



Ultrasonically Activated Shears in Extended Lymphadenectomy for Gastric Cancer

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Abstract. Gastrectomy, followed by extended lymphadenectomy, is the treatment of choice in some stages of advanced gastric cancer. Lymphorrhea, as a result of the many divided lymphatic vessels, increases the morbidity. Ultrasonically activated coagulated shears (UACS) may divide all small vessels followed by immediate sealing of the coapted vessel walls. We designed a prospective randomized study to determine the effectiveness of the UACS versus monopolar electrosurgery in D2 dissection. Forty patients with gastric cancer stage II or stage IIIA were enrolled and randomized into 2 groups of 20 patients each. Group A underwent lymphatic dissection with monopolar cautery. Group B underwent lymphatic dissection with UACS. Subhepatic and left sudiaphragmatic closed drains were left until lymphorrhea and/or oozing stopped. Total gastrectomy was performed in 16 patients of group A and 14 of group B; subtotal gastrectomy was performed in 4 patients in group A and 6 patients in group B. The drains were removed after 6–17 days (mean 9.7 ± 2.9) in group A and after 4–8 days (mean 5.6 ± 1.2) in group B ($p < 0.001$). The total amount of drained fluid was 300–2050 ml (mean 985 ± 602) in group A and 230–1080 ml (mean 480 ± 242) in group B ($p < 0.002$). Eight patients in group A and 5 in group B had postoperative fever, while 3 and 1 patients, respectively, had wound infections. In conclusion the use of UACS is a safe method of lymphatic dissection which reduces operative blood loss, postoperative lymphorrhea, blood transfusions, and hospital stay.

Gastrectomy total or subtotal followed by extended lymphadenectomy or D2 dissection markedly improves long-term survival in patients with stage II and stage IIIA gastric cancer [1, 2]. In several prospective randomized studies, D2 dissection was associated with increased postsurgical morbidity and mortality rates [3, 4]. A significant part of the morbidity is the prolonged postoperative retention of intraabdominal fluid (lymphorrhea) [5], while the lymphatic dissection itself may have an adverse effect on prognosis, because of local tumor spillage from the many divided lymphatic vessels [6].

Ultrasonically activated coagulating shears (UACS) have been shown to be a safe alternative to electrosurgery [7–9]. This device

mechanically denatures protein by disruption of hydrogen bonds within the protein structure. This disorganized protein forms a sticky coagulum that coapts the vessel walls, not only of the blood vessels but of narrow bile vessels as well [7]. This finding led us to a hypothesis that UACS may coapt and obstruct the lymphatic vessels, avoiding lymphorrhea and tumor spillage.

We designed a prospective randomized study to determine the effectiveness of the UACS versus monopolar electrosurgery in D2 dissection for stage II and stage IIIA gastric cancer.

Patients and Methods

In 1997 and 1998, 40 patients who qualified for elective total or subtotal gastrectomy with D2 dissection for gastric cancer stage II or stage IIIA were randomized to participate in a trial comparing two surgical techniques for cutting and coagulating. In group A ($n = 20$) monopolar electrosurgery was used for cutting and coagulation and hemoclips or ligations to obstruct the blood vessels. In group B ($n = 20$) UACS of 10 mm in diameter (ultracision harmonic shears, Ethicon Endosurgery Inc., Smithfield, RI, USA) was used in all steps of the dissection, while hemoclips or ligations were applied only in blood vessels more than 3 mm in diameter. Informed consent was obtained from all patients, according to the principles of the ethical committee of the G. Hatzikosta General Hospital, Ioannina, Greece.

All patients were treated preoperatively by TPN infusion for 6 days (40 calories per kg of body weight per day) and anemia repair, when it was necessary. In cases of pyloric stenosis a nasogastric tube was placed during the TPN infusion, otherwise the nasogastric tube was placed the day before surgery. At the induction of anesthesia a single dose of 2 gr of ceftriaxone was intravenously administered.

