

Laparoscopic versus Intraoperative Ultrasound in the Diagnostic of Liver Tumors

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Abstract

Introduction: Intraoperative ultrasound has become the gold standard complementary study to surgical decision making in liver surgery. In this review are analyze different variables to identified if laparoscopy ultrasound findings are equal or better than intraoperative ultrasound.

Methods: A literature search was performed using Medline and Highwire Press data base. The following search terms were use: "laparoscopic ultrasonography", "intraoperative ultrasonography" and "liver tumors". 447 citations found in total. Criteria for selection of literature were number of cases (excluded if less than 20), Ultrasonography studies IOU and LU of different types of tumors: neuroendocrine, HCC and colon metastasis were included, and method of analysis (statistical or nonstatistical).

Results: The variables analyze in the studies selected were as follows: Method of patients selection, operative technique, operating time, irresectability, postoperative morbidity, number of new tumors missed by IOU or LIOU, surgical plan changed after IOU or LIUO and Hospital stay. Patient's selection was based in patient having any type of liver tumor. Operative technique was performed in cases of IOU by conventional laparotomy, and in laparoscopy cases were use mainly 2 subcostal ports and the umbilical port. Operating time was estimated surgical prolongation of 30 minutes in the laparoscopy cases. Morbidity was lower in LIOU cases than in IOU. Lesions missed by LIOU and IOU, both methods showed a higher sensitivity in finding small lesions than other complementary diagnostic studies. Hospital stay was considerable shorter in LIOU.

Conclusions: Laparoscopy ultrasound has demonstrated to be very useful in diagnostic of liver tumor lesions. Therefore, there is big room for the LIOU improved in diagnostic liver tumors. New and improved LIOU probes would very soon allow similar findings than IOU. Targeting laparoscopy to patients at high risk for unresectable disease requires consideration to avoid unnecessary laparotomy.

Aim and objectives: The aim of this study is to compare the effectiveness of laparoscopic ultrasonography (LU) versus the open intraoperative ultrasonography.

The following parameters were evaluated for both IOU and LIOU:

1. Method of patients selection.
2. Operative technique.
3. Operating time.
4. Intraoperative and postoperative complications.
5. Postoperative morbidity.
6. Number of new tumors missed by IOU or LIOU.
7. Surgical plan changed after IOU or LIUO.
8. Hospital stay.

Material and methods: A literature search was performed using Medline and Highwire Press data base. The following search terms were use: "laparoscopic ultrasonography", "intraoperative ultrasonography" and "liver tumors". 447 citations found in total. Selected papers were screened for further references. Criteria for selection of literature were number of cases (excluded if less than 20), Ultrasonography studies IOU and LU of different types of tumors: Neuroendocrine, HCC and colon metastasis were included, and method of analysis (statistical or nonstatistical).

Keywords: Laparoscopic ultrasound, diagnostic laparoscopy, laparoscopic tumor resection, laparoscopy for cancers.

INTRODUCTION

Intraoperative ultrasonography (IOU) has become the gold standard tool in liver surgery. Patients diagnosed with colon cancer approximately one fifth have occult metastases at the time of the presentation. It has been demonstrated the sensibility of IOU in diagnosed liver tumors is high. IOU in combination with other radiological studies prior the surgery improved the diagnosed of the liver lesions. Nowadays IOU is use to perform tumor staging, metastatic survey, and guidance for whole organ

or split liver and metastasectomy, metastatic survey, intrahepatic biliary tree and vascular structures evaluation. Laparoscopy ultrasound is not always available as it is the IOU probes because not all the ultrasound scanners have adequate their probes to use in laparoscopy. Since it became available, some centers started to switch form the IOU to laparoscopy ultrasonography. The development of dedicated linear array probes improve the feasibility to have a good image and better contact with the liver surface. Before, transluminal probes were used through

laparoscopic probes making the procedure very cumbersome and had bad image quality of 1.4 cm depth.¹

A good laparoscopy probe might have less than 10 mm to be able to introduce in a 10 mm laparoscopy port. Ideally, the length of the probe should be 35-50 cm to access adequately the abdominal cavity. The IOU probes generally come in 5-10 MHz. Actually majority of this LS probes come in 5-10 MHz as it is in IOU. The 5-10 MHz probes allow a penetration depth of 4-10 cm. And the LS come with a flexible tip to maximize its capability to scan difficult angles of abdominal organs.

