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EARLY RESULTS OF LIVER RESECTION USING LAPAROSCOPIC TECHNIQUE

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The aim of the study was to present early outcomes of liver resection using laparoscopic technique.
Material and methods. Retrospective analysis of patients who underwent liver resection using laparoscopic method was conducted. The analyzed group included 23 patients (11 women and 12 men). An average patient age was 61.3 years (37 – 83 years). Metastases of the colorectal cancer to the liver were the cause for qualification to the procedure of 15 patients, metastasis of breast cancer in 1 patient and primary liver malignancy in 5 patients. The other 2 patients were qualified to the liver resection to widen the surgical margins due to gall-bladder cancer diagnosed in the pathological assessment of the specimen resected during laparoscopic cholecystectomy, initially performed for other than oncology indications.
Results. Hemihepatectomy was performed in 11 patients (9 right and 2 left), while the other 12 patients underwent minor resection procedures (5 metastasectomies, 4 nonanatomical liver resections, 1 bisegmentectomy, 2 resections of the gall-bladder fossa). An average duration of the surgical procedure was 275 minutes 65 – 600). An average size of the resected tumors was 28 mm (7 – 55 mm). In three cases conversion to laparotomy occurred, caused by excessive bleeding from the liver parenchyma. Postoperative complications were found in 4 patients (17.4%). Median hospitalization duration was 6 days (2 – 130 days). One patient (4.3%) was rehospitalized due to subhepatic abscess and required reoperation. Histopathology assessment confirmed radical resection (R0) in all patients in our group.
Conclusion. Laparoscopic liver resections seem to be an interesting alternative in the treatment of focal lesions in the liver.
Key words: laparoscopy, liver resection, liver metastases

Surgical procedures of the liver are technically demanding procedures that require significant experience from the operator (1, 2, 3) and are usually associated with high risk of postoperative complications (4). Due to their extensiveness and duration, they are a significant trauma for the patient. Introduction of minimally invasive techniques to routine surgical practice was one of the methods of its reduction. First laparoscopic liver resection was performed in 1993 by Gagner (5). Despite the fact that more than 20 years have elapsed since this time and laparoscopic liver resections are gaining more and more supporters, they are still uncommon procedures. Currently they are predominantly performed at dedicated liver surgery centers. Initially laparoscopy was used to treat small masses and non-malignant masses with convenient location. With rapid development of this technique, laparoscopic liver resection started to be used for the treatment of primary and secondary malignant liver lesions (6).

The aim of the study is to present early results of treatment of liver tumors using laparoscopic technique.

MATERIAL AND METHODS

Retrospective analysis of patients who underwent liver resection using laparoscopic method between October 2013 and December 2015 was conducted. Patients with primary and metastatic liver tumors were qualified to minimally invasive procedures in whom preoperative imaging investigations demonstrated potential respectability and ruled out metastatic tumor. Before the surgical procedure all patients underwent contrast enhanced computed tomography of abdominal cavity with subsequent 3D reconstruction and/or magnetic resonance imaging of abdominal cavity, which were used to confirm lesion location in the liver. Furthermore, PET imaging was used to rule out metastatic disease. Based on preoperative imaging investigation, extent of the surgical procedure was established. Early treatment outcomes, such as: procedure duration, blood loss, number of conversions to open procedure, number and nature of postoperative complications, course and duration of hospitalization after the procedure, were analyzed.

The analyzed group included 23 patients (11 women and 12 men). An average patient age was 61.3 years (37 – 83 years). An average body mass index (BM) was 28.07 kg/m^2 (19.72 – 42.218 kg/m^2). All patients from the study group were classified as group A according to Child-Pugh classification.

Metastases of the colorectal cancer to the liver were the cause for qualification to the procedure of 15 patients, metastasis of breast cancer in 1 patient and primary liver malignancy in 5 patients. The other 2 patients were qualified to the liver resection to widen the surgical margins due to gallbladder cancer diagnosed in the pathological assessment of the specimen resected during laparoscopic cholecystectomy, initially performed for other than oncology indications. Table 1 presents characteristics of the study group.

