

## Usefulness of T-Shaped Gauze for Precise Dissection of Supra-Pancreatic Lymph Nodes and for Reduced Postoperative Pancreatic Fistula in Patients Undergoing Laparoscopic Gastrectomy for Gastric Cancer

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### ABSTRACT

**Background** Supra-pancreatic lymph node dissection is important in patients undergoing laparoscopic gastrectomy (LG) for gastric cancer. A clear view of the supra-pancreatic area is necessary for precise dissection of supra-pancreatic lymph nodes without injury to the pancreas. This retrospective study assessed the efficacy of T-shaped gauze (TSG) in retracting the pancreas during supra-pancreatic lymph node dissection.

**Methods** The study cohort consisted of 80 patients who underwent LG for gastric cancer. Of these, 44 patients underwent pancreatic retraction with TSG (TSG group) and 36 without TSG (non-TSG group). The efficacy of TSG for pancreatic retraction was evaluated by comparing all grade and Clavien-Dindo grade  $\geq$  III postoperative pancreatic fistula (POPF) and the total number of dissected supra-pancreatic lymph nodes in the TSG and non-TSG groups.

**Results** The rates of all grade (6.8% vs. 11%) and of Clavien-Dindo grade  $\geq$  III (2.2% vs. 5.5%) POPF were lower in the TSG than in the non-TSG group. The total number of supra-pancreatic lymph nodes harvested by Dissection 1+ (D1+) lymph node dissection was significantly higher in TSG than in non-TSG patients ( $P = 0.0078$ ).

**Conclusion** TSG may be useful for safe and efficient performance of supra-pancreatic lymph node dissection.

**Key words** gastric cancer; laparoscopic gastrectomy; postoperative pancreatic fistula; T-shaped gauze

Supra-pancreatic lymph node dissection is one of the most important and demanding procedures in laparoscopic lymph node dissection for gastric cancer.<sup>1</sup> A good view of the supra-pancreatic area is important, as an insufficient view can result not only in suboptimal

lymph node dissection but an increased incidence of postoperative pancreatic fistula (POPF). POPF can cause life-threatening complications, such as intra-abdominal hemorrhage, abdominal abscesses, and secondary anastomotic leakage.

During open gastrectomy, the pancreas is pulled by hand to obtain a clear view of the supra-pancreatic area, with gauze often used to minimize injury to the pancreas. During laparoscopic gastrectomy (LG), however, the pancreas is pulled with metal forceps, which may injure the pancreas, resulting in POPF. Injury to the pancreas may be avoided by using a technique in which the caudal gland of the pancreas is gently retracted downward by gauze traction, moving the upper border of the pancreas forward.<sup>1</sup> This technique has also been used to obtain a clear view of the supra-pancreatic area without injuring the pancreas during dissection of lymph nodes in this area. Use of this technique, however, may cause the assistant's forceps to deviate from the field of view. Thus, an inexperienced assistant can injure the pancreas by using a part of the forceps that is not covered by gauze. To reduce injury to the pancreas during its traction by the assistant, we designed a T-shaped gauze (TSG) for use in the dissection of supra-pancreatic lymph nodes. This study was performed to investigate the usefulness of this TSG during LG.

### MATERIALS AND METHODS

#### Patients

This study enrolled 80 consecutive patients pathologically diagnosed with gastric adenocarcinoma, who underwent LG at Tottori University Hospital from March 2012 to February 2014. Their clinicopathologic characteristics were determined according to the Japanese Classification of Gastric Carcinoma (Table 1).<sup>2</sup> Tumors were staged preoperatively by endoscopy, endoscopic ultrasonography, upper gastrointestinal X-ray, and computed tomography.

The pancreas in the first 36 patients was retracted using rounded gauze (Fig. 1a) held by the assistant's forceps on the left-hand side (non-TSG group). The pancreas in the next 44 patients was retracted using TSG (Fig.

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Abbreviations: D1+, Dissection 1+; D2, Dissection 2; d-AMY, drain amylase; LG, laparoscopic gastrectomy; POD, postoperative day; POPF, postoperative pancreatic fistula; TSG, T-shaped gauze



**Fig. 1.** Gauze samples used in the (a) non-TSG group and (b) TSG group to retract pancreas. The arrows show the ligation of gauze. TSG, T-shaped gauze.

1b), which was formed by ligation of two points of gauze (arrows) (TSG group).

This study was approved by the Ethics Committee of Tottori University Faculty of Medicine (approval number 1606A03).

