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FACTORS DETERMINING THE INTRAOPERATIVE DURATION OF LAPAROSCOPIC SLEEVE GASTRECTOMY

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Abstract:
Background: *It has been reported that Laparoscopic sleeve gastrectomy duration was associated with increased risk of the perioperative and postoperative complications. This study investigates the risk factors associated with long duration of the surgery, thus the risk for the perioperative and postoperative complications.* ***Methods:*** *A retrospective Cohort study was conducted. Pearson correlation and Wilcoxon rank test were used as to detect the relationship between continuous and categorical variables, respectively. A multivariate regression analysis was used to detect the possible predictors of the long operative time.* ***Results:*** *The age, sex, co-morbidities and laboratory tests did not affect the duration of the LSG. Meanwhile, the concomitant cholecystectomy (P-value = 0.08) and gall stones (P-value = 0.015) were the main determinant of the operative time, however, both failed to predict the duration of LSG (P-value > 0.05).* ***Conclusion:*** *The study suggests that the main determinant of long duration of the LSG are the intraoperative concomitant surgeries and the technique of the surgery.*

Keywords: *sleeve gastrectomy, bariatric surgery, obesity*

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INTRODUCTION:

Laparoscopic sleeve gastrectomy is one of the major bariatric surgeries used nowadays for treatment of obesity [1-3]. It has become popular in recent years and was considered by many surgeons as a standard treatment for morbid obesity. It is estimated that more than 94000 surgeries were conducted in 2011 [4-6]. It is considered comparable to gastric bypass surgery and the second most common after gastric bypass surgery [7]. The popularity of this procedure is mainly due to safer and simpler techniques with less perioperative and postoperative complications compared to other procedures [8].

Laparoscopic sleeve gastrectomy was first developed by Ganger in 1999; it gained popularity in the early 2000s [9]. It is performed mainly for patients with morbid obesity more than 40 Kg/m^2 and obese persons with comorbid conditions [6]. The main mechanism of Laparoscopic sleeve gastrectomy is the restriction of the stomach which will decrease its volume, thus, decease the food intake. The main technique is formation of gastric sleeve by removal of the fundus and greater curvature [9-11]. The removal of the fundus was found to play an important role in decreasing food intake. The oxyntic cells of the fundus release Ghrelin hormone in response to fasting and cause increase in the appetite. It acts by decreasing expression of orexigenic hypothalamic neuropeptide Y (NPY). It was also observed that after sleeve gastrectomy, there is increase in the secretion of peptide YY which cause decrease excretion of orexigenic hypothalamic neuropeptide Y (NPY) [12]. Furthermore, there is stimulation of glucagon like peptide-1 by rapid gastric emptying that is caused by decrease stomach volume. Glucagon like peptide-1 was found to increase satiety [12,13]. All these mechanisms were found to increase the weight loss and earned sleeve gastrectomy an advanced place among other bariatric surgeries. It was found that the weight loss from laparoscopic sleeve gastrectomy was compared to gastric bypass. however, many studies reported that it was safer with less complications [[,14-16].

The laparoscopic sleeve gastrectomy achieved an excess weight loss of 60% after five-year follow-up. The longest follow-up reported was nine years and it achieved 69% excess weight loss. However, other studies reported weight gain after two years [17-20].

Despite its superiority to other bariatric surgery, up to 18% of cases had complications with 0.4% postoperative mortality 30 days after the surgery. One of the major complications reported in 16% of cases is the bleeding either from stapling line or from gastroepiploic vessels or other vessels [8,21-23]. Reinforcement of the staple line was found to decrease the risk of bleeding and elevation of blood pressure to identify the bleeding sites [24,25]. Another series complication that occurs in 3.7% of cases is gastric leak which occur due to poor blood supply or infection. Other complications include gastroesophageal reflux, nutrient deficiencies, abscess, stricture and failure to lose weight [21,22].