Perioperative care

All patients were admitted to the Department one day before the scheduled surgical procedure. On admission patients were informed in detail of the planned therapy and planned perioperative care. Several minutes before the surgical procedure, each patient received a prophylactic dose of an antibiotic (3rd generation cephalosporin). Restrictive fluid therapy based on crystalloid infusion was provided during the procedure and in the postoperative period. Each patient was mobilized on the day of the surgical procedure (sitting in a bed, placing in a vertical position). Oral fluids were initiated as quickly as possible after the procedure and solid diet within 24 hours of the surgical procedure. The condition of discharge home involved complete mobilization of the patient, complete tolerance of oral food, pain manageable with oral agents and biochemical indices of normal function of the remaining part of the liver.

Surgical technique

After creation of pneumoperitoneum, an optical trocar was inserted (above the umbilicus) and subsequently, under visual guidance, working trocars were inserted to the epigastric space (their number and precise location were dependent on the extent of the resection and location of the tumor). Before the skin incision, sites for trocar insertion were injected with bupivacaine solution.

In the event of extensive organ resections (right and left hemihepatectomy), after the liver has been freed from its ligaments, another stage involved its separation from the inferior vena cava. Subsequently appropriate branch of the hepatic artery, appropriate hepatic duct and appropriate branch of the portal vein were isolated. The branch of the hepatic artery was clipped and sectioned. The appro-

Table 1. Characteristics of the study group

Age	61,3 (37-83) years
Sex	
women	11 (48%) patients
male	12 (52%) patients
Indications for surgical procedure	
hepatocellular cancer	3 patients
metastasis of the colorectal cancer	15 patients
metastasis of the breast cancer	1 patient
gall-bladder cancer	2 patients
non-malignant masses	2 patients

priate branch of the portal vein was managed with a surgical stapling device.

The hepatic duct was clipped and sectioned or sectioned with a surgical stapling device at subsequent stage of the surgical procedure (after sectioning of the liver parenchyma). The hepatic parenchyma was separated using an ultrasonic aspirator, clipping the vessels and bile ducts. After isolation of appropriate hepatic vein, it was cut with a surgical stapling device.

In the event of less extensive procedures (bisegmentectomy, nonanatomical liver resection), after tumor identification, extent of the resection was established using a coagulating tool. In the event of nonpalpable lesions, the extent of resection was established based on imaging studies (intraoperative ultrasound imaging, tridimensional reconstruction of computed tomography images). Resection was performed by sectioning the liver parenchyma using Olympus Thunderbeat®, while an ultrasonic aspirator was used to resect larger lesions, clipping the blood vessels and bile ducts.

In both types of procedures hemostasis was achieved using coagulation. The removed material in a latex cover was removed through minilaparotomy. A drain was left in the cavity after the removed liver fragment. Wounds after the trocars were closed with sutures. At the end of the procedure transversus abdominis plane block (Tap-block) was performed.

RESULTS

Characteristics of the lesions, their location and extent of the resection is presented in tab. 2.

An average duration of the surgical procedure was 275 min (65 – 600). An average size of the resected tumors was 28 mm (7 – 55 mm). In three cases conversion to laparotomy was required due to bleeding liver parenchyma that could not be managed using laparoscopic technique. Intraoperative blood loss ranged from 50 ml to 1500 ml (average 463 ml), while 11 out of 23 patients who underwent surgical treatment, required transfusion of blood products in the perioperative period. In one case, due to anatomical anomaly of branches of the portal vein and suspected damage of intrahepatic bile ducts, intraoperative endoscopic retrograde cholangiopancreatography was performed and a plastic prosthesis was inserted to the bile ducts. In the postoperative period this patient required reoperation due to a subhepatic abscess resulting from migration of prosthesis through the liver parenchyma to the peritoneal cavity. Postoperative complications were found in 4 patients (17.4%). One patient developed two complications. Table 3 presents analysis of complications.

In all 23 patients oral fluid supply was started on the day of the surgical procedure. In 90% of patients oral fluids were well tolerated on the first day after the procedure. Full oral diet was well tolerated in 50% of patients on day 2 after the procedure. All patients (100%) were mobilized on the day of the surgical procedure. Five patients (21.8%) required supplementation of single opioid dose in the postoperative period. In the remaining patients nonsteroidal anti-inflammatory drugs and regional analgesia (TAP) were used. Median duration of hospitalization was 6 days (2 – 130 days). One patient was rehospitalized due to subhepatic abscess and required reoperation. Histopathology assessment confirmed radical resection (R0) in all patients in our group.

