



Can the Drain Fluid pH Predict Anastomotic Leakage after Sleeve Gastrectomy?

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Abstract

Background: Laparoscopic Sleeve Gastrectomy is the most common type of surgical treatment for morbid obesity. One of the most important complications is leakage from the stapler line. Early detection of a leakage is important in preventing undesirable events.

Objectives: The aim of this study was to evaluate the predictive value of postoperative drain fluid pH on early detection of leakage.

Methods: This study was performed with 63 patients including 33 patients who underwent laparoscopic sleeve gastrectomy for morbid obesity (Group SG) and 30 patients who underwent laparoscopic cholecystectomy (Group LC), as the control group. Fluid sample was obtained after surgery with intra-abdominal drain. The pH value of this fluid was measured using a pH meter at the Ohaus device in the biochemistry laboratory of study hospital.

Results: When the differences in the mean pH values of patients who underwent obesity surgery and gallbladder surgery were evaluated; no statistically significant difference was found between the mean pH value of patients ($p: 0.808 > 0.05$).

Conclusion: None of our patient had leakage and unable to demonstrate how would be the drain fluid pH value if there was a leak, we suggest that drain fluid pH would not be a suitable alarming sign for a leakage in the early period. Because we know that most of the leaks occur at the proximal part of the stomach and that there is more saliva drainage through the line of leakage. Although it is known that the acidic fluid of the stomach can be drained from the same leak in this condition, it is not unlikely that saliva can bring the pH to normal levels. Therefore, if the pH of the drain fluid is close to normal, it is meaning that there is no leakage from the site.

Keywords: Bariatric surgery; Drain fluid pH, Gastric leak, Laparoscopic sleeve gastrectomy

1. Background

Morbid obesity is one of common health problems today. The incidence of obesity is increasing rapidly and the number of surgical interventions for this health problem is increasing in direct proportion. Surgical treatment, especially laparoscopic sleeve gastrectomy (LSG) is one of the most commonly applied methods (1,2). Despite the postoperative promising results of LSG, it has serious complications such as leakage through the stapler line and bleeding (3).

Stapler use is indispensable in laparoscopic sleeve gastrectomy and the longest suture line is created in LSG surgeries among the operations using staples. There are two important complications of this long stitch line; leakage and bleeding. Several methods have been trialed to prevent these complications, but unfortunately no technique has been defined to eliminate the possibility of them.

The separation of the suture line occurs due to mechanical (technical) and ischemic reasons. While leaks due to mechanical causes that occur within the first 48 hours, ischemia-induced detachment occurs during the days five and seven, when the inflammatory and fibrotic response is most intense (4,5).

One of the most important points in management

of leakage following LSG operation is early detection and intervention. Most of the patients with a leakage, presents with drainage of abscess fluid or gastric fluid/bile fluid, fever, tachycardia and intense pain in the left upper quadrant. There is no gold standard diagnostic method for predicting leaks due to mechanical reasons especially in the first 48 hours.

Leakage due to technical reasons starts in the early hours and manifests by inflammation, and abscess develops within hours. The appropriate intervention is the drainage of the leak quickly and the patient hemodynamic should be stabilized. Many studies are carried out to diagnose leaks early, but no parameter has been introduced that be able to predict leak diagnosis in the early period. (6).

2. Objectives

The aim of this study was to predict the chance of leakage by postoperative drain fluid pH evaluation.

3. Methods

This study sample was consisted of 63 patients including 33 cases underwent laparoscopic sleeve gastrectomy for morbid obesity (Group SG) and 30

cases who underwent laparoscopic cholecystectomy (Group LC), as the control group.

A sample fluid was obtained from intra-abdominal drain and the pH value of the fluid was measured using a pH Meter at the Ohaus device in the biochemistry laboratory of our hospital. The participants included in the study consisted of patients who were operated on at this hospital by the authors and those volunteered to participate in the study. The control group was selected from volunteers who underwent laparoscopic cholecystectomy at our clinic.

Patients who intended to withdraw at any stage of the study were excluded from the study. Among the patients in the control group, the ones with gallbladder perforation during surgery, acute cholecystitis, prior intra-abdominal surgery, and prior biliary tract intervention were excluded from the study. In the obesity group, patients with BMI of 40 and above based on the World Health Organization classifications, and who were found to be eligible for surgery as a result of the exams were included in the study.

