The Clinical Report
Of
Laparoscopic Gasrectomy with
Sometech 3D Laparoscopy System

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EXPERIENCE OF 3 DIMENSION LAPAROSCOPIC SURGERY FOR GASTRIC CANCER

1. Introduction

Laparoscopy has become increasingly popular in gastric surgery. Within the next few years, laparoscopic gastrectomy was set to become an important component in oncological surgery and more popular and familiar with oncological surgeons worldwide especially in Korea, Japan and China. With the relentless development of technology, many advanced equipment have been applied to help surgeons being able to approach surgery in the best way. Introduction of 3 dimension laparoscopy aims at providing a better vision for novice as well as experienced surgeons. Since many studies were conducted to show the benefit and safety of 3D laparoscopy in bariatric surgery, 3D imaging seems to decrease the performance time of more difficult bariatric procedures, which involve surgical tasks as suturing and intestinal measurement. Despite these advantages of 3D system, limited study has been reported to prove the safety and feasibility of this system for gastric cancer. The purpose of this report to address the issue whether applying three-dimension laparoscopy in gastric cancer surgery.

2. Methodology

Between September, 2014 and September, 216, 240 patients were performed 3 dimension laparoscopy gastric surgery by one surgeon (Dr. Young-Woo Kim) at National Cancer Center – Korea. The inclusion criteria were pathological proven adenocarcinomas and ASA score from 1 to 4. Accordingly, we used STATA version 12.0 to conduct the operative outcomes and short-term outcomes such as surgical complications, and non-surgical complications.

We used Sometech 3D system to perform gastric surgery with characteristics such as 1920×1080P@60Hz High-Definition Image, and depth perception by 3D stereoscopic image. We set up this system as following main unit:

- Convergence Control

With a basic working distance of 5cm, working distance is possible to be adjusted from 3cm as close range to 10cm as long range.

- Binocular Disparity Control

Human eyes see objects with binocular disparity. In the same way, two cameras are used to display 3D image. Adjustment jig is provided to easily adjust the Binocular Disparity after scope replacement. Adjustment can be set with touch screen on the Binocular Disparity Control menu.

- White Balance Function

Automatically adjust the white balance of the camera image

- Interfaces 4 HDMI

Total 4 HMDI interfaces installed, 3 HDMI-out for 3D image and 1 HDMI-out for 2D image

3. Results

Table 1: Demographic characteristics of patients

Characteristics	% or mean (SD)
- Age	60.88 (±12.19) (26-87)
- Sex (male/female)	155/85 (64.6/35.4)
- BMI	23.9(±2.9)(17.5-33)
- ASA score(1/2/3/4/5/6)	81/143/15/1/0/0
	34.75/59.6/6.25/0.4/0/0
-Smoke/non-smoke	135/104 (56.5/43.5)
-Alcohol assumption (yes/no)	130/110 (54.17/45.83)

Table 2: Characteristics of tumor

Characteristics	% or mean (SD)
- Diagnosis	
EGC/AGC/GIST/Lymphoma/Others	190/35/9/0/3
- Size (longest diameter)	3.35±1.85 (0.4-13)
- Histology type:	
Differentiated/Undifferentiated/NA	145/81/14 (60.4/33.8/5.8)
- Lauren classification:	
Intestinal/Diffuse/Mixed/Indeterminate/NA	102/82/30/7/19
	(42.5/34.17/12.5/2.92/7.92)
- Location U/M/L/ML/Whole/NA	28/64/106/15/1/26
	(11.67/26.67/44.17/6.26/0.42/10.83)
- Invasion depth T1a/T1b/T2/T3/T4a/NA	97/89/20/13/4/17
	(40.42/37.08/8.33/5.42/1.67/7.08)
- Final stage1a/1b/2a/2b/3a/3b/4/NA	169/28/10/11/6/1/2/13
	(70.42/11.67/4.17/4.58/2.5/0.42/0.83/5.42)

Table 3: Operative outcomes

Outcomes (n=240)	% or mean (SD)
Reconstruction	
Billroth 1with stapler	30 (13.27)
Billroth 1(handsewn + stapler)	72 (31.86)
Billroth 2	14 (6.19)
Roux-en Y	39 (17.26)
Gastro-gastrostomy	37 (16.37)
Esophago-gastrostomy (double shouldering)	19 (8.41)

Double tract method Primary repair (Wedge resection)	2 (0.88) 13 (5.75)
Lymphadenectomy: - SBD - D1+ - D2 - D2+	 15 (6.25) 186(77.5) 24(10) 2(0.83)
Resection of the other organs - Pancreas - Spleen - Liver - Colon	 0 1 0 0
Residual tumor status R1/R2/NA	226/2/12 (94.17/0.83/5)
Operative time	219.13 ± 68,6(45-480)
Blood loss	96.13±183.9(5-2000)
Hospital stay	8.8±8.3 (3-120)
Harvested LN	33.21±13.6
Proximal resection margin	4.1 ± 3.2
Distal resection margin	4.4 ± 3.3
Positive LN	0.59±2.5
-Convert from STG to TG -Convert to open	6 (2.52%) 3 (1.26%)
Intraoperative complications	9 (3.75%)