The risk factors associated with these complications should be identified and addressed before and during the surgery to achieve the best results. Many studies were conducted to identify the risk factor associated with the laparoscopic sleeve gastrectomy complications. BMI, age, surgical techniques and duration of the surgery were the main determining risk factors for the complications [24,25-29]. A study found that high preoperative BMI and old age more than 65 years were associated with higher rate of complications [27]. Hypertension and cardiovascular diseases were also risk factors for complication [27,28]. Concomitant cholecystectomy and previous abdominal surgeries were associated with high incidence of infection and gastric leakage [27,28]. Another major determining factor of complications which is not much addressed in literature is duration of the sleeve gastrectomy. Major et al. recommended that the surgeon should expect high risk of complications if the surgery duration is increased [27]. This is explained that intraoperative complications increased perioperative complications by 163%. Furthermore, an additional procedure performed during the surgery was found to increase the perioperative complications [22].

In this study, we aim to understand the factors associated with longer intraoperative time thus, recognising the risk factors associated with higher perioperative complications.

METHODS:

This study is a part of retrospective cohort in King Fahad University Hospital in Al-Khobar, Saudi Arabia from May 2015 to June 2016 that was approved by the IRB committee of the hospital on January 2015.

Patient recruitments

All patients and procedures were conducted based on the declaration of Helsinki.

The patients were only included in cohort if; Detailed history from each patient was obtained including marital status, nationality, history of diseases and previous cholecystectomy. Pre-operative ultrasound, total bilirubin, Amylase, Lipase, Alkaline

phosphatase, Cholesterol, Triglycerides, LDL, HDL and haemoglobin A1C were obtained. The duration of surgery, any intraoperative complications, concomitant procedures were also obtained.

Statistical techniques

The results were presented as mean ± standard deviation for continuous variables that were normally distributed or as median and interquartile range (IQR) for continuous variables whose distribution was not normal. Categorical variables were presented as frequencies and percentages. The missing data were imputed by K nearest neighbors using K = 5 through VIM library in R.

We used Kendall's tau correlation for the relationship between two non-normally distributed variables, otherwise the Pearson's correlation was used. A significant correlation is considered when *P-value* is less than 0.05. For pair wise comparisons of continuous variable, Wilcoxon rank test was used for non-parametric data otherwise, t-test was used to detect the difference between two groups.

If a significant relationship was found between the two variables, a univariate and multivariate regression analysis was conducted to assess and predict the factors associated with longer operative durations. All the analyses were conducted in R 3.3.4

RESULTS:

Patient characteristics

The cohort included 123 females and 51 males. The median age of the male was 29 compared to 32 in females but it was non-significant. There was no significant difference between male and females except in BMI, total bilirubin and HDL Table 1. There was significant higher BMI in the female group than male group (P-value = 0.02). The median duration of surgery was longer in females but insignificant Table 1.

Relationship between age, BMI and preoperative laboratory tests to the duration of the surgery

There was no significant correlation between intraoperative duration and age (r = -0.04) and pre-operative weight (r = 0.0018). The fit line representing the relation between them and duration of surgery is horizontal indicating no significant relationship is present. Furthermore, no significant correlation was found between any lab tests and duration of the surgery Figure 1.

Relationship between sex, marital status, history of surgeries, preoperative diseases and intraoperative procedures to the duration of the surgery

The duration of the surgery did not significantly differ between male and female (P-value = 0.35) or single and married (P-value = 0.38) Figure 2.

Diabetes mellitus, hypertension and hyperlipidaemia were not associated with change of duration of the surgery Figure 3. The presence of gall stones was associated with significant long duration of surgery (P-value < 0.008).

Surgical procedures including previous cholecystectomy was not associated with significant increase of the LSG duration (P-value = 0.8) Figure 4. Intraoperative procedures did not have the same significant effect on the duration of the surgery. The intraoperative conversion surgery was not significantly associated with long duration of the LSG Figure 4, while concomitant cholecystectomy significantly increased the duration of the LSG (P-value = 0.015).

