Original Article

Electrocautery on Sleeve Gastrectomy Staple Line: A Histological Study on Extracted Specimens

Wittayapairoch J, MD[1,2], Sangkhamanon S, MD[3], Boonyagard N, MD[1], Tanomphetsanga R, MD[1], Tangpanitandee K, MD[1], Techagumpuch A, MD[1,4], Udomsawaengsup S, MD[1]

[1] Department of Surgery, Faculty of Medicine, Chulalongkorn University, Bangkok, Thailand

[2] Department of Surgery, Faculty of Medicine, Khon Kaen University, Khon Kaen, Thailand

[3] Department of Pathology, Faculty of Medicine, Khon Kaen University, Khon Kaen, Thailand

[4] Department of Surgery, Faculty of Medicine, Thammasart Univertsity, Bangkok, Thailand

Background: Sleeve gastrectomy has become the most common procedure to treat patients with morbid obesity. Hemostasis on the staple line is essential to prevent bleeding complication. Electrocautery on the staple line must be applied carefully and precisely. The electrocautery effect on postoperative leakage is still controversial. The present study was designed to demonstrate histological changes on the extracted specimens after applying electrocautery that may help addressing this question.

Materials and Methods: After sleeve gastrectomy was performed, the divided part of the stomach was immediately used as a surgical specimen. Different spots on the staple line of each specimen were electrocauterized by a monopolar hook for different length of time such as one second, two seconds, three seconds, four seconds, and five seconds. A systematic study was conducted. Each electrocauterized spot on the staple line was studied in three dimensions, two lateral sides, two longitudinal sides, and thermal injury in depth to evaluate tissue injury on the staple line.

Results: Eighty-five pieces of tissue, five on each of seventeen slides, were studied macroscopically and microscopically. Macroscopically, the tissue injury did not exceed the staple line. Microscopically, submucosa, and intramuscular hemorrhage and cellular swelling were found in both electrocauterized and non-electrocauterized areas. Nevertheless, neither cell death nor structural change was found.

Conclusion: Precisely and carefully performed electrocautery on sleeve gastrectomy staple line is effective for hemostasis and has been proven to be safe in the present histological study.

Keywords: Electrocautery, Sleeve gastrectomy, Staple line

J Med Assoc Thai 2019;102(2):203-6
Website: http://www.jmatonline.com

These days, among several bariatric and metabolic surgical procedures, laparoscopic sleeve gastrectomy has gained popularity[1,2]. Post-operative complication includes gastroesophageal reflux disease, insufficient weight loss, and stricture or dilation of a gastric tube. However, bleeding and leakage from the gastric staple line is the most serious complication[3]. This postoperative complication can lead to severe morbidity, prolonged hospital-stay, and further reoperation or intervention[4].

Gagner and Buchwald reported that the rate of bleeding on the staple line, which required blood transfusion or reoperation, was 1.1% to 8.7%[5]. D'Ugo et al conducted a retrospective multicenter study[4] with two groups of patients, one with reinforcement on the staple line and the other without reinforcement. It was found that the bleeding on the staple of the first group was only 0.92% while the latter was 13.7%.

At King Chulalongkorn Memorial Hospital, the routine laparoscopic sleeve gastrectomy is performed without any type of staple-line reinforcement, neither in a form of a material nor oversewing. The researchers always employ electrocautery with a monopolar hook for the hemostasis of a bleeding staple line. Some

Correspondence to:

Udomsawaengsup S.

Department of Surgery, Faculty of Medicine, Chulalongkorn University, Bangkok 10330, Thailand.

Phone: +66-2-2564117, **Fax**: +66-2-2564194

Email: suthep.u@gmail.com

How to cite this article: Wittayapairoch J, Sangkhamanon S, Boonyagard N, Tanomphetsanga R, Tangpanitandee K, Techagumpuch A, et al. Electrocautery on Sleeve Gastrectomy Staple Line: A Histological Study on Extracted Specimens. J Med Assoc Thai 2019;102:203-6.

surgeons are concerned that electrocauterization on a staple line may cause tissue injury and necrosis, followed by leakage on the staple line.

The authors aimed to conduct the present study to explore histopathological alteration of the gastric wall after electrocautery on the staple line of sleeve gastrectomy specimens.