At our clinic, laparoscopic sleeve gastrectomy was performed using five trocars. After separating the omentum from the stomach, a 38F gastric calibration tube was placed in the stomach, and then the gastrectomy was completed using staples. In the routine procedure, the clips are placed only at the junction of stapler lines and to the probable sites of hemorrhage and no additional procedure is performed. The patients with bleeding more than 100 ml during the operation, the ones with the application of sutures or fibrin glue at the stapler line and those underwent additional procedures beside sleeve gastrectomy such as cholecystectomy were excluded from the study. Data collection was terminated after enrollment of thirty patients. Then, the participants that met the inclusion criteria were included in the study as control group.

3.1. Statistical Analysis

Statistical analysis of the study was performed using SPSS 20 (SPSS for Windows, Inc., Chicago, IL, USA). Mean and standard deviation was used for age and pH values and frequency analysis of gender variable was applied for the patients examined within the scope of the study. Moreover,

independent sample t-test was applied to examine the differences in the pH values of the patients in different genders. The correlation method was used to determine the relationship between the age of the patients and PH values.

One-way analysis of variance (ANOVA) test was used to determine the difference of the pH values of the patients in terms of their ages. Independent samples t-test was used to compare the difference between the mean pH values of patients with gallbladder and obesity surgery.

3.2. Ethical considerations

This study was performed following the approval of Firat University Faculty of Medicine Ethics Committee (Date of Decision, 21.02.2019, and Number 04-06). The informed consents were obtained from the patients and volunteers enrolled in this study.

4. Results

Gender distribution, age and pH values of the patients with gallbladder surgery (Group LC) was examined and 76.7% (23 patients) of the patients were females and 23.3% (7 patients) males. Mean age was 42.37 ± 13.07 years (Range: 24-64 years), and the mean pH was 7.17 ± 0.49 (Range: 6.22 - 8.27).

When the gender distribution, age and pH values of the patients with obesity (Group SG) surgery were examined; 78.8% of these patients were females (26 patients) and 21.2% (7 patients) were males. In addition, the minimum, maximum age and the mean age of the patients were 17, 64 and 33.24 ± 12.29 years, respectively. When the pH values of the patients were evaluated, the lowest and highest pH values were 6.59 and 8.02, respectively. Mean pH values of the patients were calculated as 7.19 ± 0.38 . The detail of demographic data of study groups is demonstrated in Table 1.

When the differences in the mean pH values of patients who underwent obesity or gallbladder surgery were evaluated; no statistically significant difference was found between the mean pH value of the patients with obesity and gallbladder surgery ($p: 0.808 > 0.05$). Comparison between the drain fluid pH values of two groups is given in Table 2.

Table 1. Demographic Data

	Gender	N (30)	%		
Group LC	Female	23	76.7		
	Male	7	23.3		
Group SG	Female	26	78.8		
	Male	7	21.2		
	Parameters	Min	Max	Mean	S.d.
Group LC	Age	24	64	42.37	13.07
	PH	6.22	8.27	7.17	0.49
Group SG	Age	17	64	33.24	12.29
	PH	6.59	8.02	7.19	0.38

Table 2. Comparison of PH Values of Patients in Group SG and Group LC (t Test Results)

PH Values	n	\bar{x}	sd	Levene Test			t Test	
				F	p	sd	t	p
Surgery								
Group LC	30	7.172	0.491	3.118	.082	61	-.244	.808
Group SG	33	7.199	0.381					

Table 3. Differences of PH Values of Patients with Laparoscopic Cholecystectomy in Terms of Age (ANOVA Results)

Group LC PH Values	n	\bar{x}	Yes Kay.	Sum of Squares	SD	Mean Squares	F	p	LSD
Age									
1. 25 Years and Under	3	6.784	Between Groups In Group Total	.760 6.235 6.995	4 25 29	.190 .249	.762	.560	1-5
2. Between 26-34 years	8	7.257							
3. Between 35-44 years	5	7.283							
4. Between 45-54 years	8	7.067							
5. 55 years and above	6	7.301							
Total	30	7.172					Levene (F:2.721 ; p:.065)		

