

Transthoracic Approach (TTA) for Subdiaphragmatic Liver Metastasectomy

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Abstract

Background. Hepatic and pulmonary recurrences are major determinants of survival for patients who have undergone curative resection of colorectal carcinoma. In a selected group of patients, resection of metachronous, liver and lung metastases prolongs survival despite the aggressive nature of these lesions. The experience from an exclusive transthoracic, transdiaphragmatic approach (TTA) is limited. We present our experience with metastasectomy in patients with metachronous liver and right lung metastases, in whom an exclusive transthoracic approach was performed. **Methods.** Between 2002 and 2007, seven patients with metachronous colorectal liver and right-lung metastases, underwent an exclusive transthoracic approach. There were five men and two women, with a median age of 69 years (range 55 to 78 years). Liver resections performed included segmentectomy of segments VII, VIII, or both. Previous operations, including colon resection, adhesiolysis, ventral hernia repair, or transabdominal segment V resection, were performed in all patients. **Results.** No peri-operative mortality was documented. Morbidity included pleural effusion (n=3) and post-operative pneumonia (n=1), which responded to conservative management. Median hospital stay was 8 days (range 5-12 days). With a median follow-up of 31 months, one patient died of generalized disease. **Conclusion.** The factors that led to the increase of performances in colonoscopy in our department were the use of proper sedation and analgesia, the permanent internal audit of the maneuver, as well as the motivation of the endoscopist to obtain good results.

Key words

Colorectal carcinoma – liver metastases – lung metastases; diaphragmatic plication – TTA

Introduction

Liver and lung are the most common sites of distant metastases from a primary colorectal carcinoma [1]. Although target oriented chemotherapy prolongs survival, in search of a more effective treatment, the emphasis has shifted to surgical interventions. Recent efforts have aimed at aggressive resection of both lung and liver metastases associated with long term survival in selected patients [1-9]. This has taken the form of a staged or simultaneous resection achieved by both thoracic and abdominal approach. However in selected cases, and particularly for liver tumors located in segments VII and VIII, a transthoracic transdiaphragmatic approach is feasible. The purpose of this manuscript is to describe the technique for a combined liver and lung resection through a single thoracotomy in a patient with a combined liver and lung metastases from colorectal cancer. The technique has the advantage of better intrathoracic staging with direct segment VII and VIII exposure avoiding severe adhesiolysis, liver mobilization and possible hepatic congestion. Our experience in using this technique is also provided.

Patients and methods

Between 2002 and current 2007, seven patients with metachronous colorectal liver and right-lung metastases, underwent an exclusive transthoracic-transdiaphragmatic approach in the Liver Unit of Agia Olga Hospital (Table I). There were five men and two women, with a median age of 69 years (range 55 to 78 years). All patients had had colon resection in the past for a colorectal primary cancer (Table I) followed by adjuvant chemotherapy with 5-FU and leucovorin.

Presentation of metachronous liver and lung metastases varied between 6 months and 2 years after colon resection. All patients underwent contrast enhanced computed tomography (CT) of abdomen and chest in addition to PET scan for staging and exclusion of extrahepatic disease. Intraoperative ultrasound was performed routinely to assess the number of hepatic lesions and the relation of tumors to

Table I. Patients who underwent one stage liver and lung resection for colorectal metastases

Patient No	Location of the primary lesion	Stage (Dukes)	Previous operation(s)	Operation performed	Adjuvant therapy	Location of metastases	No lesions	Neoadjuvant therapy before metastasectomy	Result
1	Sigmoid	C1	1.Sigmoidectomy + Adhesiolysis	liver segmentectomy + wedge right lung resection	5-FU + Leucovorin	VII liver segment + inferior lobe, right lung	1 1	----	AFD
2	Sigmoid	B3	Sigmoidectomy + adhesiolysis	liver segmentectomy + wedge right lung resection	5-FU + Leucovorin	VIII liver segment + median lobe, right lung	1 1	----	AFD
3	Descending colon	C2	Left colectomy + ventral hernia repair	liver segmentectomy + wedge right lung resection	5-FU + Leucovorin	VII liver segment + inferior lobe, right lung	1 2	Folfox + Avastin	Pneumonia + pleural effusion Died after 11 months
4	Descending colon	C1	Left colectomy	liver segmentectomy + wedge right lung resection	5-FU + Leucovorin	VIII liver segment + median lobe, right lung	1 1	----	AFD
5	Caecum	C3	Right colectomy + ventral hernia repair	liver segmentectomy + wedge right lung resection	5-FU	VII+VIII liver segment + upper lobe, right lung	1 2	Folfox + Avastin	Pleural effusion AFD
6	Sigmoid	B3	Sigmoidectomy + adhesiolysis	liver segmentectomy + wedge right lung resection	5-FU + Leucovorin	VIII liver segment + median lobe, right lung	1 1	----	Pleural effusion AFD
7	Sigmoid	B3	Sigmoidectomy + adhesiolysis	liver segmentectomy + wedge right lung resection	5-FU + Leucovorin	VII liver segment + median lobe, right lung	1 1	----	AFD

AFD: Alive, free of disease

vascular structures. All patients underwent one stage liver and lung metastasectomy. Liver resections performed included segmentectomy of segments VII, VIII, or both (Table I).