The multivariate linear regression analysis revealed that the gall stone and concomitant cholecystectomy was not significant predictors of long duration of the LSG Table 2.

DISCUSSION:

The duration of the LSG was reported as one of the risk factors associated with the perioperative and postoperative complication. The study was set out to recognize the risk factors associated with long operation time thus predicting the risk of complications. In this study, gall stone presence and concomitant cholecystectomy were the only risk factors for long surgery. Surprisingly, the patient age and sex were not significant effector on the duration of the surgery (P-value >0.05). Furthermore, there was not any significant correlation between any laboratory tests and duration of surgery. Despite the longer surgery time in the intra-operative complicated cases but it was a not significant factor. The presence of previous surgical history as in our study cholecystectomy, there was no significant effect on the duration of the surgery.

Major et al. found that the perioperative complications were associated with longer post operative time [27]. They did not find this association in the other bariatric surgery. Their results were not verified in other studies. In literature, there is almost no studies that assessed the duration and complication relationship. In addition, there is no studies that assessed factors affecting duration o the operative time. However, it was obvious that many studies with duration less than sixty hours had less incidence of complications [30,4]. A study that had a complication rate about 2.7% had mean operative

time of 60 minutes. The study reported leak (0.7%) and bleeding (0.7%) with long term complication of stricture (0.7%). This study had a shorter duration than our study, yet, it is considered like our study regarding the distribution of male and female, age, and preoperative BMI [4]. Despite the similarity between the both studies, we had a longer duration of surgery. The study had one case of iatrogenic colotomy due to previous surgeries. This is somewhat supporting our results. As in our study with longer duration, there is no difference between age, sex or laboratory tests and yet our study had a longer duration. The long duration might be related to the techniques of the surgery or intraoperative complications. In this study, eight patients had concomitant cholecystectomy which caused elongation of the time of surgery despite it failed to be a predictor of the duration of surgery. Intraoperative adhesion had been reported in LSG an study which is caused by previous abdominal surgery [8,31]. In our cases, the previous cholecystectomy was reported in eight cases, yet, it did not produce elongation of the duration of the surgery. This was supported by Tucker et al who had cases with previous history of abdominal surgeries and had shorter duration of the surgery than our study [4]. Another study had long mean long duration of 126.5 minutes [30]. The study is like our study regarding age, sex and preoperative BMI but it had 20 % of post-operative complications in the first six months. This suggests that the long duration is associated with more complications, however, no specific predictors for the long duration is identified. This study had fewer patients with hypertension, diabetes mellitus and hyperlipidemia, yet, the study had a longer duration than ours. This may support our results that previous history of diseases did not affect the operative time. A study found that the operative time dramatically decreased by using different techniques [32]. Costil et al. devised a technique using three incisions and posterior access to stomach [16]. There are other proposed techniques that produce a good result with less operative time.

In conclusion, our study is considered the first study that assessed the factors affecting the operative time. In this study, we suggest that patient characteristics, history of diseases and laboratory tests did not affect the duration of the surgery. However, the operative techniques and concomitant cholecystectomy is considered the main effectors of the operative time.

CONCLUSION:

The cholecystectomy and presence of gall stones was the main determinant of the operative time, meanwhile, the patient characteristics and lab tests did not affect the operative time.