#### Definition of POPF

Amylase concentrations in blood and fluid obtained from abdominal drains were determined on postoperative day (POD) 3. The International Study Group on Pancreatic Fistula has defined POPF as drain output of any measurable volume of fluid on or after POD3, with a drain amylase (d-AMY) concentration of more than three times the concentration of serum amylase.<sup>3</sup> Additional criteria for POPF included clinically obvious pan-

creatic leakage requiring continuous drainage for  $\geq 10$  days or a spiking fever ( $> 38^\circ\text{C}$ ) with a peripancreatic abscess demonstrated by computed tomography. POPF was graded according to Clavien–Dindo criteria.<sup>4</sup>

#### Supra-pancreatic lymph nodes

The supra-pancreatic lymph nodes were defined by the Japanese Classification of Gastric Carcinoma.<sup>2</sup> We compared the number of supra-pancreatic lymph nodes harvested by Dissection 1+ (D1+) lymph node dissection and Dissection 2 (D2) lymph node dissection.

#### Statistical analysis

The Mann–Whitney *U* test and chi-square test were employed to evaluate differences in continuous and cate-

**Table 1. Demographic and clinicopathologic characteristics of patients in the TSG and non-TSG groups**

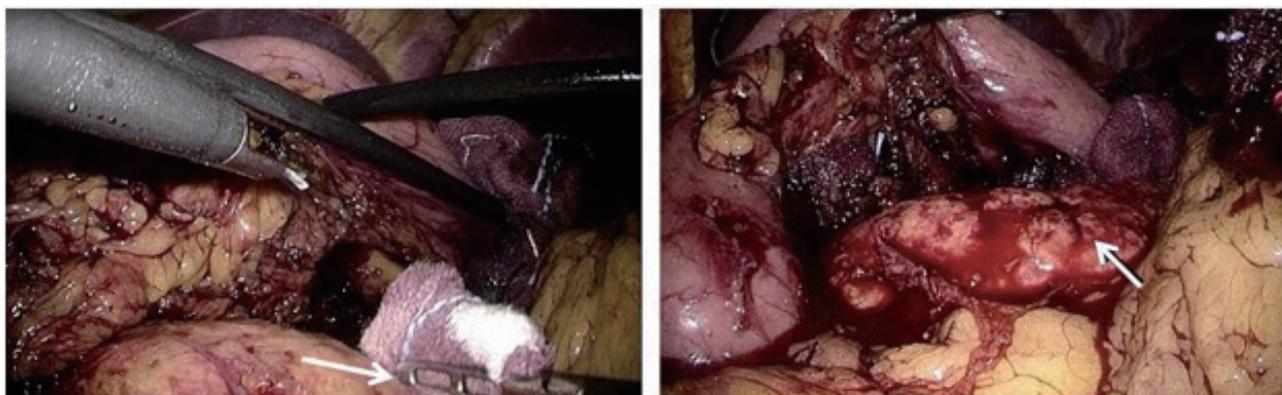
	Non-TSG group	TSG group	<i>P</i> value
Age (years)	67.3 ± 14.1	67.6 ± 13.8	0.99
Gender			1.00
Male ( <i>n</i> = 60)	27 (75%)	33 (75%)	
Female ( <i>n</i> = 20)	9 (25%)	11 (25%)	
Depth of invasion			0.77
T1 ( <i>n</i> = 61)	28 (78%)	33 (75%)	
T2/T3/T4 ( <i>n</i> = 19)	8 (22%)	11 (25%)	
Lymph node dissection			0.50
D1+ ( <i>n</i> = 64)	30 (83%)	34 (77%)	
D2 ( <i>n</i> = 16)	6 (17%)	10 (23%)	
Operation			0.42
LDG ( <i>n</i> = 58)	24 (67%)	34 (78%)	
LPG ( <i>n</i> = 13)	8 (22%)	5 (11%)	
LTG ( <i>n</i> = 9)	4 (11%)	5 (11%)	
Operation time (min)	360 ± 84	340 ± 83	0.22
D-amylase (POD3)	288 ± 362	253 ± 192	0.7

Results reported as mean ± SD or as number (%). D1+, Dissection 1+; D2, Dissection 2; LDG, laparoscopic distal gastrectomy; LPG, laparoscopic proximal gastrectomy; LTG, laparoscopic total gastrectomy; POD, postoperative day; T1, tumor has invaded lamina propria or submucosa; T2, tumor has invaded the muscularis propria; T3, tumor has penetrated subserosal connective tissue without invasion of visceral peritoneum or adjacent structures; T4, tumor has invaded serosa (visceral peritoneum) or adjacent structures; TSG, T-shaped gauze.

gorical variables, respectively. GraphPad Prism software version 6.0 (GraphPad Software, La Jolla, CA) was used for all statistical analyses, with *P* < 0.05 considered statistically significant.

