Annals of Clinical Surgery

Research Article
Published: 30 Dec, 2020

Accuracy of D2 Lymphadenectomy in Laparoscopic Subtotal Gastrectomy 3D *vs*. 2D: Preliminary Results

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Abstract

Background: Three-Dimensional (3D) vision systems have been applied recently in the field of general surgery. Here we aim to assess the feasibility and accuracy of D2 lymphadenectomy during subtotal gastrectomy performed in 3D laparoscopic approach in comparison with standard laparoscopy (2D).

Materials and Methods: This retrospective observational study compared operative measures and post-operative outcomes between laparoscopic 3D and laparoscopic 2D subtotal gastrectomy with D2 lymphadenectomy. From 2014 to 2016, retrospective review of 48 patients with gastric cancer located in the lower third of the stomach treated with laparoscopic subtotal gastrectomy with D2 lymphadenectomy; 23 of them with 3D laparoscopic approach and 25 with standard laparoscopic approach (2D). Operative time, blood loss, harvested lymph nodes and post-operative hospital stay were compared.

Results: 48 subtotal R0 gastrectomy with D2 lymphadenectomy were performed. These patients were divided into two groups (3D and 2D). The mean number of dissected lymph nodes was 35.5 ± 11.1 in 3D group and 23.5 ± 5.3 in 2D group. Perioperative mortality and morbidity rates were 2.1% and 17% in 3D group and 0% and 16% in 2D group. The conversion rate was 8.7% in 3D group and 24% in 2D group. Hospital stay was similar in the two groups. The operative time and blood loss were lower in 3D group in the absence of a statistically significant difference.

Conclusion: 3D Laparoscopic D2 lymphadenectomy during subtotal gastrectomy for early and advanced gastric cancer is feasible and oncological effective with a statistically significant evidence of a greater number of retrieved lymph nodes ($p<0.05$). In our experience it is therefore demonstrated that there is a higher accuracy of D2 lymphadenectomy performed with 3D approach.

Keywords: Gastrectomy; Lymphadenectomy; Laparoscopic; Early gastric cancer (EGC)

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Received Date: *25 Nov 2020*
Accepted Date: *23 Dec 2020*
Published Date: *30 Dec 2020*

Citation:
D'Urbano C, Pennacchi L, Cornelli A, Marazzi F, Viti M. Accuracy of D2 Lymphadenectomy in Laparoscopic Subtotal Gastrectomy 3D vs. 2D: Preliminary Results. Ann Clin Surg. 2020; 1(3): 1012.

Introduction

Although a steady decline in the incidence and mortality rates of gastric cancer has been observed in the last century worldwide, the absolute number of new cases/years is increasing due to the aging of the population. R0 resection is the only chance for cure in patients with resectable gastric cancer. Gastric resection with adequate lymph node dissection remains a challenging procedure, which should respect the oncological principles. Subtotal gastrectomy is the treatment of choice for the middle and distal-third gastric cancer. The extent of lymphadenectomy has already been the subject of debate. In Early Gastric Cancer (EGC) not suitable of endoscopic treatment, the JGCA guidelines advice a D1 or D1 plus lymphadenenctomy in cases of clinically negative nodes [1]. The D1 lymphadenectomy involves the removal of perigastric lymph nodes and station number 7, whereas in the D1 plus lymph node stations 8a and 9 for subtotal gastrectomy. JGCA treatment guidelines advice a D2 lymphadenectomy in case of clinically positive lymph nodes which involves the removal of stations 12a and 11p in subtotal gastrectomy [1]. Despite the recent advancement of staging procedures (CT scan, endoscopic US) the risk of a clinical understaging is still considerable, and this may be associated with a potentially fatal under treatment, as the probability of advanced nodal status in non-early forms of gastric cancer in Western patients in considerable [2,3]. For these reasons, the GIRCG (Italian Research for Gastric Cancer) guidelines advice a D2 lymphadenectomy in clinically early forms not suitable for endoscopic resection [4]. The extent and quality of lymph node dissection is critical: In laparoscopic-assisted distal gastrectomy for Advanced Gastric Cancer (AGC), this can be measured by the number of harvested lymph nodes and the incidence of non-compliance (the identification of nodal tissue at a node station that