Table 4. Differences in pH values of patients with Laparoscopic cholecystectomy in terms of gender (t Test Results)

Group LC PH Values	n	\bar{x}	sd	Levene Test			t Test	
				F	p	sd	t	p
Gender								
Female	23	7.146	0.482	.753	.393	28	-.511	.613
Male	7	7.256	0.548					

When the intra-group analyzes were performed; no significant difference was found in the pH values of patients with gallbladder surgery in terms of the ages of the patients ($p: 0.560 > 0.05$). However, when binary comparisons between age groups were performed, a statistically significant difference was found between the pH values in the patients aged 25 years and under and patients aged 55 years and above ($t: -2.468$; $p: 0.043 < 0.05$).

Accordingly, the pH values of patients aged 55 years and above were higher in comparison to the patients under 25 years old. In addition, although no significant differences were found in general, an increase in PH values was observed as the age of the patients increased. Difference of pH values of the patients who underwent laparoscopic cholecystectomy in terms of their ages is presented in [Table 3](#).

No statistically significant difference was found in the pH values of patients who had gall bladder surgery in terms of gender of the patients. Our findings demonstrated that the pH values of male patients were found to be higher compared to female patients. However, this was not statistically significant. The pH values of the patients who underwent laparoscopic cholecystectomy in terms of gender are presented in [Table 4](#).

When patients with obesity surgery were examined within the group; no statistically significant difference in the pH values of the patients was found in terms of the gender. When the results were examined, the pH values of female patients were found to be higher in comparison to male patients. However, this was not statistically significant. These values are presented in [Table 5](#). Correlation analysis was used to evaluate the correlation between the pH values and age of patients with obesity surgery. A statistically significant correlation was found between age and pH values of patients with obesity ($r: -0.310$ $p: 0.041 < 0.05$). Accordingly, as the age of patients increased, the pH values decreased (Pearson Correlation coefficient = -0.310 , $P = 0.041$).

No significant difference was found in the pH values of patients with obesity surgery in terms of the age of the patients ($p: 0.302 > 0.05$). However, when binary comparisons between age groups were performed, a statistically significant difference was found between the pH values of patients aged 25 years and under and those aged 45 years and above ($t: -1.905$; $p: 0.047 < 0.05$). Accordingly, the pH values of patients aged 45 years and above were higher compared to the pH values of patients under 25 years old. ([Table 6](#))

Finally, although no significant differences were

Table 5. Differences in pH values of patients with obesity surgery in terms of gender (t Test Results)

pH Values of Patients with Obesity	n	\bar{x}	sd	Levene Test			t Test	
				F	p	sd	t	p
Gender								
Female	26	7.204	0.389	.136	.715	31	.141	.888
Male	7	7.181	0.379					

Table 6. Differences in pH values of patients with obesity surgery in terms of age (ANOVA Results)

pH Values of Patients with Obesity	n	\bar{x}	Yes Kay.	Sum of Squares	SD	Mean Squares	F	p	LSD
Age									
1. 25 Years and Under	13	7.298	Between Groups In Group Total	.219 4.445 4.664	3 29 32	.073 .153	.976	.302	1-4
2. Between 26-34 years	8	7.158							
3. Between 35-44 years	5	7.131							
4. Between 45-54 years	7	7.111							
5. 55 years and above	-	-							
Total	33	7.199							Levene (F:1.776 ; p:.174)

found in general, an increase in pH values demonstrated a direct relationship with age of the patients as the correlation analysis supported.

5. Discussion

Obesity, unfortunately, is currently an important health problem. The frequency of this health problem is continuously increasing in the society. The medical doctors for long have struggled with obesity due to aesthetic and metabolic concerns (7). The surgical interventions have come to the forefront in the treatment of obesity especially during the past half century. Sleeve gastrectomy is perhaps a breakthrough in this issue, and is a procedure that can be applied and accepted almost worldwide (2, 8-10).

This method was initially performed as a first choice in order to provide weight loss before by-pass surgery in obese patients for several years. It has been applied in a considerable number in the past ten years and has now found its place as a stand-alone method in the surgical treatment of obesity (1,9,10). An increasing number of operations has led to increased experience of the surgeons. As this experience is accumulated, the rate of "leakage" which is the most important and frightening complication has substantially decreased. However, even by the most experienced hands, this risk can never be reach to zero. Therefore, in the best series, this rate varies between 0.4 and 3% (3).