Materials and Methods

Between January and June 2018, patients who had sleeve gastrectomy at King Chulalongkorn Memorial hospital were included in the present study. Informed consents were obtained and sleeve gastrectomy was performed. First, the greater curvature of the stomach was devascularized by an ultrasonic device. Second, a complete mobilization of the fundus in this area and the division of posterior fibrous attachments behind the antrum and the body of the stomach was performed. Third, Endo GIA was used to cut the stomach starting from 4 centimeters proximal to the pylorus. After the first staple firing, the second surgeon passed a 36-French bougie as a sizer. Next, the surgeon gradually divided the stomach along the line adjacent to the bougie with the desired diameter up to 0.5 centimeter lateral to angle of His. After the greater curve was completely divided, the staple line of the in situ stomach was inspected. If the staple line bled, electrocautery would be performed on the staple line for hemostasis by a monopolar hook.

Three specimens of the divided stomach from the patients who consented to the present study were included. A monopolar hook was used to electrocauterize (30W) on the staple line of each specimen. Each electrocauterized spot was 2 centimeters apart from each other, and all of them were electrocauterized for a different length of time as one second, two seconds, three seconds, four seconds, and five seconds, respectively. After the electrocauterization, each specimen was removed from the abdomen and decontaminated with normal saline. The greater curve sides were cut and the specimens were spread out. Pins were used to mark the electrocauterized spots. All the specimens were then preserved in formalin before they were sent for histological study.

Each electrocauterized site was inspected in three dimensional fashion, two lateral sides, two longitudinal sides, and thermal injury in depth. These pieces of tissues were kept in a paraffin block. Lateral tissue was studied on the other end of each lateral side not affected by the elcetrocauterization, and was inked to prevent confusion in microscopic study.

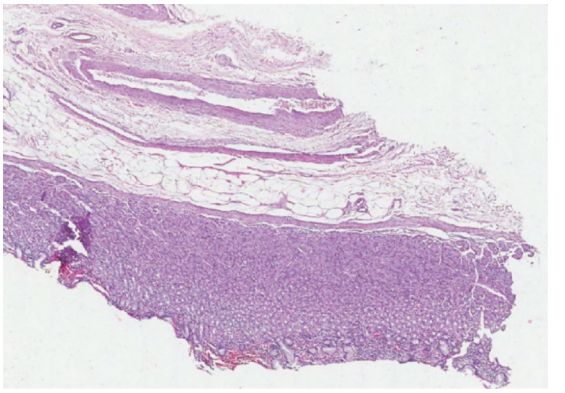

Figure 1. Microscopic finding of lateral thermal injury.

The tissue on each slide was examined by the author SS with a microscope to identify serosal layer, muscular layer, submucosal layer, and mucosal layer. The main focus was to inspect the thermally-injured areas adjacent to each electrocauterized spot. The areas were examined for lateral thermal injury, longitudinal thermal injury, and thermal injury in depth. The lateral thermally-injured areas were studied in comparison with the non-cauterized areas, which were inked as a controlled group. The microscopic view of different thermally-injured sites adjacent to the five-second electrocauterized spot and the non-cauterized areas.

Results

Between January 2018 and June 2018, eighty-five pieces of tissue from three extracted specimens were included in the present study. There were 17 slides to review microscopically. The areas adjacent to five-second electrocauterized spot showed small clear vacuoles or hydropic change within the cytoplasm, which was found only in the muscular layer, not in the submucosal or the mucosal layers. In addition, the red blood cells found in the submocosal layer evidenced a submuscosal layer and intramuscular hemorrhage and tissue swelling. Nevertheless, cytoplasmic change, increased eosinophilia (pink staining) with nuclear change and clumping of chromatin, or increased basophils were not found, indicating that there was no necrotic cell in the whole tissue. It was also found that the electrocauterized spots and the non-cauterized (inked) areas had no difference in terms of tissue change (Figure 1-3).

