



# Distal gastrectomy: the evidence—a narrative overview

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**Objective:** To perform a narrative overview of the distal laparoscopic gastrectomy in the last 30 years.

**Background:** Since the first minimally invasive distal gastrectomy performed by Kitano in 1991, there has been an enormous development in the minimally invasive surgery, especially after the year 2000. The first well-structured studies were performed in Japan and Korea, particularly regarding early tumors. In the East, during the early years, several European papers especially in Italy showed good results in small series, at that time also including advanced tumors, with survival rates equal to those of open surgery. In the initial experience, the laparoscopic operative time was superior to the gastrectomy performed by laparotomy. As the years went by, the better training and experience, led to a shorter surgical time, with the same lymph node number, faster time to the first flatus, decreased use of anti-inflammatory drugs, and shorter hospital stay with a lower complication rate, especially regarding the abdominal wall and blood loss. The robotic surgery was also incorporated into the surgical arsenal with results very similar to those of laparoscopy. Recently, several randomized controlled trials have demonstrated the efficacy, safety and equal oncologic results of laparoscopic distal gastrectomy in both early and advanced cancer.

**Methods:** We reviewed the pivotal studies that promoted an advance in the distal laparoscopic gastrectomy since 1991.

**Conclusions:** The good results obtained by subtotal gastrectomy studies, as well as in the robotic trials showed that the method can be incorporated in the arsenal of surgical techniques to treat distal gastric cancer. The only very difficult aspect to be solved is the cost, that seems insurmountable at the moment, especially for the robotic procedures, particularly in developing countries.

**Keywords:** Gastric cancer; surgery; gastrectomy; laparoscopic; robotic

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## Introduction

The first laparoscopic distal gastrectomy (LDG) was performed by Kitano in 1991. It was a revolution in the surgical treatment of stomach cancer with the following rationale: to provide better quality of life, less pain in the postoperative period, less blood loss, earlier recovery and shorter hospital stay, all with equal surgical quality (1).

Over the last 30 years with the development of

equipment and improvement in optical systems, there has been a great advance in studies that confirmed technical safety and good oncological results (2). Although the first patients were operated on in the early 1990s, it was only between 2000 and 2010 that the most consistent studies appeared, first reporting on the effectiveness of the technique and later, showing encouraging oncological results. Nowadays, the method is receiving international approval after the publication of randomized clinical trials.

Following the same pathway, the robotic distal gastrectomy (RDG) is also receiving attention because of the 3D image, ergonomics with less fatigue to the surgeon, stability of the images and precision (3). On the other hand, the cost is still high, especially for developing countries.

The rationale of this paper is to determine if the minimally invasive distal gastrectomy provides better equal surgical quality and comparable oncologic endpoints.

We present the following article in accordance with the Narrative Review reporting checklist (available at <https://ales.amegroups.com/article/view/10.21037/ales-21-4/rc>).

## Objective

To provide a narrative overview of the evolution of minimally invasive distal gastrectomy

## Methods

We reviewed through PubMed, the pivotal articles in English language that promoted significant changes in the field related to the development of the laparoscopic and RDG since 1994.

## LDG for early cancer

Pioneer in the method, Kitano published in 2002 his 10-year experience with 116 cases of laparoscopic assisted distal gastrectomy (LADG). The mean blood loss was 139 mL and the operative time was 234 minutes. The morbidity was very low, with only four major complications: 1 anastomotic leak, 1 pneumonia, 1 anastomotic stenosis and 1 pancreatic injury, without mortality. Among the 116 patients, 115 were alive with a mean follow-up of 45 months (4).

The Japanese Society for Endoscopic Surgery (JSES) published a survey showing that 5,271 LADG were performed in Japan between 1991 and 2003 and 1,525 gastric cancer patients were treated by LADG in 2003. Among the 5,271 patients submitted to LADG, D1+ number 7 lymph nodes was performed in 3,787 (at that time D1 did not include number 7 lymph nodes), 781 underwent a D1+7, 8, 9 nodes dissection and 703 were submitted to D2 (5). In 2008, a study on 167 patients with early cancer showed that, as the laparoscopic surgery approached the completion of the first 100 cases, it presented better results. The surgical time at the beginning was 350 minutes against 230 in open surgery, but after the 60<sup>th</sup> case, it matched this result, reaching 220 minutes. The number of excised

lymph nodes, that in the first 20 cases was twenty, against an average of 25 in the open surgery, reached 36 after the 80<sup>th</sup> case, being significantly higher. Blood loss has always been less in the minimally invasive surgeries since the beginning. There were other benefits, such as faster time to intestinal transit return, less use of anti-inflammatories and shorter hospital stay (6).