All procedures were performed by a single operating team. A subtotal gastrectomy was performed in carcinomas pT1-2 located in the distal third of the stomach. In all other patients a total gastrectomy was performed. The spleen was resected in carcinomas of the cardia, fundus, and upper part of the corpus, while distal pancreatectomy was not performed in the present study. An en bloc resection of the stomach with lymph node dissection of

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Table 1. Demographic data and preoperative clinicopathologic features.

Data	Group A (mean \pm SD)	Group B (mean \pm SD)
Age (years)	62 \pm 9	59 \pm 10
Men/women	16/4	15/5
Weight (kg)	61 \pm 5	62 \pm 6
Height (cm)	162 \pm 9	163 \pm 7
Body weight loss (%)	3.9 \pm 1.8	3.7 \pm 1.6
Serum total protein (g/L)	6.4 \pm 1.2	6.6 \pm 1.4
Serum albumin (g/L)	3.9 \pm 0.9	4.1 \pm 0.8

compartments I and II was performed in all cases as previously described [10, 11]. The extent of the lymphadenectomy was evaluated by the pathologist by a careful count of the removed lymph nodes.

Subhepatic closed drainage was left until intraabdominal fluid stopped. A second closed drainage was left in the splenic bed in cases of splenectomy. In cases of total gastrectomy, a feeding needle jejunostomy was performed for infusion of commercial liquid foods between the 1st and 8th postoperative days.

We determined the daily amount of drained fluid, the number of units of blood transfusions, and the frequency of major complications. Statistical analysis of the data was performed with SPSS. Values represent the mean \pm SD, and *t*-test and chi-square analysis were used. Significance was defined as *p* < 0.05.

Results

Four patients were excluded from the study because the operative stage was different than the preoperative one; 3 were stage IIIB while the last patient was stage IV.

Total gastrectomy was performed in 16 patients in group A (splenectomy in 14) and in 14 in group B (splenectomy in 12); subtotal gastrectomy was performed in 4 and 6 patients, respectively.

The demographic characteristics of the patients are shown in Table 1. The median operating time was 190 minutes in group A and 168 minutes in group B (Table 2). This difference was not statistically significant.

In Table 2 the surgically related events are shown for the two

groups of patients. All the parameters of this table are significantly better in group B than in group A. In Figure 1 the daily amount of abdominal drainage during the first 6 postoperative days is shown. During the first 4 postoperative days, a statistically significant higher fluid amount was drained daily in group A than in group B.

Major postoperative complications—cardiac ischemia (2 patients in group A and 1 in group B) and atelectasis (4 patients in group A and 3 in group B)—were about similar in each group, while in 3 cases of group A and 1 of group B, a wound infection was observed. None of the 40 patients in this study died during the first 30 postoperative days.

Discussion

Surgical resection is the only curative treatment, presently available, for gastric carcinoma, while extended lymphadenectomy or D2 dissection can improve survival [1–3] especially in patients with stage II or stage IIIA disease [1–3, 12]. The operation is based on knowledge of the regional lymphatic drainage of the stomach. In accordance with the basic tenets of oncologic resection for epithelial cancers, surgical treatment requires wide excision of the primary gastric tumor and en bloc removal of the draining lymphatic network, including the regional lymph nodes and the intervening lymphatic vessels [13, 14].

D2 gastric resections are followed by higher morbidity and mortality rates than D1 resections [3, 4]. Although prospective trials indicate that the higher morbidity in the D2 dissection is due not to the extended lymphadenectomy but largely to pancreatic resection and splenectomy [3, 4], the prolonged retention of intraabdominal fluid or lymphorrhea probably originated from the cut end of the retroperitoneal lymphatic vessels [5]. Meticulous ligation of lymphatic vessels may be essential when these nodes are removed [5], but this procedure is of long duration. The use of electrosurgery is a faster procedure than meticulous ligation, but electrosurgery is not effective in lymphatic vessels because the vessel wall is usually not coapted [8].