Later, a study to find the electrocautery effect on the gastric wall without a staple line was performed using a monopolar hook (30W). After the gastric wall was electrocauterized for five seconds it was found

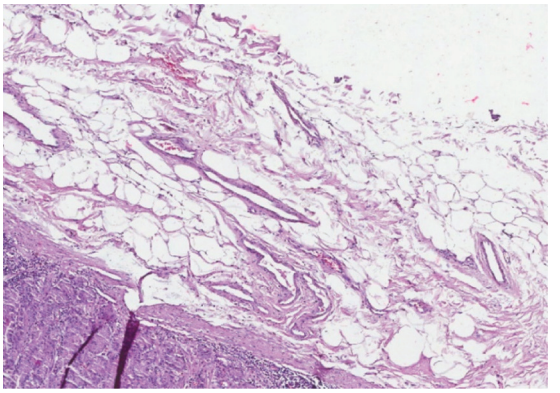

Figure 2. Microscopic finding of longitudinal thermal injury.

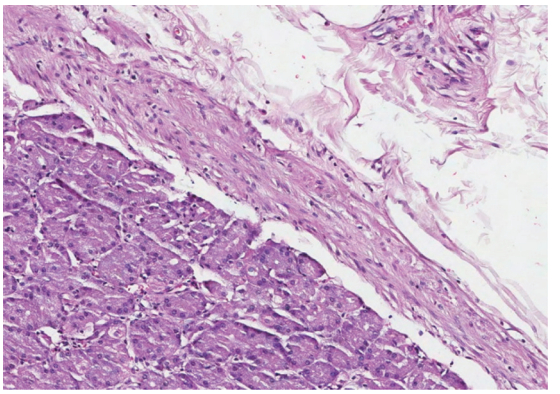

Figure 3. Microscopic finding of depth of thermal injury.

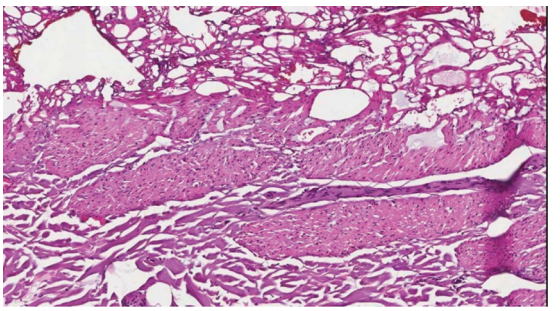

Figure 4. The cross-section of the gastric wall from serosal to submucosal layers (electrocautery on serosa of stomach without a staple line).

that, macroscopically, the area of injury expanded approximately 2 cm. along the diameter. In contrast, the injury caused by the electrocautery on the staple line was found to be limited within the staple line only. Furthermore, a histological study revealed that there was a loss of nucleus and cell boundary from serosal to submucosal layers, indicating extensive necrosis. Surprisingly, on the outer muscular layer, both cell edema and necrosis were found instead of only necrosis (Figure 4).

Discussion

The causes of cellular injury on the gastric wall with a staple line after sleeve gastrectomy included mechanical force which was caused by tissue handling with an endo-grasper and by the compression and cutting with an Endo GIA(6), ischemic time to tissue fixation, and heat from the electrocautery by a monopolar hook[7]. The researchers attempted to reduce the effect of cellular injury by rapidly preserving the tissue in formalin after the procedure was completed. The effects of mechanical injury on the gastric wall was found in the tissue. They were submucosal and intramuscular hemorrhage and cell edema.

The electrocautery on the gastric wall without a staple line caused extensive tissue injury visible in both the macroscopic and the microscopic study. Edema of cells was discovered in the outer muscular layer of the stomach, while necrosis of cells was found in the inner muscular and submucosal layers, indicating that muscular cells are more resistant to heat than the collagen fiber localized in submucosal layer. However, both electrocautery with a staple line and that without a staple line showed no histological change in mucosal layer of the stomach.

Titanium is a poor electricity conductor. If the conductivity of copper were considered to be 100%, that of titanium would be only 3.1%[8]. Thus, it was hypothesized that the poor conductivity of titanium and the arrangement of the titanium staple line in triple staggered rows accounted for the limited tissue injury within the staple line.