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Table 1. the baseline characteristics of included population

		Female	Male	p
n		123	51	
Age (median [IQR])		32.00 [24.00, 38.50]	29.00 [25.00, 37.00]	0.695
Marital status (%)	Married	57 (46.3)	20 (39.2)	0.488
	Single	66 (53.7)	31 (60.8)	
Nationality (%)	Egypt	7 (5.7)	3 (5.9)	0.765
	Jordan	2 (1.6)	2 (3.9)	
	Kuwait	1 (0.8)	0 (0.0)	
	Non-Saudi	1 (0.8)	0 (0.0)	
	Palestine	1 (0.8)	0 (0.0)	
	Saudi	108 (87.8)	44 (86.3)	
	Sudan	1 (0.8)	0 (0.0)	
	Syria	1 (0.8)	2 (3.9)	
	Yemen	1 (0.8)	0 (0.0)	
BMI (median [IQR])		45.20 [42.00, 50.95]	48.80 [42.85, 55.02]	0.024
Diabetes mellitus (%)	No	108 (88.5)	45 (88.2)	1.000
	Yes	14 (11.5)	6 (11.8)	
Hyperlipidemia (%)	No	109 (88.6)	48 (94.1)	0.406
	Yes	14 (11.4)	3 (5.9)	
Hypertension (%)	No	111 (91.0)	45 (90.0)	1.000
	Yes	11 (9.0)	5 (10.0)	
Previous cholecystectomy (%)	No	115 (93.5)	47 (95.9)	0.801
	Yes	8 (6.5)	2 (4.1)	
Findings of ultrasound if done (%)	Gall stone	9 (7.5)	2 (3.9)	0.408
	Normal	77 (64.2)	30 (58.8)	
Total bilirubin (median [IQR])		0.30 [0.20, 0.40]	0.40 [0.30, 0.50]	<0.001
Amylase (median [IQR])		42.00 [29.00, 56.00]	43.00 [42.00, 53.00]	0.465
Lipase (median [IQR])		106.00 [72.50, 126.00]	63.00 [25.75, 125.50]	0.579
Alkaline phosphatase (median [IQR])		90.00 [72.00, 105.00]	92.00 [83.00, 102.00]	0.305

Cholesterol (median [IQR])		185.00 [169.00, 201.00]	173.50 [161.50, 208.50]	0.694
Triglyceride (median [IQR])		103.00 [63.00, 140.00]	114.00 [82.00, 169.00]	0.202
LDL (median [IQR])		120.00 [105.50, 139.50]	130.00 [104.50, 152.00]	0.490
HDL (median [IQR])		46.00 [39.00, 52.00]	35.50 [32.00, 41.00]	<0.001
HBA1C (median [IQR])		6.00 [5.65, 6.75]	6.30 [5.50, 7.00]	0.869
Concomitant cholecystectomy (%)	No	115 (93.5)	47 (92.2)	1.000
	Yes	8 (6.5)	4 (7.8)	
Intraoperative complication (%)	bleeding from stomach edge	1 (0.8)	0 (0.0)	0.663
	difficult intubation, hypoxia	1 (0.8)	0 (0.0)	
	No	121 (98.4)	50 (100.0)	
Conversion (%)	No	121 (99.2)	51 (100.0)	1.000
	Yes	1 (0.8)	0 (0.0)	
Duration of the surgery (median [IQR])		90.00 [75.00, 110.00]	85.00 [66.50, 113.25]	0.371

LDL: low density lipoproteins, HDL: high density lipoproteins, HBA1C: glycated haemoglobin, BMI: body mass index

Table 2. the multivariate regression analysis results

	B-coefficient	Standard error	P-value	R-squared
gall stone	-36.86	18.69	0.0502	0.12
concomitant cholecystectomy	24.22	17.95	0.179	