## RESULTS

Figure 2 shows a patient with POPF, resulting from injury to the pancreas caused by the part of the assistant's forceps not covered by gauze. This result indicated the importance of proper retraction of the pancreas during LG to avoid POPF.



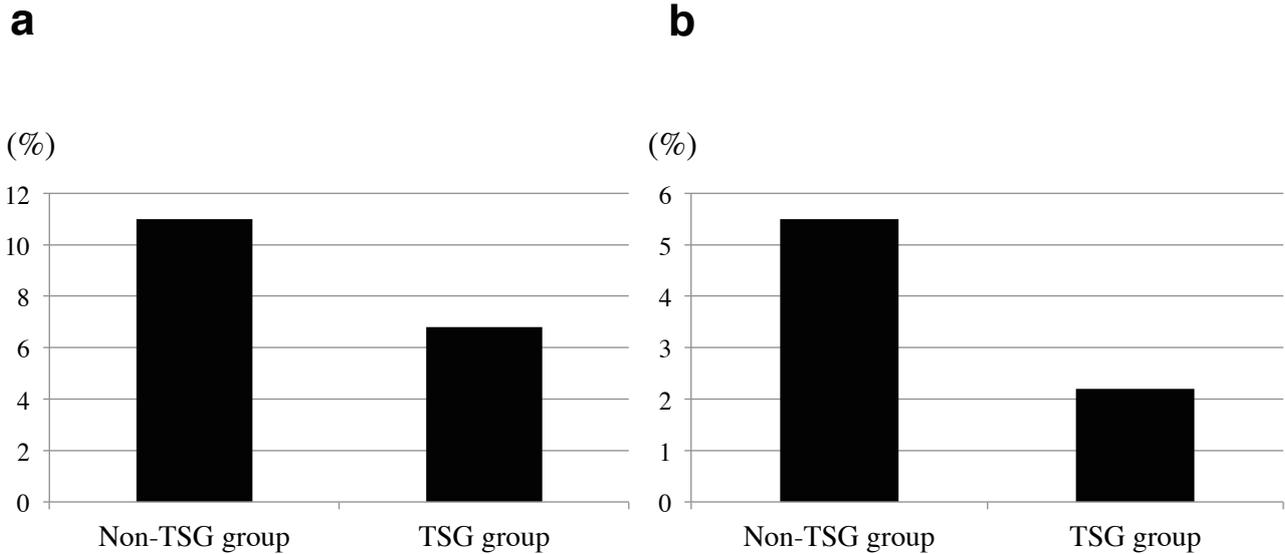
**Fig. 2.** A representative patient who experienced an injury to the pancreas caused by the surgical assistant's forceps during supra-pancreatic lymph node dissection (arrow). POPF later developed. POPF, postoperative pancreatic fistula.

Patient characteristics are shown in Table 1. There were no significant differences between the TSG and non-TSG groups in age, gender, depth of invasion, lymph node metastasis, operation procedure, and operation time. Of the patients in the TSG and non-TSG groups, 23% and 17%, respectively, underwent D2 lymph node dissection, although the difference was not statistically significant. Furthermore, d-AMY concentrations on POD 3 did not differ significantly in the TSG and non-TSG groups.