DISCUSSION

Currently open procedures predominate in the treatment of focal hepatic lesions, however laparoscopic resections are gaining more and more supporters worldwide. Currently majority of laparoscopic procedures of the liver are performed in the treatment of malignant lesions (6, 7, 8). Similarly they were the most common indication for surgical treatment in our group: 75% of patients underwent surgical treatment due to malignancy.

Laparoscopic liver resections are still performed in few surgical centers. This clearly results from the fact that they are technically demanding procedures, associated with significant risk of perioperative complications, from w few to several dozen per cent (9, 10, 11). They require adequate equipment at the surgical theater with required tools and advanced manual skills of the operator. Initially such surgical procedures of the liver were performed at dedicated liver and biliary surgery centers, where conventional procedures

Table 2. Characteristics of focal lesions in the liver and type of surgical procedures

No.	Lesion location (segment)	Lesion diameter (mm)	Type of the procedure	Procedure duration (min)	Lesion histology	Conversion to laparotomy
1	V/VII	-	right hemihepatectomy	330	no neoplasm histology (after chemotherapy)	yes
2	VI/VII	30	right hemihepatectomy	540	metastasis of the colorectal cancer	yes
3	II/IVa	55	left hemihepatectomy	335	metastasis of the colorectal cancer	yes
4	III	25	metastesectomy	90	metastasis of the colorectal cancer	no
5	VII/VIII	50	right hemihepatectomy	540	metastasis of the colorectal cancer	no
6	V, VI, VIII	52, 20,21	right hemihepatectomy	480	metastasis of the colorectal cancer	no
7	V/VI/ VII/VIII	20	right hemihepatectomy	600	metastasis of the colorectal cancer	no
8	V/VI/VII	37	right hemihepatectomy	270	metastasis of the breast cancer	no
9	IVa, VI	40, 25	double metastasectomy	240	metastasis of the colorectal cancer	no
10	III	35	left hemihepatectomy	240	metastasis of the colorectal cancer	no
11	IV/V	-	resection of the gall-bladder cavity	210	gall-bladder cancer	no
12	VII	11	right hemihepatectomy	330	metastasis of the colorectal cancer	no
13	III	40	metastasectomy	65	metastasis of the colorectal cancer	no
14	III	25	nonanatomical liver resection	100	metastasis of the colorectal cancer	no
15	II/III	38	bisegmentectomy	195	HCC	no
16	IV/V	-	resection of the gall-bladder cavity	200	gall-bladder cancer	no
17	III, IVb	47, 11	nonanatomical resection of two segments	190	HCC	no
18	V/VII	8	right hemihepatectomy	330	metastasis of the colorectal cancer	no
19	II/III	7	nonanatomical liver resection	130	subcapsular liver abscess	no
20	V	10	nonanatomical liver resection	120	rheumatoid liver nodule	no
21	IVb	10	metastasectomy	130	mrtastasis of hepatocellular carcinoma	no
22	III, IV/V, VII/VIII	10, 13, 20	triple metastasectomy	240	metastasis of the colorectal cancer	no
23	VII, VIII	25, 15	right hemihepatectomy		metastasis of the colorectal cancer	no

were mainly performed. Currently centers specialized in minimally invasive surgery expand the range of their procedures and start to include liver surgery. At our center laparoscopic liver procedures were preceded by gaining experience in stomach, bowel, spleen, adrenal or pancreatic surgery.

An average duration of procedures performed at our department was slightly above 275 minutes. Alkhalili and Berber in their literature review reveal that an average duration of laparoscopic resections ranges from 95 to 280 minutes (12). The longest procedure lasted for almost 10 hours and resulted from anomalous blood supply to the liver and requirement for intraoperative ERCP to insert prosthesis to bile ducts. Relatively long duration of procedures at our department is probably a consequence of learning curve. One can expect that duration of laparoscopic liver resections will decrease with increasing experience. Naomi et al. suggest that the number of hemihepatectomy procedures that need to be performed to fully explore the learning curve, is 45 to 75 (13). Thus at a center performing several such procedures annually, such learning takes at least a few years.