should have been resected) [5-8]. It is now established that lymph node metastasis is the most important prognostic factor for gastric cancer, and adequate lymph node dissection is fundamental for both accurate tumor staging and the R0 resection of gastric cancer. A recent systemic review recommended that more than 16 lymph nodes should be removed, especially in case of advanced gastric cancer [9]. Many authors have reported no difference between laparoscopic and open procedures in terms of number of harvested lymph nodes [10-12]. Using traditional laparoscopic approach, surgeons had to face a limitation of movements and 2D visualization without proper sense of depth in the operative field [3]. Three-Dimensional Laparoscopic Vision System (3D LVS) seems to solve all of these disadvantages which make more difficult the lymphadenectomy. 3D LVS has the potential to improve the learning curve, and reduce the operating time and the error rate during the performances of laparoscopic surgeons [13]. Byrn et al. [14] have reported that independently of the biomechanical advantages of the da Vinci Robot System, 3D LVS improved performance times by 34% to 46% and reduced error rates by 44% to 66% for both inexperienced residents and advanced laparoscopic surgeons. In multicentric prospective trial from South Korea the authors compared robotic with laparoscopic gastrectomy [15]. The complications rates were similar, without mortality in both arms. Robotic approach was associated with longer time and higher cost. 3D laparoscopic approach, due to the perception of depth and consequently a better vision of the anatomy may probably help in more precise and safer operation especially in most critical lymph nodes stations like n°1,5,6 and suprapancreatic area with stations n°7,8a and 9.

Material and Methods

Between April 2013 and April 2016, 48 patients suffering from cancer of the distal third of the stomach underwent a laparoscopic subtotal gastrectomy with associated D2 lymphadenectomy at our center. Twenty-three of these were operated with tridimensional laparoscopic approach (3D), 25 other with standard laparoscopic approach. Demographics, perioperative and postoperative data (sex, age, American Society of Anesthesiologists status, preoperative diagnostic work up, digestive reconstruction and lymph node dissection, operative time, postoperative complications, blood loss and hospital stay) were retrospectively collected and analyzed. All patients were discussed at a multidisciplinary meeting. A D2 lymphadenectomy and Roux-en-Y gastrointestinal reconstruction or a Billroth II reconstruction were performed. All operations began with the intent for a completely laparoscopic approach with intracorporeal anastomosis. Conversion to an open procedure was performed when necessary to complete a R0 resection. The data were entered into a computer spreadsheet (Microsoft Excel XP for Windows). All values are expressed as the mean ± the standard error of the mean. The comparisons were tested with the Student t test and linear regression test. Significance was taken at the level of the P value of less than 0.05.

Results

The patients were divided into two heterogeneous groups (2D and 3D). All the procedures were performed with a totally laparoscopic approach with a periumbilical laparotomy for the removal of the specimen. Surgical data are reported in Table 1. There were 27 (56%) men and 21 (43.7%) woman. The mean age was 71 ± 12.8. Preoperative assessments included routine blood test with tumor markers, cardiac evaluation, gastroscopy with biopsy and marking ink, chest-abdomen computer tomography and EUS. Surgical risks

Table 1: Procedures were performed with a totally laparoscopic approach with a periumbilical laparotomy for the removal of the specimen.

	2D N (%)	3D N(%)
Conversion to open surgery	6 (24%)	2 (8.7%)
Mean operative time (min)	274 ± 34.7	246 ± 5 6.8
Mean n° of dissected lymph nodes	23.5 ± 5.3	35.5 ± 11.1
Hospital stay (days)	11.3 ± 5.5	11.7 ± 8.3
Blood loss (ml)	184 ± 15.5	121.5 ± 18.4
Perioperative morbidity	4 (16%)	4 (17%)
Perioperative mortality	0	1 (2.1%)

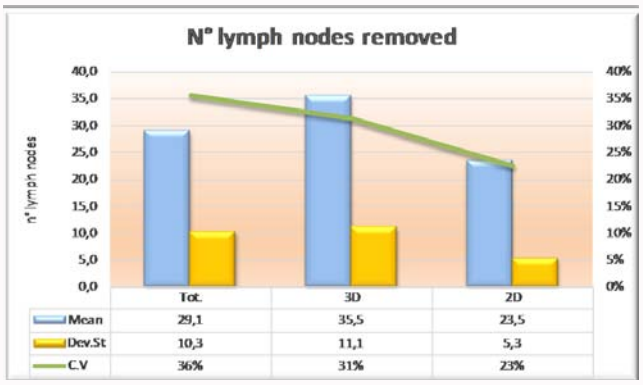

Figure 1: The mean number of dissected lymph nodes was 23.5 ± 5.3 in 2D group and 35.5 ± 11.1 in 3D group.
Dev. St: Standard Deviation; C.V: Coefficient of Variation