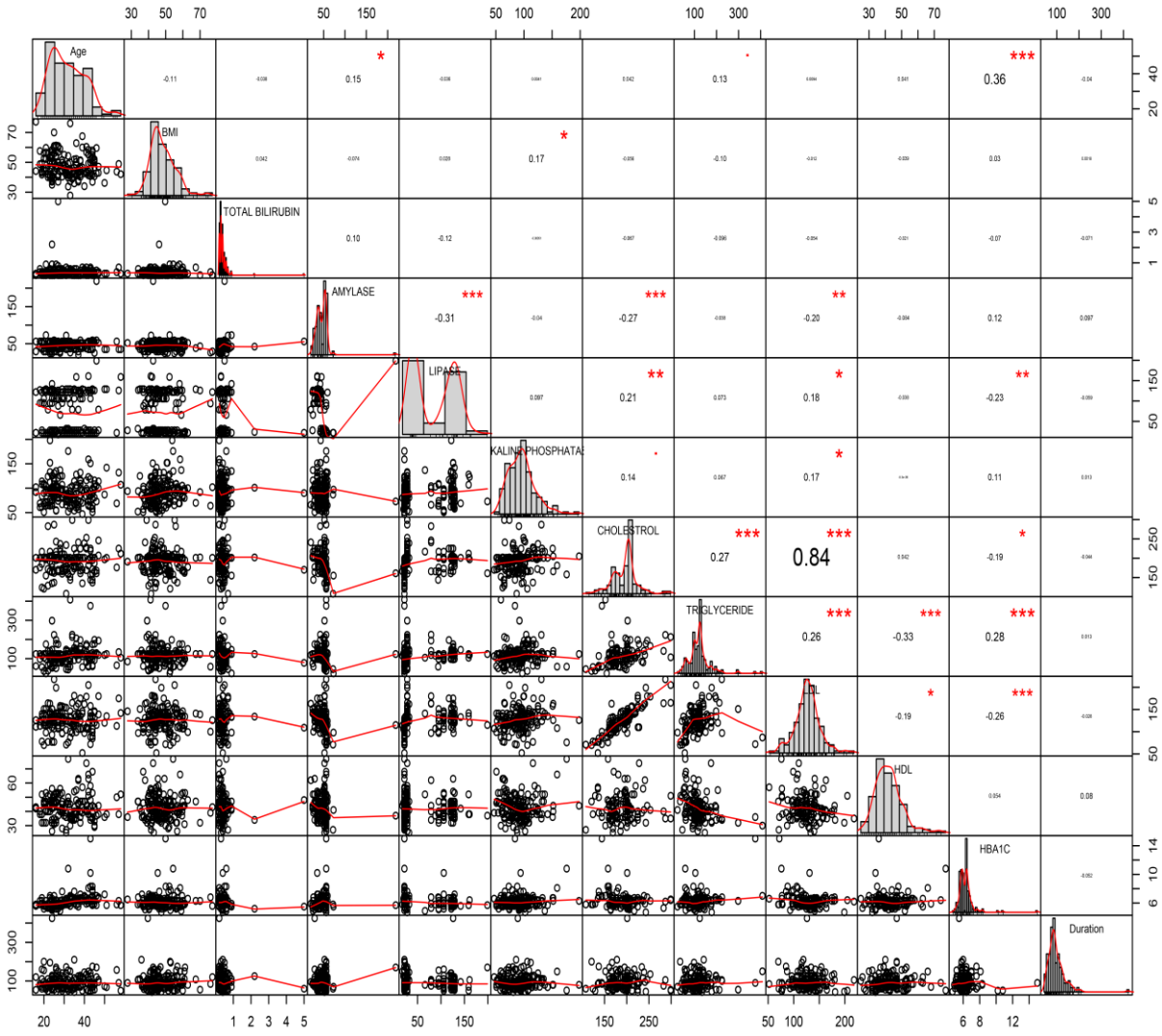

Figure 1 *the correlation matrix showing the pairwise correlation and distribution of each variable. The left side of the graph represent the possible fit line between the variables. The red * represent only the significant relation between the duration and any of the reported variables*

