pancreaticoduodenectomy, surgeons should pay close attention to the amylase

content of the patient's drainage fluid to find potential postoperative pancreatic fistulas in a timely manner.

There are still some limitations in this study. The subgroup analysis considering different diagnosis (not only location of lesions), and also different types of surgeries, and the different surgical teams, might render the final analysis difficult to interpret (due to small numbers considering the subgroups). Therefore, the results of this study should be interpreted with caution. Also, this study ³² was a single-center retrospective cohort study, and only six surgeons performed pancreaticoduodenectomy. The conclusions of this study may not be convincing enough to extend to all institutions. Finally, this study did not analyze the long-term prognosis of patients, such as progression-free survival, and overall survival. More research is needed in the future.

CONCLUSION

Overtime pancreaticoduodenectomy ³⁶ may increase the incidence of postoperative pancreatic fistula. The government and hospital administrators may need to take measures to change the situation where surgeons frequently work overtime or even stay up late for surgery.

ARTICLE HIGHLIGHTS

Research background

Fatigue and sleep deprivation can result in an increased error rate at work. The effect of overtime work for pancreaticoduodenectomy on the prognosis of patients is unclear.

Research motivation

Overtime surgery may result in an increased incidence of intraoperative errors. This study is intended to be further clarified.

Research objectives

To explore the impact of overtime work for pancreaticoduodenectomy on the short-term prognosis of patients.

Research methods

Patients were stratified by operative start time into the control group (surgery that started between 8:00 and 16:49) and the overtime group (surgery that started between 17:00 and 22:00) and compared intraoperative and postoperative parameters.

Research results

The overtime group ¹⁰ had a higher incidence of pancreatic fistula than control ³¹ group (32.8% vs 15.8%, $P < 0.05$).

Research conclusions

The overtime group ¹⁰ had a higher incidence of pancreatic fistula.

Research perspectives

This study did not analyze the long-term prognosis of patients, such as progression-free survival, and overall survival. More research is needed in the future.

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