Table 4: Comparative operative outcomes by operative procedure

	Types of procedure	Number of cases	Operative time Mean (SD)	Intraoperative blood loss Mean (SD)
1	Totally laparoscopic total gastrectomy (TLTG)	7 (2.95)	313.6 ± 46.8	125 ± 88
2	Laparoscopy assisted total gastrectomy (LATG)	3(1.27)	401.7 ± 75.2	150 ± 70.7
3	Totally laparoscopic distal gastrectomy (TLDG)	125(52.74)	221.16 ± 57.2	102.2 ± 221.9
4	Laparoscopy assisted distal gastrectomy (LADG)	17(7.17)	204.7 ± 38.7	80 ± 44.7
5	Totally laparoscopic pylorus-preserving gastrectomy (TLPPG)	21(8.86)	211 ± 36.4	46.25 ± 35
6	Laparoscopy assisted pylorus-preserving gastrectomy (LAPPG)	17(7.17)	237.4 ± 39.3	101.1 ± 84.8
7	Totally laparoscopic proximal gastrectomy (TLPG)	19(8.02)	237.6 ± 65.6	56 ± 37.6
8	Laparoscopy assisted proximal gastrectomy (LAPG)	2(0.84)	372.5 ± 109.6	600
8	Laparoscopy Wedge resection (LWR)	26(10.97)	134.5 ± 60.3	36.5 ± 29.3

Table 5: Comparative operative time by reconstruction

	Reconstruction	Mean (SD)
1	Billroth 1with stapler	167.1 ± 90.8
2	Billroth 1(handsewn + stapler)	223.7 ± 57
3	Billroth 2	225.7 ± 40
4	Roux-en Y	229.2 ± 69.5
5	Gastro-gastrostomy	216 ± 70.7
6	Esophago-gastrostomy (double shouldering)	241.3 ± 68.4

7	Double tract method	269 ± 99
8	Primary repair (Wedge resection)	215 ± 44

Table 6 : Short-term postoperative outcomes

	Number of patients (%)
Surgical complications:	
- Anastomosis leakage	8 (3.3)
- Anastomosis stenosis	6 (2.5)
- Anastomosis bleeding	1 (0.42)
- Wound-related complications	6 (2.5)
- Delayed emptying syndrome	2 (0.83)
- Intra -abdominal abscess	1 (0.42)
Total	24 (10)
Non-surgical complications	5 (2.18)
Mortality	0 (0)

4. Discussion

Laparoscopic surgery was accepted widely for gastric malignant with some highlight advantages and acceptable oncological outcomes. However, the big obstacle for surgeon especially novice surgeons was hands on 3d space with 2 dimension visualization. Therefore, surgeons lose depth perception and spatial orientation, and thus experience a higher visual and cognitive load. Given a need for alternative surgical demand, 3D imaging is now a reality owing to technological innovation. Over last two decades, most of the studies which showed

superiority of 3D system have been conducted using endo-trainer and experimental surgical mode [1].

Thus far, the limited number of studies examining whether 3D systems have significant advantages over conventional 2D systems have been conducted, especially in gastric surgery.

Giuseppe Currò et al examined the efficacy of 3D laparoscopy bariatric surgery in 40 obese participants who were randomly to receive either 3D or 2D. 3D imaging seems to decrease the performance time of more difficult bariatric procedures, which involve surgical tasks as suturing and intestinal measurement [2]

Application of 3 dimension in laparoscopic gastric surgery, they shows some advances to improve surgical performance of trainees during a procedure as well as increase anatomical awareness. And this significant improvement in performance time and error reduction were greater for the more complex tasks of needle capping and knot tying [3]. Not only novice surgeons, for more demanding procedure, using the vision system with depth perception is able to reduce operating time independently of the surgeon's experience [4]. Moreover, an efficient 3D optical system would facilitate advanced laparoscopic surgery and increase performance sped by 60-70%.

Depth perception and hand eye coordination were excellent with 3D imaging system leading to accurate and swift dissection as well as better intra-corporeal knotting. Especially in total gastrectomy, there are quite difficult for surgeons to be able to approach and perform some advanced technical maneuvers such as suturing or knot tying. In our study, the mean of operative time with intracorporeal knotting is lower than extracorporeal group except distal gastrectomy. However, Y.W Kim et al [5] reported the surgical outcomes of LADG through a randomized clinical trial. In that study, the mean of operating time was 252.6 minutes which

is longer than our study. As shown in previous study [4], the time of 3D performance was better than 2D system by 30-40%.

There are several methods that are used for reconstruction after laparoscopic gastric surgery. Our results showed no clearly difference between each reconstruction. However, this result might be associated with the diversity of equipment to complete reconstruction. Especially in hand sewing suture during laparoscopy, 3 D was extremely useful and convinient than using 2 D laparoscopy. For delicate needle handling, 3D was beneficial.

During minimally invasive surgery, surgeons learn to interpret monocular visual depth cues from 2D displays to perform the accurate and intricate movements required. The final target was be able to minimize the rate of morbidity. A meta-analysis by Stine et al found out that the most common reasons for surgical laparoscopic injuries were visual misperception. Therefore, the enhancements of 3D vision on visual depth perception may improve the quality of laparoscopic surgery and patient safety [6]. In 2014, H.H, Kim et al.[7] reported the surgical outcomes of 2976 patients who were treated with laparoscopic gastrectomy. They showed that the morbidity was 12.5 in laparoscopic group. Similarly, one Randomized control trial was published in 2013 (COACT 0301) to report the short-term complications after distal gastrectomy. The results showed the rate of short-term complications after laparoscopic distal gastrectomy was 29.3% [8]. In our research, there were 10 patients over 240 patients had complications with the rate was 10%. This number is slightly smaller than other studies which show some probably promised benefit of using 3D laparoscopy in gastric surgery.

5. Conclusion

The 3 Dimensional laparoscopic system showed promised surgical outcomes in terms of operating time, intraoperative blood loss and complications comparing with previous 2 dimensional surgery experiences. There must be a fine randomized controlled study to show the benefit in the future. With more technological advancements in vision of surgical field, minimally invasive surgery will expand the scope more.

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