According to available literature, the rate of conversions to laparotomy ranges from 0 to 19.4% (12). The rate of conversions to laparotomy in our material was 13% (3 patients). However, these conversions occurred in the first procedures performed at our department and with increasing experience, such rate of conversions was minimized. As in the material of other authors, conversions were forced

Table 3. Postoperative complications

Complication	Number of patients
Subdiaphragmatic abscess	1 (4,3%)
Bile leakage in the postoperative period	1 (4,3%)
Subhepatic abscess	1 (4,3%)
Pneumonia in the postoperative period	1 (4,3%)
Infection of a postoperative wound	1 (4,3%)

by excessive bleeding from the liver parenchyma as well as technical and anatomical variants of blood supply to the liver.

Various reports present quite variable intraoperative blood loss (usually from several to a few hundred milliliters) (12). Slightly higher blood loss was found in our group of patients (100 -1500 ml), and 48% of them required transfusion of blood products in the perioperative period. Martin et al. present data demonstrating that the transfusion rate in laparoscopic resections was 10%. Concurrently they emphasize that in conventional surgery the blood loss is higher and the perioperative transfusion rate reaches even 40 % (4).

In one patient who had been initially qualified for right hemihepatectomy due to a metastasis of the colorectal cancer, no neoplasm tissue was found in the postoperative material. Furthermore, in the rectum specimen obtained during a surgical procedure of primary rectal tumor, no cancer cells were found in the pathology assessment. A long course of preoperative radiochemotherapy had been used in this patient, resulting in complete remission of the cancer.

Oncological safety is the principal issue related to the performed procedures. Histopathology assessment confirmed radical resection (R0) in 100% in our patient group. Since the sample size presented by us is relatively small, we make reference to available literature. Numerous publications demonstrate that the rate of cancer free margins ranges from 87% to 100% (12). Topal et al. demonstrated Lower rate of positive surgical margins in laparoscopic procedures (1.2% vs 2.1% favoring laparoscopy) (8). Similarly Casting et al. demonstrated higher rate of R0 procedures for laparoscopy versus conventional procedures (87% vs 72%) (14). This is an important observation in view of the fact that the laparoscopic technique dues not allow for liver assessment using palpation. This may suggest that currently imaging investigations play a key role, providing us with an objective assessment. With regard to patient survival, three publications have demonstrated that with regard to hepatocellular cancer, there are no statistically significant differences in survival between laparoscopic and conventional therapy (14, 15, 16). Similarly with resection of liver metastases of the colorectal cancer, many authors have demonstrated that there are no statistically significant differences in survival between laparoscopic and conventional therapy (14, 20).

Duration of hospitalization after the liver resection in our group was similar to that according to literature data (median duration – 6 days) (4, 8, 16, 20). We would like to emphasize that in 20 of 23 patients, duration of hospitalization was shorter than 10 days. Three patients were discharged home on day two after the surgical procedure, and another two patients on day three. Short hospitalization was possible due to utilization of ERAS protocol (rapid mobilization of patients after the surgical procedure, rapid initiation of oral diet, among others) (19). Blind et al. using their data indicate that median duration of hospitalization of patients in whom oral diet was rapidly initiated and who were rapidly mobilized after the procedure, was 6 days (20). Huges et al. in their metaanalysis demonstrate that implementation of ERAS protocol for laparoscopic liver resections reduces incidence of complications and shortens duration of hospitalization of patients at the department of surgery after the procedure (21).

We would like to emphasize that our study is a preliminary one and we are unable to determine if laparoscopic liver surgery is better than conventional liver surgery. Available literature reviews (22, 23) suggest that laparoscopic liver surgery has similar benefits as laparoscopic procedures involving other organs: reduces time to return to activity, duration of hospitalization, number of certain complications. This can be of great importance for cancer patients since rapid convalescence may be critical here to allow quick initiation of adjuvant therapy.

CONCLUSION

Despite persisting dominance of open surgery, laparoscopic liver resections seem to be an interesting alternative in the treatment of focal lesions in the liver. They are associated with shorter duration of hospitalization, lower postoperative pain and lower complication rate. In view of the fact that liver resections are technically demanding procedures that are performed at few centers, it is difficult to envisage expansion of this method beyond large clinical centers.