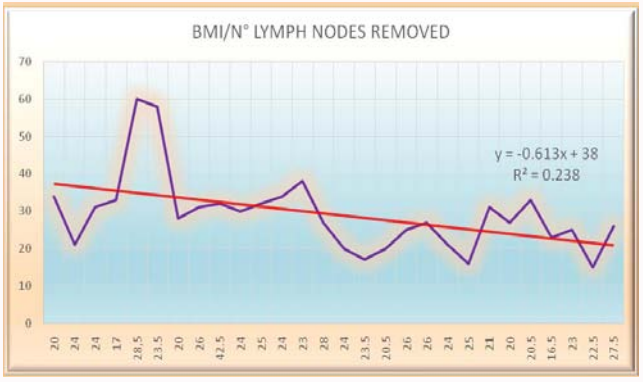

Figure 2: This shows using the linear regression test, the possible correlation between BMI and the number of lymph nodes removed.

were classified as ASA 2 in 22 (45.8%) patients and ASA 3 in 26 (54%) patients. Computer tomography was negative for metastasis in all patients and EUS had allowed us to have more precise information about the nodal status and the degree of invasion of the gastric wall. Histological type was intestinal in 24 (50%) patients, diffuse in 17 (35%) and mixed in 7 (15%) patients. The mean surgical time for the procedure was 274.1 ± 34.7 min in 2D group and 246 ± 56.8 min in 3D group. The estimated blood loss was 184 ± 15.5 ml in 2D group and 121.5 ± 18.4 ml in 3D group. The mean hospital stay was 11.3 ± 5.5 days in 2D group and 11.7 ± 8.3 days in 3D patients. The mean BMI was 24.1 ± 2.5 in 2D group and 23.2 ± 3.2 in 3D group. The mean number of dissected lymph nodes was 23.5 ± 5.3 in 2D group and 35.5 ± 11.1 in 3D group (Figure 1). From the analysis of the mean it was found a great difference regarding the lymph nodes in 3D than in 2D removed. We applied Student's t test and we observed a statistically

significant difference between the lymph nodes removed in 3D than in 2D approach. Conversion to open surgery was necessary in 6 patients (24%) in 2D group because of intestinal adhesions in four patients and suspected infiltration of the pancreatic body in the other patient. In 3D group instead the conversion was necessary in 2 patient (8.7%) because of the difficulty in recognizing the tumor site and thus ensure the surgical margins. The surgical margins were free in all patients. Postoperative mortality was 0% in 2D group and 2.1% (1 patient) in 3D group. This patient developed during the postoperative course a bilateral pneumonia and myocardial infarction and died on the thirtieth day for acute respiratory failure. Postoperative complications were four (16%) in 2D group and four (17%) in 3D group. In 2D group two patients had a gastrojejunostomy leak discovered on the fifth day after surgery and treated with conservative management. The other two patients had hemoperitoneum that required revision with hemostasis. In 3D group two patients had a mild bleeding from gastrojejunal anastomosis that had stopped spontaneously without necessity of blood transfusion. The other patients had multiple episodes of vomiting from the sixth day after surgery because of gastrojejunal anastomosis edema. These patients were treated conservatively with nasogastric tube and total parenteral nutrition regimen. We also evaluated, using the linear regression test, the possible correlation between BMI and the number of lymph nodes removed (Figure 2). The analysis shows that there is a very low correlation between BMI and the number of lymph nodes removed in the total group of patients (R2=0.2).

Conclusion

In our experience there is statistically significant ($p<0.05$) evidence of a greater number of lymph nodes removed with the 3D approach; consequently it has demonstrated the highest accuracy of lymphadenectomy in laparoscopic subtotal gastrectomy performed with 3D approach then the traditional approach, regardless of the small number of cases. 3D technology gives the surgeon an excellent depth of field combined with outstanding synchronism between the eye and surgical instruments. This allows overcoming the main disadvantage of traditional laparoscopy: The vision in only two dimensions. In fact 3D laparoscopy allows improving surgical performances such as dissection and suture. Moreover 3D laparoscopy combines excellence features of traditional high resolution laparoscopy (sharpness of vision, high color rendering, and resolution) to those digital image processions, allowing a three-dimensional view with depth of field close to open surgery. In our opinion, best perception of depth and spatial orientation facilitate vessels dissection and make more accurate lymph node dissection. These advantages are particularly evident in patients with advanced gastric cancer and in those with high BMI in which the dissection is more complex and bloody. 3D laparoscopy ensures better laparoscopic vision and so reduces the technical error. The high-definition 3D vision also allows surgeons to quickly improve surgical skills and shorten the learning curve.

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