ORIGINAL ARTICLE

Open versus laparoscopic hepatectomies within an enhanced recovery after surgery program. Are there differences?

Hepatectomía abierta versus laparoscópica dentro de un programa de enhanced recovery after surgery. ¿Hay diferencias?

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Abstract

Background: *Laparoscopic procedures have gained popularity because they favor a faster recovery. In the same way, the establishment of an enhanced recovery after surgery (ERAS) program in major abdominal surgery has shortened the hospital stay. There are several studies that report the results on ERAS programs applied to open or laparoscopic hepatectomies or comparing one of them with the classic approach, but few have compared the results between both within an ERAS program.* **Objective:** *The objective of this study was to compare the results between open and laparoscopic hepatectomies in the same ERAS program.* **Methods:** *Thirty-six patients undergoing hepatectomies were enrolled in this study and were either laparoscopically or open in an identical ERAS program. Hospital stay and the number of complications were taken as primary endpoints.* **Results:** *There were no significant differences between both groups in terms of hospital stay or the number of complications. The differences were in a shorter time of surgery and an earlier ambulation in favor of open surgery and a better full recovery in favor of the laparoscopic approach.* **Conclusions:** *Initial data suggest that there would be no benefits in terms of hospital stay and complication rate of laparoscopic hepatectomies over open ones within an ERAS program.*

Key words: *Open hepatectomies. Laparoscopic hepatectomies. ERAS program.*

Resumen

Antecedentes: *Los procedimientos laparoscópicos ganaron popularidad porque favorecen una recuperación rápida. El establecimiento de programas enhanced recovery after surgery (ERAS) en cirugía mayor abdominal ha acortado la estancia hospitalaria independientemente de la vía de abordaje. Varios trabajos informan los resultados sobre programas ERAS aplicados a hepatectomías abiertas o laparoscópicas, o comparando una de ellas con el abordaje clásico, pero pocos han comparado los resultados entre ambas dentro de un programa ERAS.* **Objetivo:** *Comparar, dentro un mismo programa ERAS, los resultados entre hepatectomías abiertas y laparoscópicas.* **Método:** *Se incorporaron a este estudio 36 pacientes sometidos a hepatectomías que fueron abordados por vía laparoscópica o abierta dentro de un programa ERAS. Los objetivos primarios fueron la estancia hospitalaria y el número de complicaciones.* **Resultados:** *No hubo diferencias significativas entre ambos*

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grupos en cuanto a estancia hospitalaria ni número de complicaciones. Las diferencias radicaron en un menor tiempo de cirugía y una deambulación más precoz a favor de la cirugía abierta, y una recuperación total mejor a favor del abordaje laparoscópico. **Conclusiones:** *Los datos iniciales sugieren que no habría beneficios en cuanto a estancia hospitalaria e índice de complicaciones de las hepatectomías laparoscópicas sobre las abiertas dentro de un programa ERAS.*

Palabras Clave: *Hepatectomía abierta. Hepatectomía laparoscópica. Programa ERAS.*

Introduction

Since the introduction of accelerated recovery programs in colonic surgery by Kehlet and Wilmore[1], and their subsequent application to other surgeries such as pancreatectomies and gastrectomies, the use of these programs has undergone a multiplying effect[2-7].

A decrease in-hospital stay, lower number of complications, and cost reductions are, according to different authors, the most important advantages of an enhanced recovery after surgery (ERAS) program[8-12].

Liver resections were not left out of this trend and, although there are several studies that measure ERAS programs application to hepatectomies, some protocols have differences regarding the measured variables to assess their effectiveness[13].

Most authors agree on highlighting a decrease in hospitalization times, and therefore in hospital costs, with savings of around USD 2000 when compared to usual perioperative management[14]. A decrease in the percentage of complications is another of the claimed advantages, although the literature is quite contradictory on this point[15]. In a previous study that compared open hepatectomies due to colorectal metastases with traditional management versus ERAS, a 50% decrease in-hospital stay was found, but there were no differences regarding the rate of complications or other measured parameters, although this was an initial experience[16].

The minimally-invasive approach is usually mentioned as one of the strong points for the success of an ERAS program in major abdominal surgery[14,17]. There are few publications comparing open versus laparoscopic liver resections within an ERAS program.