Regarding the technique of the IOU is use the regular bilateral subcostal approach used for liver surgery. The most common technique of laparoscopy approach describe in SAGES guidelines is one trocar placed periumbilically with other trocar subcostally and a last one placed xyphoid or under the left costal margin at the level of the midaxillary line and the anterior axillary line.¹

CONTENT

The papers reviews mostly look at the feasibility of increased diagnosed by laparoscopy ultrasonography. It is well known the need of intraoperative ultrasound diagnosis in liver surgery. Then we show here the information collected.

NUMBER OF PATIENTS INVOLVED IN THE STUDIES

A total number 2580 patients are analyze in this review.²⁻²¹ 946 out of 1290 with different types of tumors received as a complementary diagnostic ultrasound laparoscopy. And total number of 1290 patients received as a complementary diagnostic ultrasound with conventional laparotomy. All this studies were performed in patients with colorectal cancer, primary HCC and endocrine tumors.

OPERATIVE TECHNIQUE

IOU was perform in all of the cases through conventional laparotomy. LIOU approach was carried out under general anesthesia CO₂ pneumoperitoneum was induced by using a standard open technique or a Veress needle. Access to the abdominal cavity was obtained by three 10 or 11 mm trocars (umbilical and left and right subcostal). Laparoscopic examination was complete if anterior and posterior surfaces of the right and left hepatic lobes, the gastrohepatic omentum, porta hepatis, pelvis, and peritoneal cavity were well-visualized. If feasible, adhesions were taken down laparoscopically.^{6,7}

NUMBER OF NEW TUMORS MISSED BY IOU OR LIOU

Although IOU had the highest sensitivity for the detection of HCC lesions, it could not visualize all of the primary tumors in 14 cases (2.6%) in Dr Zhang study of 430 cases. The non-

identifiable lesions were 10 at the primary hepatectomy and 4 at the second hepatectomy. The lesions missed by IOU were very small, all of them less than 10 mm. Three small lesions out of 10 were positive on lipidol CT.⁴ When it compares the LIOU with CT, LIOU showed more sensitivity than CT in finding lesions between 0.3 to 2.4 cm. But we can not conclude out of these findings that LIOU is better than IOU because there is more data need. Actually, it should be more difficult accessing some liver segments due to the shape of the LIOU.²²

IRRESECTABILITY

One of the biggest advantage of minimal access surgery in terminal patients or patients that do not meet the conditions to received the benefit of tumor resection, is the feasibility to overcome faster the surgical procedure and follow other alternative treatment, like chemotherapy, alcohol injection, chemoembolization or radiofrequency ablation.

The benefit to the patient with unresectable liver disease is clearly address in several papers, as it is the sensitivity to find small tumors, and give an early opportunity to the patient feasible to go under liver resection.

A total of 232 patients in the group of LIOU from 7 studies look to the data and refine diagnosed of irresectability. All this patients had complementary studies, CT, transabdominal ultrasound and MRI. The irresectability of the tumor or tumors was found in LIOU. Therefore, when this finding is done with IOU, means for the patient an unnecessary laparotomy with a larger probability of morbidity, larger length of hospital stay and delay in palliative treatment. 268 patients in enroll in 6 studies had tumor irresectability after IOU. Majority of the studies of IOU compares the IOU with other complementary studies, and did not take in account this important variable of irresectability.

SURGICAL PLAN CHANGED

Ninety-six patients out of 1290 that underwent LIOU, the previous surgical plan were changed to another one in term of liver resection. The fact is only 2 papers were looking to this variable out of 8 papers in the group of LIOU and 4 papers out of 8 in the IOU group.^{4,19-21} In the group of IOU 72 patients, the surgical decision making was changed after different tumor findings. This variable we are included the patients when this variable was included in the study by the authors. Data of irresectability is not included here, but could also be here in terms of modification in decision making and surgical plan changed. It would increase the numbers of patients and it has a clear diagnostic impact in the clinical setting.