Wedge right lung resection after thorough palpation was performed with a stapler device.

Surgical technique

A right anterolateral thoracotomy (Fig.1) is made through the 7th or 8th intercostal spaces along the inframammary line anteriorly to 1 cm below the tip of the scapula and midway between the scapula and the spine posteriorly. The pleura is entered at the 7th or 8th intercostal space. Additional exposure may be obtained by resecting 1-cm section of the rib above or below, preserving the intercostals neurovascular bundle. Exposure is gained to the entire pleural space and the lateral mediastinum. With deflation and gentle retraction of the ipsilateral lung the mediastinum and pericardium

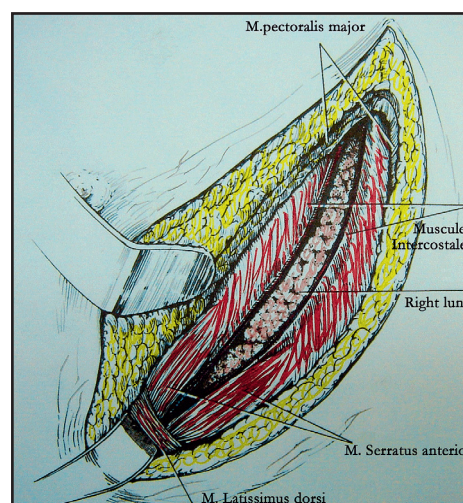


Fig.1 Right anterolateral thoracotomy

are exposed (Fig.2). After manual palpation of the lung to detect the metastatic lesion, wedge resection of the lung metastases is performed and simplified by the use of the GIA stapler. Application of the stapling device is facilitated by allowing the lung to collapse and an adequate margin should be ensured.

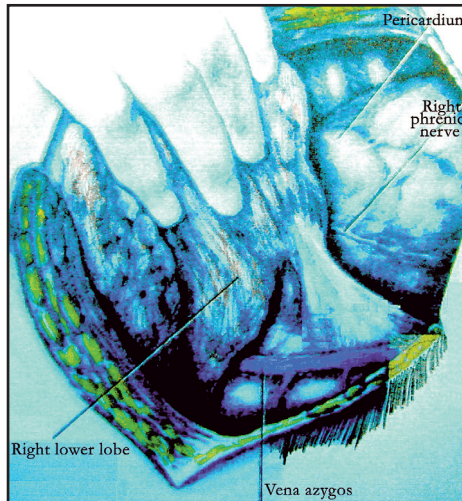


Fig.2 Exposure of the mediastinum and pericardium is obtained. Azygos vein can be seen here also.

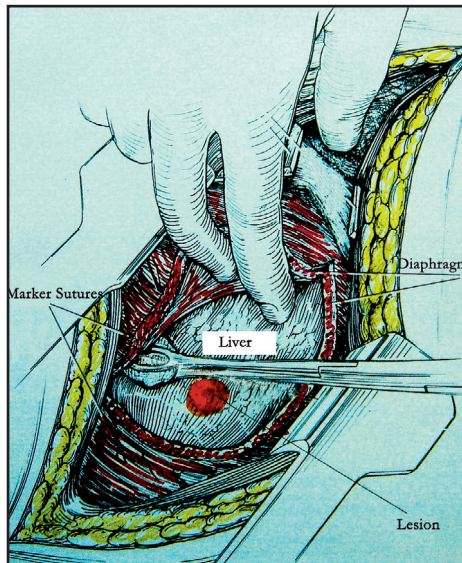


Fig. 3 Circumferential division of the diaphragm and exposure of VII and VIII liver segments

Division of the diaphragm should be performed at this stage with intraoperative ultrasound (IOUS) guidance (Aloca, Japan, 7.5 MHz probe) for accurate liver tumor identification in segment VII and VIII. The diaphragm is divided in a circumferential manner (Fig.3) to minimize damage to the phrenic nerves. The line of incision is parallel to the chest cavity approximately 2cm from the insertion of the diaphragm to the chest wall and extended posteriorly to the foramen of the inferior vena cava (IVC).