The UACS uses mechanical energy rather than electrical energy to achieve hemostasis. There is a transducer in the handpiece that vibrates at 55,000 cycles per second (Hz) with a 50–100 micron excursion. The blade couples with tissue and mechanically denatures protein by disruption of hydrogen bonds within the

Table 2. Surgically related events in 2 groups of patients.

Data	Group A (mean \pm SD)	Group B (mean \pm SD)	<i>p</i>
Operative time (minutes)	190 \pm 18 (162–223)	184 \pm 15 (154–205)	NS
Operative blood loss (ml)	580 \pm 198 (250–980)	318 \pm 163 (150–720)	<0.001*
Postoperative abdominal drainage (ml)	985 \pm 602 (300–2050)	480 \pm 242 (230–1080)	<0.002*
Postoperative day drain removed	9.7 \pm 2.9 (6–17)	5.6 \pm 1.2 (4–8)	<0.001*
Number of units transfused	1.95 \pm 1.87 (0–4)	0.7 \pm 0.9 (0–2)	<0.01*
Number of patients transfused	11	7	>0.1**
Postoperative hospital stay	12.5 \pm 5.5 (12–20)	9.3 \pm 4.3 (10–14)	<0.05*

**t*-test.

** χ^2 test.

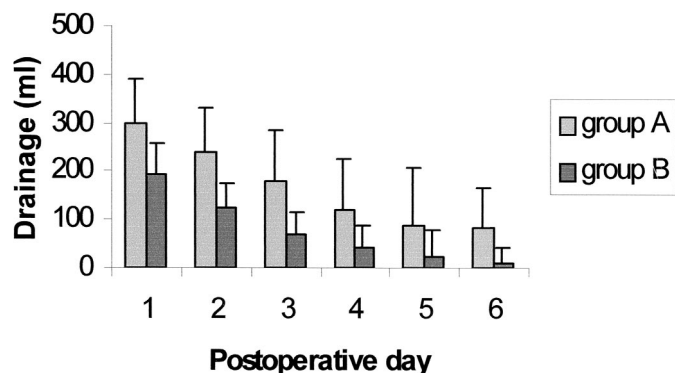


Fig. 1. Schematic representation of the daily mean \pm standard deviation of the abdominal drained fluid during the first 6 postoperative days. A statistically significant higher fluid amount was drained daily in group A than in group B during the first 4 postoperative days. During postoperative days 5 and 6 the amount of drained fluid was higher in group A but statistical analysis was impossible because the number of remaining drained patients was small.

protein structure. This disorganized protein forms a sticky coagulum that coopts the vessel walls. Thus, UACS could safely obstruct not only the blood vessels but the narrow accessory bile ducts as well [7].

In the present study the use of UACS in D2 gastric resection for stage II or stage IIIA gastric cancer led to significant decrease of blood loss and drained fluid from the dissection areas compared with electrosurgery dissection. These events led to earlier postoperative drain removal, fewer blood transfusions, and shorter postoperative hospital stay. We believe that the better hemostasis and the coaptation of the lymphatic vessel walls are the beneficial mechanisms that result from use of UACS instead of electrosurgery. The significance of this report, in addition to the shorter postoperative hospital stay and the lesser quantity of postoperative fluid discharge through drains, is the decrease of blood transfusions in patients where UACS was used. There are some indications that perioperative homologous blood transfusion may be a significant risk factor in the recurrence or progression of gastrointestinal cancer [15]. Thus, the use of UACS, by reducing transfusions, may prevent an increased risk of bad prognosis.

In conclusion, the use of UACS in total or subtotal gastrectomy followed by extended lymphadenectomy or D2 dissection is a safe method which reduces the operative blood loss and the postoperative lymphorrhea, leading to decreased blood transfusion and hospital stay.