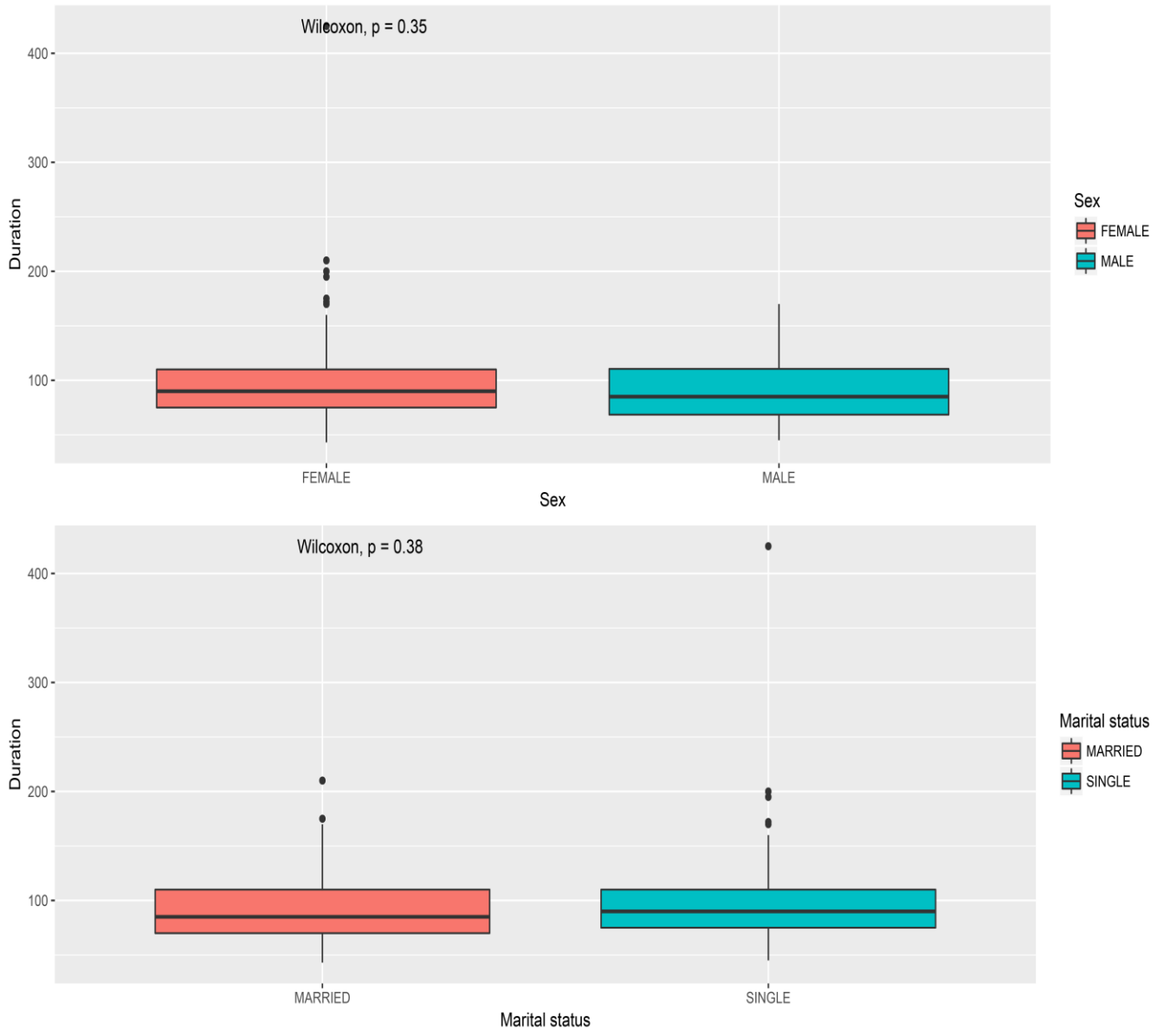

Figure 2 *the median and IQR of the surgery duration in each possible risk factor, Wilcoxon rank was used to identify the significance level.*