Undoubtedly, both the increment of the surgeons' experience and the development of the stapler technology have had an important role in the reduction of the rate of leakage. By now, all obesity surgeons have accepted the risk of leakage. The main problem is the early detection of leakage and performing the necessary steps after it is detected. No consensus is reached among the surgeons on this subject And different The approaches are suggested depending on the schools and countries (3,11).

In order to detect and prevent the risk of leakage, methylene blue test can be performed during surgery. Also, leak tests with methylene blue or scopy can be performed postoperatively (12). However, studies have shown that the success rate of none of these tests is 100 percent (13). For this purpose, in this study we aimed to predict the leakage by measuring the pH value of the drain fluid in this

study. It was hypothesized that the acidic content of the stomach would reduce the pH value when there is a leakage. Moreover, no statistical difference was found between two study groups.

The pH value in pre- and post-surgery was evaluated in a study for gastro-esophageal reflux in patients with sleeve gastrectomy. They showed that the pH value of the patients was less than four both pre- and post-surgery. Considering this study, leaks may be seen more frequently after sleeve gastrectomy in patients with gastroesophageal reflux (14). No results can be extrapolated from this condition.

Isil et al. in their experimental study, they observed an evaluated amylase level in the drain fluid in rats following sleeve gastrectomy and intentional fistulization. In their study, they found the amylase level of drain fluid was elevated in rats with a leak and they suggested to analyze the drain fluid amylase levels. High drain fluid amylase level rates might be seen in all leaks in the gastrointestinal system, especially in pancreatic fistula (15). However, in another study; the determination of drain fluid amylase levels after sleeve gastrectomy was shown as a significant indicator of gastric leak with high sensitivity and specificity (16).

In some studies; It has been reported that an increased intra-abdominal pressure during laparoscopy causes a reduction in tissue pH in the stomach and other intestinal organs. Considering this, it can be concluded that the pH will decrease even more in case of leakage (17,18). The time of operation in laparoscopic cholecystectomy and sleeve gastrectomy are not equal and is longer in last one. In this case, it can be estimated that the pH would be lower in the early postoperative period. However, as it is known, the splanchnic circulation increases again with the desufflation performed following the end of the surgery. Therefore, the pH level variation in the tissue is caused by elevation of intra-abdominal pressure may not be very effective in case of possible leakage.

A major limitation of this study was small number of the patients. So studies with larger population are needed since the rate of leakage is low and ranges between 0.4% to 3%. The devices that can detect very low pH values are required to perform routine drain fluid pH analysis especially in patients with a leak, and this increases the expenses of this method.

No study similar was retrieved as a result of literature review. As, none of our patient had a leakage and we were thus unable to demonstrate the possible drain fluid pH value in case of a leak, we should conclude that drain fluid pH would not alert the surgeon for a leakage in the early period. As we know that most of the leaks occur at the proximal part of the stomach due to higher saliva drainage through the line of leakage in this type of leak.

Although it is known that the acidic fluid of the stomach can be drained from the same leak in this condition, it is not unlikely that saliva be able to balance the pH to normal levels. In addition, it is likely that the patient present another clinical manifestations prior to a detectable modification in the pH value of the drain fluid.

6. Conclusion

None of our patient had leakage and unable to demonstrate how would be the drain fluid pH value if there was a leak, we suggest that drain fluid pH would not be a suitable alarming sign for a leakage in the early period. Because we know that most of the leaks occur at the proximal part of the stomach and that there is more saliva drainage through the line of leakage. Although it is known that the acidic fluid of the stomach can be drained from the same leak in this condition, it is not unlikely that saliva can bring the pH to normal levels. Therefore, if the pH of the drain fluid is close to normal, it is meaning that there is no leakage from the site.

Footnotes

Conflicts of Interest: The authors declare that they have no conflict of interest.

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Ethical Considerations: This study was designed after approval of Firat University Faculty of Medicine Ethics Committee (Date of Decision, 21.02.2019, and Number 04-06).

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