A metanalysis published in the United States in 2012 used only high-quality papers that included 3,055 patients submitted to distal gastrectomy. Among those, 1,658 were operated on by means of a minimally invasive access, LDG, and 1,397 through laparotomy [open distal gastrectomy (ODG)]. They observed that LDG was associated with longer operative times and lower overall complications, with a blood loss and hospital stay significantly lower. The mortality rate and major complications were similar. At that time, the patients in the ODG group had a significantly higher number of lymph nodes harvested, but the proportion of patients with less than 15 lymph nodes was similar (7).

In 2013, a Japanese propensity-matched analysis involving more than 9,000 early cancer patients, comparing open versus laparoscopic gastrectomy (LG), showed a small, but significant, reduction in the median hospitalization duration (13×15 days,  $P < 0.001$ ) and a slight, but non-significant, increase in the cost (US \$21,510 × US\$21,024). There were no differences in mortality, overall morbidity (12.9% × 12.6%), or 30-day readmission (3.2% × 3.2%). At this moment, there was a tendency also to employ completely LG with linear stapled anastomosis, instead of a laparoscopic-assisted procedure (8,9).

In 2013, also in Japan, a phase III study (JCOG0912) comparing the open versus LADG showed no differences, indicating that the laparoscopic procedure definitively had its place in the treatment of gastric cancer in the early phases (10).

By the end of the first decade following 2000, the minimally invasive techniques seemed to be well established, especially for early cancers, nevertheless, studies with a larger number of patients and well controlled trials were still lacking. The robotic surgery had also begun to appear as a safe method. There was a rapid increase in the number of patients operated on in Japan and Korea at the same time, while in the West, more papers began to appear.

The Korean researchers gave an extraordinary impulse to the minimally invasive techniques, with a cumulative number of approximately 14,000 laparoscopic gastrectomies performed in Korea between 1995 and 2009. They presented several studies showing the safety and good

results of the minimally invasive techniques. After 2001, they created the Korean Laparoscopic Gastrointestinal Surgery Study Group (KLASS) which promoted several randomized trials, some of them recently published (11).

The KLASS group, comprised of 15 surgeons from 13 hospitals, recently published the results of a prospective randomized clinical trial (KLASS-01) only analyzing LDG and ODG in clinical stage I gastric cancers. Patients were randomly assigned to LDG (n=705) or ODG (n=711). The 5-year survival rates were the same between the 2 groups (97.1% LDG, 97.2% in ODG) (12). Shortly after this, another trial (JCOG 0912) was published. In that series with 33 participating institutions, they included only stages IA and IB in a non-inferiority, phase 3, randomized controlled trial, also analyzing only distal gastrectomy. The 921 patients were assigned through a randomization (1:1) to receive ODG (n=459) or LADG (n=462). Among those, 912 (99%) had the assigned surgery. The 5-year relapse-free survival was 94.0% in the ODG group and 95.1% in the LADG group, showing that LADG was non-inferior to ODG for relapse-free survival (13).

### Distal LG for advanced cancer

While in the East the studies involved mainly early tumors, in the West, Huscher *et al.* published in Italy, in 2005, a prospective randomized study, in which they compared 30 patients undergoing LDG, with 29 patients undergoing open gastrectomy. Almost 70% of the cases underwent D2 lymphadenectomy in both groups and in this series, there were also advanced neoplasms (only approximately 20% of the cases were of early tumors); the groups were comparable. As in previous studies, the mortality rate was the same (6.7% for open surgery and 3.3% for laparoscopic surgery). Morbidity was similar with a rate of 27.6% in the group undergoing open surgery, against 23.3% in patients undergoing LG. The overall survival for patients undergoing open surgery was 55.7% in five years and the disease-free survival was 54.8%. In those who underwent minimally invasive surgery, 58.8% and 57.3%, respectively (14).