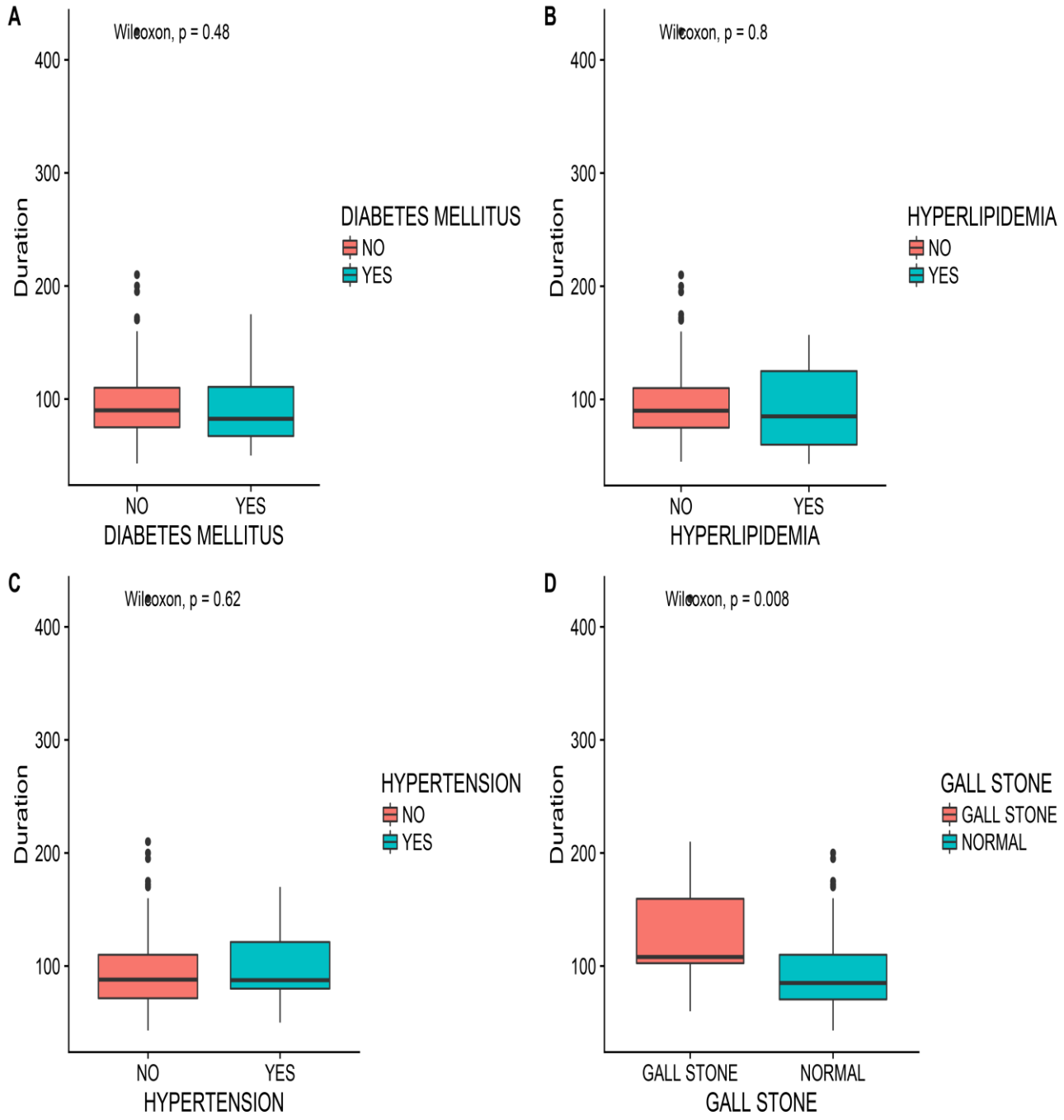

Figure 3 *the median and IQR of the surgery duration in each possible risk factor, Wilcoxon rank was used to identify the significance level.*