The purpose of this communication is to compare the results between open and laparoscopic hepatectomies within an identical ERAS program in two institutions, taking hospital stay and the number of complications as primary endpoints, and protocol adherence, blood loss, ambulation initiation, and functional recovery at discharge as secondary endpoints.

Methods

A cross-sectional, observational, and descriptive study on the application of an ERAS program in open versus laparoscopic hepatectomies carried out in two institutions. One of them (Josep Trueta Hospital, Gerona, Spain) was the provider of the cases operated on by laparoscopy, while others (Tránsito Cáceres de Allende Hospital, Córdoba, Argentina) provided most hepatectomies carried out with an open approach. Laparoscopic surgeries that required conversion to open surgery were included as open hepatectomies in the analysis.

An ERAS program with basic points in the pre-operative, intraoperative, and post-operative periods was agreed on by both teams, and it is described below.

Applied ERAS program

1) Pre-operative period:
   - Complete information on the procedure, its scope, and involvement of the patient in its development.
   - Pre-operative day: diet (since the night before surgery). Intake of carbohydrate-rich fluids until 2 h before surgery.
   - Use of low molecular weight heparin 12 h before surgery
2) Intraoperative period:
   - Fluid therapy control (balance close to zero).
   - Drains (preferably not).
   - Nasogastric tube (removed at the end of surgery).
   - Epidural catheter or intrathecal morphine.
3) Post-operative period:
   - Fluid therapy withdrawal within the first 48 h.
   - Prokinetic agents regulated indication.
   - Start of liquid diet within the first 24 h.
   - Start of regular diet within the first 48 h.
   - Urinary catheter removal within the first 24 h.
   - Early ambulation initiation.

The criteria used to consider total functional recovery were as follows:

- Pain control with oral analgesics.
- No use of intravenous fluids.
- Mobilization to pre-operative level.
- Solid food ingestion.
- Normal serum bilirubin or with decrease toward normality.

Functional recovery was assessed at patient discharge. Adherence to the ERAS program was assessed through a printed checklist where the surgeon marked "yes" or "no" for compliance with each one of the items on the list.

Demographic data, those referring to etiology and hepatectomies, post-operative evolution, and information referring to the ERAS program were assessed. Hepatectomies were recorded according to the Brisbane classification[18], biliary fistulas, according to the International Study Group of Liver Surgery proposal[19], liver failure, according to the 50/50% criterion[20], and complications, according to Dindo-Clavien classification[21]. All patients underwent surgery with controlled central venous pressure decrease, and all had mean blood pressure measured. Antithrombotic prophylaxis with low molecular weight heparin associated with lower limb bandaging was used in all patients, as well as antibiotic prophylaxis. Intraoperative ultrasound was performed on all patients.

Statistical analysis

Categorical variables are described using proportions, symmetric continuous variables, with the mean and standard deviation, and asymmetric continuous variables, with medians and ranges.

The Chi-square test was used to compare between-group proportions, and Fisher's exact test when appropriate. For between-group mean comparisons, the Mann–Whitney U-test was used, which was considered more appropriate than Student's t-test due to the reduced sample size. In all cases, a bilateral alpha error < 5% was considered significant.

Data were analyzed with the PASW 18 software.

Results

Thirty-six patients were included in the study, out of which 20 were initially openly approached and 16 with laparoscopy, but one of them was converted (6.25%) and incorporated to the open hepatectomy group, with final distribution being 21 patients in the open approach group and 15 in the minimally-invasive approach group.

Table 1. Demographic data

Variable	Open surgery (n = 21)	Laparoscopic surgery (n = 15)	p
Male gender	66.7%	93.3%	0.104
Mean age ± SD (years)	58.1 ± 11.1	59.9 ± 13.5	0.810
ASA 2	23.8%	13.3%	0.674
ASA 3	76.2%	86.7%	
Alcohol consumption	4.8%	6.7%	1.000
Smoking	33.3%	26.7%	0.729
BMI (kg/m^2)	26.9	27.3	0.961
Physical exercise	28.6%	13.3%	0.424

BMI: Body mass index; SD: Standard deviation.

Table 1 shows patient demographic data. There were no differences in terms of gender, age, operative risk, body mass index, etc., distribution.