Résumé. La gastrectomie, suivie d'un curage ganglionnaire étendu, est le traitement de choix dans certains cas de cancer gastrique évolués. La lymphorrhée, résultant de la division de petits vaisseaux lymphatiques, augmente cette morbidité. Les appareils de coagulation activés ultrasoniquement (UACS) permettent de diviser ses petits vaisseaux et d'assurer la fermeture hermétique des parois vasculaires divisées. Nous avons initié une étude prospective randomisée pour déterminer l'efficacité de l'UACS comparée à l'électrochirurgie monopolaire dans la dissection D2. Quarante patients porteurs d'un cancer gastrique stades II ou IIIA ont été inclus, en les randomisant dans deux groupes de 20 patients (groupe A: lymphadénectomie avec le bistouri monopolaire; groupe B: lymphadénectomie avec l'appareil UACS). On a laissé en place des systèmes de drainage sous-hépatique et sous diaphragmatiques à circuit fermé, jusqu'à la fin de la période de lymphorrhée et/ou du suintement. On a réalisé une gastrectomie totale chez 16 patients du

groupe A et chez 14 du groupe B, alors qu'on a réalisé une gastrectomie subtotale dans les groupes A et B, respectivement. On a enlevé les drains après 6–17 jours (moyenne 9.7 ± 2.9) dans le groupe A et après 4–8 jours (moyenne 5.6 ± 1.2) dans le groupe B ($p < 0.001$). La quantité totale de liquide recueilli a été de 300–2050 ml (moyenne 985) dans le groupe A et de 230–1080 ml (moyenne 480) dans le groupe B ($p < 0.002$). Huit et cinq patients dans les groupes A et B, respectivement, ont eu une hyperthermie postopératoire, alors que l'infection pariétale s'est vue chez, respectivement, 3 et 1 patients. En conclusion, l'utilisation de l'appareil UACS est une méthode sûre de dissection des tissus lymphatiques qui réduit les pertes sanguines, la lymphorrhée postopératoire, le besoin de transfusions, et la durée du séjour hospitalier.

Resumen. La gastrectomía combinada con linfadenectomía ampliada es el tratamiento de escogencia en determinados estados del cáncer gástrico. La linforrea, como resultado de la división de los numerosos canales linfáticos, incrementa la morbilidad. Tijeras de coagulación activada por ultrasonido (TAU) pueden seccionar los pequeños canales linfáticos con coagulación inmediata por coaptación de las paredes de los vasos. Hemos diseñado un estudio aleatorizado para determinar la efectividad de las TAU versus la electrocirugía monopolar en la disección D2. Cuarenta pacientes con cáncer gástrico en estados II o IIIA fueron aleatorizados a dos grupos de 20 cada uno. En el grupo A se practicó la disección ganglionar con cauterio monopolar, y en el grupo B se practicó la disección con TAU. Se colocaron drenes cerrados subhepáticos y subdiafragmáticos izquierdos y se mantuvieron hasta el cese de la linforrea. Se practicó gastrectomía total en 16 pacientes del grupo A y en 14 del grupo B, y gastrectomía subtotal en 4 y 6, respectivamente. Los drenes fueron removidos a los 6–17 días (promedio 9.7 ± 2.9) en el grupo A y a los luego de 4–8 días (promedio 5.6 ± 1.2) en el grupo B ($p < 0.001$). El total de líquido drenado osciló entre 300 y 2050 ml (promedio 985 ml en el grupo A) y entre 230 y 1080 ml (promedio 480 ml) en el grupo B ($p > 0.002$). Se registró fiebre postoperatoria en 8 pacientes del grupo A y en 5 del grupo B, y se presentó infección de la herida en 3 y 1 casos, respectivamente. En conclusión el uso de la TAU es un método seguro de disección ganglionar que reduce la pérdida operatoria de sangre, la linforrea postoperatoria, el volumen de transfusiones y la estancia hospitalaria.

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