In 2010, another Italian group published a series of 70 distal cancers (37 early and 33 advanced tumors), operated on by minimally invasive surgery, 52 by laparoscopy and 18 through robotic access. The overall 3-year survival was 85% for LG and 78% for robotic gastrectomy (RG) (non-significant). The overall 5-year survival was 81% (97% for early cancers and 67% for advanced) (15).

Shortly after this, a randomized trial comparing open versus LG was published. Although there were only 35 patients in the subtotal gastrectomy group, the 5-year survival rate was 54.5% for the laparoscopic procedures and 56% for the open surgeries (16).

In Brazil, we presented 148 cases of LG with 53.3% of advanced cases among them, 98 being subtotal laparoscopic gastrectomies with more than 30 lymph nodes dissected per case, an acceptable morbidity (22.3%) and no mortality in the subtotal gastrectomies (17).

In 2020, the KLASS-2 study was published. This time they analyzed the LDG compared to the ODG regarding locally advanced tumors, with another randomized controlled trial. The goal was the three-year survival rate in 492 patients submitted to LDG and 482 submitted to ODG. The laparoscopy group presented fewer early complications (15.7% × 23.4%, P=0.0027), as well as fewer late complications (4.7% × 9.5%, P=0.0038). The 3-year disease-free survival was 80.3% in the LDG and 81.3% in the ODG (P=0.726). They concluded that LDG can be a standard surgery for locally advanced gastric cancer (18).

### RDG

Although robotic surgery has been used more frequently since 2005, after 2010 the studies started to be more frequent and more consistent. There was evidence that after the first cases, robotic surgery presented the same results as laparoscopic surgery. The learning curve comparing the first 100 cases of robotic surgery with 282 cases of laparoscopic surgery, revealed that the surgical time, which in the beginning was longer in robotic operations, was equal after the first 20 cases. The blood loss was always lower in the robotic access and the complication rates were the same, even in the initial periods (19).

The RG had the same efficacy as the open or laparoscopic gastrectomies, with a good number of dissected lymph nodes—40, with the same morbidity and mortality, with higher costs, but at that time the long-term studies were not yet available (20,21). For the robotic procedures, An *et al.* in Korea showed that after 25 gastrectomies the surgeons reached a plateau, indicating that the learning curve was already finished. In the initial cases the duration of the gastrectomy was 420.8 minutes and for the later cases, it was 281.7 minutes (P<0.001). The console time was 247.1 minutes for the early cases and 168.6 minutes for the later cases (P<0.001) (22). Also in Korea, a 7-year experience with 232 RDG revealed that there was a tendency towards

longer operations using the robotic access, compared to 809 LDGs, even after 5 years of experience. When they compared the morbidity, it was not different, suggesting that the RDG may not surpass the LDG, even after experience acquired over the years (23).

In 2017, Tokunaga *et al.* showed that the RG was two times more expensive and did not show oncologic advantages (24). In a meta-analysis Liao *et al.* analyzed 3,410 gastric cancer patients, comparing long-term oncologic outcomes between laparoscopic and robotic gastrectomies, and did not find significant differences in the overall survival, disease-free survival, recurrence-free survival and recurrence rate. The length of the hospital stay, complication rate, 30-day mortality rates and rate of conversion to open surgery were comparable in the two techniques (25).

Obama *et al.* analyzed retrospectively through a propensity-scored matched cohort, 311 cases of RG, compared to 311 LGs, among which were 229 RDGs and 233 LDGs. The 5-year survival and free-disease survival rates were the same, as well as the pattern of recurrence, showing that the RG can be used safely (26).

### Future perspectives

Nowadays, the evidence shows that the LADG and RADG can be performed safely, from the oncologic point of view, nevertheless, the problem of the costs of robotic systems has yet to be solved.

The most critical problem to be immediately solved in the robotic surgery is the cost. We believe that with the fall of the patent and the diversification of the industries fabricating new devices, the cost will be lower than today. Besides the comfort to the surgeon, the theoretical advantages of the robotic surgery over the laparoscopic surgery are still lacking reliable evidence. We think that the lack of tactical perception is a problem to be solved in the future.

In this scenario, we believe that the three methods, open, laparoscopic and RG will still be used for a long time, depending on the financial and technologic possibilities of the service where the surgery is being performed. In developing countries, RG will only be performed at reference centers.

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