Hepatectomy indications were mostly due to metastases of colorectal origin (15 in the open approach group and 10 in the laparoscopic approach group), and most were limited resections. Table 2 shows the hepatectomy results; regarding surgical time, there was a statistically significant difference in favor of the open technique. Another variable in which, although no significant difference was obtained, there was a significant number of cases in the open technique group, was simultaneous resections: nine (42.8%) versus one (6.6%).

On the other hand, in patients who underwent open surgery, the placement of drains was used to a greater extent (6 vs. 1). Hospital stay with and without readmission did not show differences between both groups, as complications also did (3 vs. 2 and 14.3 vs. 13.3%); patients who underwent open surgery had type I complications, while those who underwent the laparoscopic approach had more serious complications (type III). There was no mortality.

Table 3 shows the results of ERAS program application, where the outstanding data are prompter ambulation in patients who underwent open surgery (12.8 vs. 26.5 h; p = 0.000) and greater functional recovery in favor of the laparoscopic approach (61.9 vs. 100%; p = 0.011). There were no significant differences in the remaining measured variables, although the duration of drains permanence was much shorter in the open surgery group (30 vs. 120 h).

Table 2. Hepatectomy data

Variable	Open surgery (n = 21)	Laparoscopic surgery (n = 15)	p
Major hepatectomy	1 (4.76%)	2 (13.3%)	0.559
Simultaneous resection	9 (42.8%)	1 (6.6%)	0.054
Mean surgical time (min)	150	297.5	0.001
Blood loss > 300 mL	42.9%	46.7%	0.821
Complications	3 (14.3%)	2 (13.3%)	1.000
Drain placement	6 (28.7%)	1 (6.6%)	0.200
Hospital stay without readmission (mean, days)	3.86	3.93	0.696
Hospital stay with readmission (mean, days)	4.10	5.00	0.841

Table 3. ERAS program data

Variable	Open surgery (n = 21)	Laparoscopic surgery (n = 15)	p
100% adherence	13 (61.9%)	9 (60%)	1.000
Ambulation initiation	12.79 h	26.5 h	0.000
Urinary catheter withdrawal time	25.7 h	29.6 h	0.120
Drain withdrawal time	30 h	120 h	0.114
Fluid therapy withdrawal time	35.3 h	34.53 h	0.935
Functional recovery	13 (61.9%)	15 (100%)	0.011
Hospital readmission	2 (9.5%)	2 (13.3%)	1.000

Discussion

The application of an ERAS program in the major colon and rectal surgery has shown benefits for patients and has favored its application to other organs. The use of ERAS programs in liver surgery has been increasingly implemented, with most works consistently observing a decrease in-hospital stay and, therefore, in costs[22,23].

There are few studies where ERAS programs application is compared between open and laparoscopic hepatectomy. The minimally-invasive approach has been considered one of the strong points to achieve a faster and higher-quality recovery, in comparison with open surgery, in patients undergoing liver surgery[17,24-29]. The studies refer to a clear improvement in terms of hospital stay, decreased complications, and less blood loss, with a consequent decrease in transfusion requirements, in comparison with the open technique. They also state that there is a decrease in post-operative ileus time. Croome and Yamashita[28] conclude that laparoscopically-operated patients start food ingestion earlier and require less intravenous analgesia. These studies were carried out outside ERAS protocols,[24-29] and our study aims at answering whether there are differences between both techniques within an ERAS program.

For this study, a program was agreed between both institutions, considering some of the points with the highest level of evidence and recommendation suggested by the ERAS Society[17].

From the comparison of both groups, and considering the purposes of the work, we noticed that hospital stay with and without readmissions was similar. Hospital stay without readmissions was 3.86 days for patients operated on with the open technique and 3.93 days for the laparoscopic approach (p = 0.696), while when hospitalization days were added, hospital stay was 4.10 and 5.00 days, respectively (p = 0.841). Literature-reported hospital stay ranges between 3 and 7 days[30-34]. In all series, a significant decrease of several days is reported in comparison with conventional management, which has a direct impact on the costs of this type of surgery[14].