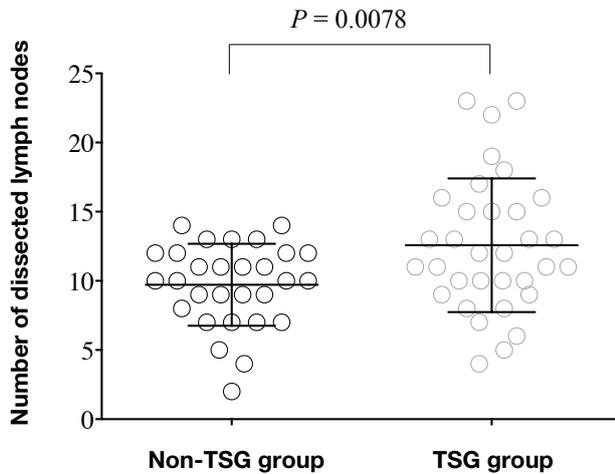
The rates of all grade (6.8% vs. 11%; Fig. 3a) and Clavien-Dindo grade ≥ III (2.2% vs. 5.5%; Fig. 3b) POPF were lower in the TSG than in the non-TSG group. Moreover, the total number of supra-pancreatic lymph nodes harvested by D1+ lymph node dissection was significantly higher in the TSG group (12.6 ± 0.8) than in the non-TSG group (9.7 ± 0.6) (*P* = 0.0078; Fig. 4), which represent that more precise lymph node dissection was performed by using TSG. On the other hand, the total number of supra-pancreatic lymph nodes harvested by D2 lymph node dissection was not significantly higher in the TSG group (12.5 ± 5.5) than in the non-TSG group (13.5 ± 3.3) (*P* = 0.56).

## DISCUSSION

The number of patients undergoing LG for gastric cancer is increasing rapidly in Japan. Japanese gastric cancer treatment guidelines recommend LG or open distal gastrectomy for the treatment of clinical stage I gastric cancer.<sup>5</sup> The development of less invasive treatment techniques and recent advances in perioperative management have improved the postoperative mortality rate and incidence of postoperative complications in patients undergoing gastrectomy. However, POPF remains a serious complication, which may contribute to the development of life-threatening conditions. Careful handling of the pancreas during surgery may reduce the incidence of POPF. Supra-pancreatic lymph node dissection usu-



**Fig. 3.** The incidence of POPF. The rates of (a) all grade and (b) Clavien-Dindo grade  $\geq$  III POPF in the TSG and non-TSG groups. The rates of all grades of POPF in these two groups were 6.8% and 11%, respectively, and the rates of grade  $\geq$  III POPF were 2.2% and 5.5%, respectively. POPF, postoperative pancreatic fistula; TSG, T-shaped gauze.



**Fig. 4.** Numbers of lymph nodes harvested during D1+ lymph node dissection in the TSG and non-TSG groups. The total number of supra-pancreatic lymph nodes harvested were  $12.6 \pm 0.8$  and  $9.7 \pm 0.6$ , respectively, a difference that was statistically significant ( $P = 0.0078$ ). D1+, Dissection 1+; TSG, T-shaped gauze.

ally involves ultrasonic cutting and coagulating devices. Because the laparoscope provides a magnified view, the cutting lines for supra-pancreatic lymphadenectomy tend to be closer to the cranial edge of the pancreas, which may cause heat injury.<sup>6,7</sup>

Retraction of the pancreas is necessary to obtain a clear view of supra-pancreatic lesions and perform precise lymph node dissection, regardless of whether open gastrectomy or LG is performed. However, retraction of the pancreas can cause parenchymal injury, which may

result in pancreatic leakage. To avoid possible injury, surgical assistants should retract the pancreas gently and carefully with gauze, paying close attention to the tips of the forceps. However, the assistant's forceps may deviate from the field of view when attempting to obtain a magnified view of the supra-pancreatic area during supra-pancreatic lymph node dissection. Therefore, an inexperienced assistant can injure the pancreas by using part of the forceps not covered TSG. We found that this TSG could be easily held by the assistant due to the presence of a convex part avoiding the gauze gap of the forceps. Furthermore, the parts of the forceps that touch the surface of pancreas are always covered by gauze. Indeed, this study showed that use of TSG significantly reduced the incidence of POPF.

As the most likely source of pancreas-related complications is seepage of pancreatic juice from the surface of the pancreas, d-AMY concentration may be useful in the early diagnosis of pancreas-related complications,<sup>8</sup> including POPF.<sup>9</sup> However, we found no significant difference in d-AMY levels between the TSG and non-TSG groups. Obama et al. also reported that although there was a statistically significant difference in the d-AMY level between the patient groups with and without pancreas-related complications, they did not find a very high predictive value of the d-AMY level alone for postoperative complications.<sup>8</sup> It is likely that the drained fluid volumes may have altered amylase level. Lymphorrhea following radical lymph node dissection may have diluted the amylase concentration of the drainage fluid,

which may have concealed the leakage of pancreatic juice. Furthermore, drains in some patients may have come obstructed or dislocated.

In conclusion, this study showed that TSG may be useful for the safe and efficient performance of supra-pancreatic lymph node dissection, decreasing the incidence of POPF.

*The authors declare no conflict of interest.*

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