SURGICAL TIME

This variable was address in only 2 papers, one of this compare IOU time with LIOU. In this comparison time consuming of LIOU was just 30 minutes prolonged conventional laparotomy. Other paper does not compare but give us their time in LIOU which is 58 ± 19 minutes.⁶

MORBIDITY

Three papers out of 8 analyze the morbidity of LIOU. Then numbers in each paper describe only minor complications after LIOU. MD Angelica describes in his data 27% of morbidity after IOU. The same author claim to have only 9% of morbidity in the cases performs by LIOU. There is significant difference in morbidity in MD' Angelica study that compares the advantage of LIOU vs IOU.¹⁶

HOSPITAL STAY

Hospital stay was much shorter in LIOU. Average stay was 2 days. The longest stay in patients who underwent LIOU was 5 days. The median hospital stay describe by Dr Lai in the of the laparoscopic treatment group was significantly shorter than for the open treatment group for patients with unresectable HCC (5 vs 7 d; P = 0.003).³ Other authors in the LIOU report a range of 1.3-1.5 median hospital stay days. If we compare the standard stay of 8 days after IOU perform through a conventional laparotomy approach. There is a remarkable advantage when we analyze the hospital stay between these two procedures.

DISCUSSION

The liver primary and secondary tumors treatment have changed toward a more aggressive approach. Indications for metastasis resection are treated more aggressively and it surgical approach is perform by local or segmental resection for multiple lesions and bilobar disease. Definitely, a better definition of liver anatomy and the skill evolved in the use of IOUS has led to a much more safe and practical approach of these lesions.⁶

Small liver metastasis about 1 cm can be find with Intraoperative US (IOUS), for that reason is considered the gold standard, it has a sensitivity of 80% for evaluating this small liver lesions.¹⁷

LIOU was able to identify 55% of patients with unresectable disease, suggesting that there is much room for improvement.⁴ The difficult recognize as an advantage of IOU over LIUO is the possibility to identify vascular invasion and invaded lymph nodes. Clearly, if staging laparoscopy for hepatobiliary malignancy is to be improved, efforts must be directed at better identifying vascular invasion and metastatic disease in lymph nodes. The grade of vascular invasion is difficult to establish by image studies and in particular cases only are possible to find in the pathological specimen. Because of vascular invasion is a difficult issue, most of the patients do not have encasement of vessels on imaging studies or laparoscopy, but rather have only a suggestion of vessel contact, which can often be assessed only at operation. Lymph node metastasis requires persistence at finding and requires some level of advanced laparoscopic skills and could probably require additional operative time.⁴ Unresectable disease was defined as presence of histological proven extrahepatic metastases; severe cirrhosis of the proposed liver remnant, precluding resection; or extensive

disease without the possibility of leaving a sufficient liver remnant, precluding radical resection.⁶

There are some issues that are very important do discuss here. First, any surgeon performing IOU has to be experience in transabdominal ultrasonography and have some basic knowledge in ultrasonography. Second, the surgeon has to be familiarized with the available probes for the ultrasound scanner, the ones use for transabdominal, intraoperative and laparoscopy. Third, the experience is very important because each different probe offers a different image and sometime area and image varies depending on how the ultrasound crystals are aligning in the probe. There are new probes coming to market-offering improvements with working channels and biopsy needle guide. Other characteristics have to be analyze, for example echogenicity of the lever metastasis. But for sure it would take a longer time and experience to raised consistent conclusions. Many authors agreed that IOU sensitivity might be good for small lesions with different textures.⁸

Limitation of the LIUO that require converting the patient to open surgery, were cases with multiple adhesions due to previous surgeries. SMM Castro report in his study five patients (13%) from the LIOU group could not be performed because of adhesions from previous surgery.⁶

CONCLUSION

Laparoscopy ultrasound has demonstrated to be very useful in diagnostic of liver tumor lesions. Therefore, there is big room for the LIOU improved in diagnostic liver tumors. New and improved LIOU probes would very soon allow similar findings than IOU. Targeting laparoscopy to patients at high risk for unresectable disease requires consideration to avoid unnecessary laparotomy.

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