As for complications, there were also no significant differences between both groups (p = 1.000). Mean complications were 14.3% for open hepatectomies and 13.3% for laparoscopic interventions. Complications in the open surgery group were less severe than those in the laparoscopic group (Dindo-Clavien type I vs. type III, respectively), which required minimally-invasive

procedures for resolution. The percentage referred to in the literature is higher and is around 30% in most series[32,33]. On the other hand, Stoot et al.[34] report only two complications in 13 laparoscopic hepatectomies (15.4%). It is likely that the reason for our low percentage of complications lies mainly in the fact that the number of major hepatectomies in both groups is small (open 4.76% and laparoscopic 13.3%), which would agree with some authors who have reported differences in the number of complications and length of stay when major and minor hepatectomies were compared[31].

Adherence to the entire protocol was achieved in 61.9% of patients with open surgery and 60% of patients with laparoscopic surgery (p = 1.000). The main difficulties for compliance were seen mainly post-operatively at ambulation initiation in patients undergoing laparoscopic surgery (26.5 h), while in open surgery, ambulation initiation was earlier (mean: 12.79 h; p = 0.000). This difference might be explained by two reasons: one, that perhaps, the use of pneumoperitoneum is a factor to be taken into account, and the other, that it is probably justified because the operative act duration was longer in laparoscopic surgery than in the open approach (297 vs. 150 min; p = 0.001). On the other hand, we agree with some authors that the more complete and better understood initial information received by the patient, and the greater the commitment the patient assumes, the higher the adherence to protocols will be[35].

Some authors[36] report that within the first 24 h, they indicate the patient to remain seated in bed or on a chair, and after this time, to start ambulation. This is a decision that is made individually according to the perception of the surgeon and patient characteristics.

Regarding blood losses, there were no significant differences (p = 0.821) between both groups; in both, more than 50% had losses of < 300 mL. Some authors[34] report that laparoscopic surgery significantly decreases blood losses in comparison with traditional care.

Total functional recovery at discharge had differences in favor of laparoscopic surgery (p = 0.011): it was achieved by 13 patients (61.9%) of the open surgery group and 15 (100%) of the laparoscopic surgery group. The difference in this factor was that, in the open surgery group, post-operative pain control at discharge was less satisfactory. It is likely that, just like the performance of pneumoperitoneum and longer surgical time delayed ambulation in the group of patients operated on with laparoscopy, its minimally-invasive characteristics may have favored better pain control at discharge. Another important point that might explain this difference is that, in the group of patients operated on with laparotomy, there were nine who underwent colonic resection simultaneously, while in the group with laparoscopic approach, only one simultaneous resection was associated (p = 0.054). Wong Lun Hing et al.[30] refer that most of their patients achieved full functional recovery on the 5th post-operative day. The difference of nearly 1 day of hospital stay between open and laparoscopic surgery in our series could also be another way to understand the differences between both approaches at this point.

As for other compared parameters, more drains were placed in open than in laparoscopic surgery (6-28.5 vs. 1-6.6%); the choice of intra-abdominal drains placement was left to the surgeon's judgment. It is important emphasizing again that, on the one hand, in the open surgery group, there was a higher number of simultaneous resections, and on the other, that in the laparoscopic surgery group, complications belonged to Dindo-Claven type III and consisted of intra-abdominal collections that required the placement of percutaneous drains. Some authors report 20% of drain placement with the open technique[13]. We agree with most authors that, in many patients, the placement of drains in hepatectomy is unnecessary[37]; perhaps, it would be convenient to standardize in which patient drains should be left. Some authors found that, in patients with hepatectomies lasting more than 350 min, with blood loss higher than 650 ml, or with bile leak during surgery, drains should be placed[38].

Conclusions

We can claim that in our series of patients, there were no differences in terms of days of stay or number of complications that there is indeed a reduction in hospitalization days when compared to traditional management that our study is a small sample and that a larger number of patients is required that the number of major hepatectomies is low and that, as we incorporate more, the results may vary; and finally, that initial information to the patient is essential for being able to carry out an ERAS program in any liver surgery unit.

Conflicts of interest

The authors have no conflicts of interests and neither have they received any funding to carry out this work.

Ethical disclosure

Protection of people and animals. The authors declare that the procedures followed adhered to the ethical standards of the responsible human experimentation committee and were in accordance with the World Medical Association and the Declaration of Helsinki.

Confidentiality of data. The authors declare that they have followed the protocols of their work center on the publication of patient data.

Right to privacy and informed consent. The authors declare that no patient data appear in this article.

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