Routine laparoscopic sleeve gastrectomy at King Chulalongkorn Memorial Hospital is performed by applying a precise electrocautery with a monopolar hook for hemostasis of the bleeding staple line for less than five seconds. The leakage rate was 0.9% (2 of 222 cases) and the post-operative bleeding rate was 1.35% (3 of 222 cases) (unpublished data). These complication rates corresponded to the previous systematic review from 33 studies conducted by Brethauer et al[3]. With 2,367 patients as the subjects, Brethauer et al[3] discovered that the leakage rate was 2.2% (53 of 2367) and the bleeding rate was 1.2% (28 of 2367). Meanwhile, D'Ugo et al[4] conducted a retrospective multicenter study with two groups of

patients, one with reinforcement on the staple line and the other without reinforcement. Significantly different from the results of the studies conducted by Brethauer et al[3], it is reported in the present study that the bleeding on the staple of the first group was 0.92% (9 of 973 cases) while that of the latter was 13.7% (26 of 189 cases). Gagner and Buchwald reported a systemic review in 8,920 patients found to have overall leak rate 2.1%[5]. As histological results of the present study correlated to the clinical data. It supports the safety of using electrocautery on the staple line to secure the hemostasis during sleeve gastrectomy.

In the present study, the electrocautery on the staple line was performed for different length of time, ranging from spot electrocautery up to five seconds, whereas in the routine surgical procedure, electrocautery is performed with shorter and limited time of contact for effective hemostasis of the bleeding staple line.

It should be noted that there are some limitations in the present study. Since the staple line could not be removed from the tissue, the exact depth of tissue injury beyond the first row of the staple line could not be determined. However, no damage was found around the tissue close to the third row of the staple line. Therefore, it was assumed that the electrocautery was safely performed. The focus of the present study was the histological change immediately after electrocautery performed on the sleeve gastrectomy specimens, so the delayed effects could not be specified.

The electrocautery on sleeve gastrectomy specimen with a staple line contributed to histological change differently from that on the gastric wall without a staple line.

Conclusion

Electrocautery on sleeve gastrectomy staple line is proved histologically to be locally effected to the tissue at the cautery spot. Precisely and carefully cautery assures the hemostasis and reduces chance of deep tissue injury.

The surgical procedures, specimen preparation, and the study were done at the Faculty of Medicine, Chulalongkorn University Bangkok, Thailand.

The microscopic evaluation was done at the Faculty of Medicine, Khon Kaen University, Khon Kaen, Thailand.

What is already known on this topic?

Some surgeons are routinely applying electrocautery on staple line to secure the hemostasis. There are no reports to demonstrate clinical side effects of direct electrocautery on the staple line such as leakage.

What this study adds?

This histological study on extracted specimen demonstrated the limited effect of electrocautery to superficial layer. Moreover, it showed that electrocautery on staple line reduce depth of tissue injury comparing to tissue without staple due to a poor electric conduction of titanium.

Acknowledgement

The authors would like to acknowledge the Department of Pathology, Faculty of Medicine, Khon Kaen University for providing paraffin blocks for the present study.

Conflicts of interest

The authors declare no conflict of interest.

References

1. Buchwald H, Oien DM. Metabolic/bariatric surgery worldwide 2011. Obes Surg 2013;23:427-36.
2. Lomanto D, Lee WJ, Goel R, Lee JJ, Shabbir A, So JB, et al. Bariatric surgery in Asia in the last 5 years (2005-2009). Obes Surg 2012;22:502-6.
3. Brethauer SA, Hammel JP, Schauer PR. Systematic review of sleeve gastrectomy as staging and primary bariatric procedure. Surg Obes Relat Dis 2009;5:469-75.
4. D'Ugo S, Gentileschi P, Benavoli D, Cerci M, Gaspari A, Berta RD, et al. Comparative use of different techniques for leak and bleeding prevention during laparoscopic sleeve gastrectomy: a multicenter study. Surg Obes Relat Dis 2014;10:450-4.
5. Gagner M, Buchwald JN. Comparison of laparoscopic sleeve gastrectomy leak rates in four staple-line reinforcement options: a systematic review. Surg Obes Relat Dis 2014;10:713-23.
6. Derici S, Atila K, Bora S. The effect of the cartridge used in laparoscopic sleeve gastrectomy on the development of a staple-line leak. Am Surg 2018;84:1499-503.
7. Chung AY, Thompson R, Overby DW, Duke MC, Farrell TM. Sleeve gastrectomy: surgical tips. J Laparoendosc Adv Surg Tech A 2018;28:930-7.
8. Physical properties of titanium and its alloys [Internet]. 2005 [cited 2018 Sep 13]. Available from: http://www.totalmateria.com/Article122.htm.