REFERENCES

1. *Bryant R, Laurent A, Tayar C* et al.: Laparoscopic liver resection-understanding its role in current practice: the Henri Mondor Hospital experience. *Ann Surg* 2009; 250: 103-11.
2. *Kurosaki I, Yamamoto S, Kitami C* et al.: Video -assisted living donor hemihepatectomy through a 12-cm incision for adult-to-adult liver transplantation. *Surgery* 2006; 139: 695-703.
3. *Buell JF, Thomas MT, Rudich S* et al.: Experience with more than 500 minimally invasive hepatic procedures. *Ann Surg* 2008; 248: 475-86.
4. *Martin RC, Scoggins CR, McMasters KM:* Laparoscopic hepatic lobectomy: advantages of a minimally invasive approach. *J Am Coll Surg* 2010; 210: 627-34, 634-36.
5. *Gagner M, Rheault M, Dubuc J:* Laparoscopic partial hepatectomy for liver tumor. *Surg Endoscopic* 1993; 6: 99.
6. *Nguyen KT, Gamblin TC, Geller DA:* World review of laparoscopic liverresection- 2,804 patients. *Ann Surg* 2009; 250(5): 831-41.
7. *Dagher I, O'Rourke N, Geller DA* et al.: Laparoscopic major hepatectomy: an evolution in standard of care. *Ann Surg* 2009; 250(5): 856-60.
8. *Topal B, Fieuws S, Aerts R* et al.: Laparoscopic versus open liver resection of hepatic neoplasms: comparative analysis of short-term results. *Surg Endosc* 2008; 22(10): 2208-13.
9. *Harimoto N, Shirabe K, Ikegami T* et al.: Postoperative complications are predictive of poor prognosis in hepatocellular carcinoma. *J Surg Res* 2015; 199(2): 470-77.
10. *Xiao L, Xiang LJ, Li JW* et al.: Laparoscopic versus open liver resection for hepatocellular carcinoma in posterosuperior segments. *Surg Endosc* 2015; 29(10): 2994-2300.
11. *Jackson NR, Hauch A, Hu T* et al.: The safety and efficacy of approaches to liver resection: a meta-analysis. *JSLS* 2015; 19(1): e2014. 00186.
12. *Alkhalili E, Berber E:* Laparoscopic liver resection for malignancy: a review of the literature. *World J Gastroenterol* 2014; 20(37): 13599-606.
13. *Nomi T, Fuks D, Kawaguchi Y* et al.: Learning curve for laparoscopic major hepatectomy. *Br J Surg* 2015; 102(7): 796-804.
14. *Castaing D, Vibert E, Ricca L* at al.: Oncologic results of laparoscopic versus open hepatectomy for colorectal liver metastases in two specialized centers. *Ann Surg* 2009; 250(5): 849-55.
15. *Truant S, Bouras AF, Hebbar M* et al.: Laparoscopic resection vs. open liver resection for peripheral hepatocellular carcinoma in patients with chronic liver disease: a case-matched study. *Surg Endosc* 2011; 25(11): 3668-77.
16. *Lee KF, Chong CN, Wong J* et al.: Long-term results of laparoscopic hepatectomy versus open hepatectomy for hepatocellular carcinoma: a case-matched analysis. *World J Surg* 2011; 35(10): 2268-74.
17. *Hu M, Zhao G, Xu D* et al.: Retroperitoneal laparoscopic hepatectomy: a novel approach. *Surg Laparosc Endosc Percutan Tech* 2011; 21(5): e245-8.
18. *Topal B:* Minimally invasive liver surgery for metastases from colorectal cancer: oncologic outcome and prognostic factors. *Surg Endosc* 2013; 27(6): 2249.
19. *Pędziwiatr M, Matłok M, Kisialeuski M* et al.: Enhanced recovery (ERAS) protocol in patients undergoing laparoscopic total gastrectomy. *Wideochir Inne Tech Maloinwazyjne* 2014; 9(2): 252-57.
20. *Blind PJ, Andersson B, Tingstedt B* et al.: Fast-track program for liver resection – factors prolonging length of stay. *Hepatogastroenterology* 2014; 61(136): 2340-44.
21. *Hughes MJ, McNally S, Wigmore SJ:* Enhanced recovery following liver surgery: a systematic review and meta-analysis. *HPB* (Oxford) 2014; 16(8): 699-706.
22. *Rao A, Rao G, Ahmed I:* Laparoscopic vs. open liver resection for malignant liver disease. A systematic review. *Surgeon* 2012; 10(4): 194-201.
23. *Ciria R, Cherqui D, Geller DA* et al.: Comparative Short-term Benefits of Laparoscopic Liver Resection: 9000 Cases and Climbing. *Ann Surg* 2015; 27: (Epubahead of print)

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