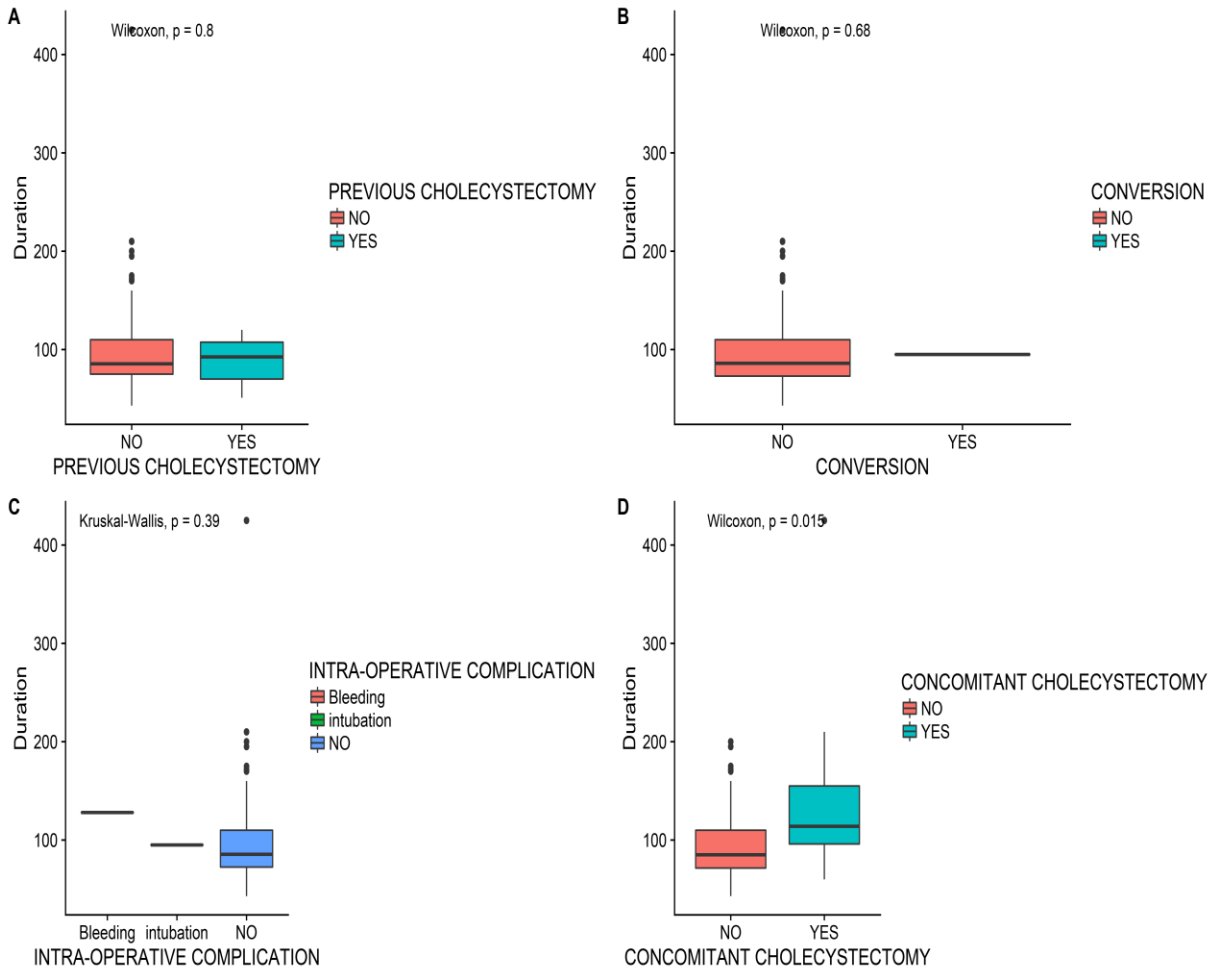

Figure 4 *the median and IQR of the surgery duration in each possible risk factor, Wilcoxon rank was used to identify the significance level.*