The right triangular ligament is divided next towards the IVC and the right hepatic vein is identified by blunt

and sharp dissection. This can be accomplished with slight segment VII mobilization towards the midline if necessary. Segmentectomy of segments VII and VIII is achieved (Fig.4) without inflow occlusion using the traditional Kelly-crashing technique. The right hepatic vein (RHV) is sacrificed for oncologic purposes if the tumor is in close proximity or invades the vessel. Exposure of segments VII and VIII with TTA is adequate to accomplish safe control of the hepatic vasculature. It is worth noting that cranio-caudal approach facilitates RHV dissection with safe proximal control of the vessel at the junction with IVC.

A closed suction drain is placed under the diaphragm and a chest tube in the pleural space one or two interspaces below the incision (Fig.4). Then attention focuses upon closure of the diaphragm.

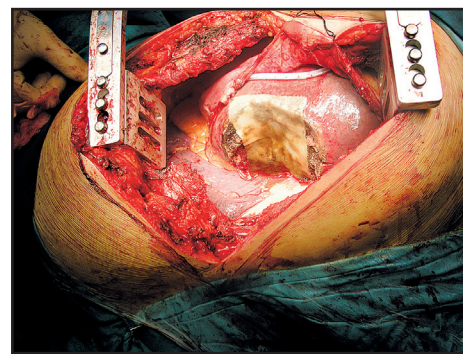


Fig.4 Segmentectomy is completed and a drain is properly placed under the diaphragm

Multiple widely spaced interrupted horizontal mattress sutures of non-absorbable material are preferred. Plication is also helpful to maintain good function of the diaphragm and minimize the dead space after liver resection. The ribs are approximated with heavy pericostal sutures and the fascial layers of the chest are closed in an anatomic pattern. Intraoperative blood loss is minimal and no blood transfusion is required. Mean duration of surgery is 190 minutes.

The patient remains the first postoperative day in the surgical ICU, and the chest tube is usually removed the third postoperative day. Pain can be successfully managed by PCA pump initially, followed by oral medication.

Our patients who underwent the TTA for combined liver and lung metastasectomy had more than one previous operation including colon resection, adhesiolysis for small bowel ileus, ventral hernia repair and segment V liver resection (Table 1). Segment V resection was performed in one patient through an abdominal incision six months after right colectomy for caecum carcinoma, but after another six months the patient developed recurrence at segment VIII and the right lung and required a cranio-caudal approach.

Results

No peri-operative mortality was documented. Morbidity included pleural effusion (n=3) and post-operative pneumonia (n=1) which responded to conservative management.

No bile leaks or abscess were documented. Median

hospital stay was 8 days (range 5-12 days). With a median follow-up of 31 months (range 6 to 59 months), one patient died due to generalized disease. Median operative time in the TTA group was 180 min (range 170-210 min). Pain was successfully managed by PCA pump initially, followed by oral medication. Tumor size based on histopathology report varied from 2 to 4 cm in our cohort. Resection margins were microscopically clear of tumor in all patients; however two patients had margins that were clear but less than 1cm away from tumor. Ventilatory function was not evaluated in the early postoperative period.

Discussion

Liver and lung metastases are a common finding after curative resection of a colorectal carcinoma. Approximately 25% of patients with isolated hepatic metastases have tumors that can be resected curatively with a reasonable long term survival (21-48%) [10, 11]. There is also a subset of patients with both hepatic and pulmonary metastases from colonic cancer who are suitable candidates for resection [1-4]. Several reports documented prolong survival following staged or simultaneous resection of colorectal metastases to both liver and lung [1-4, 12].

However, they were limited by a small cohort of patients. Reported 5-year life expectancy with such an aggressive approach is 30-55% [2, 4]. Number of metastases, location and CEA levels are strongly associated with prognosis although do not preclude surgery in a patient with adequate cardio-pulmonary reserve. Resection of hepatic and pulmonary metastases at various intervals after resection for colorectal carcinoma is feasible and safe. However, the morbidity of a combined abdominal and thoracic approach remains high. The concept of a less invasive technique convinced our group to adopt a novel transthoracic transdiaphragmatic hepatectomy. We consider that careful palpation of the lung is preferred to VATS for detection of small intra-parenchymal lesions. In the case of hepatectomy of Couinaud's segments VII and VIII, severe compression and mobilization of the liver are required to establish the operative field via the usual transabdominal approach. This places the patient at a high risk for hepatic and systemic circulatory impairment due to portal vein and IVC torsion [5]. Restricted operative fields along with a hostile abdomen from previous abdominal operations makes the dissection difficult and increases operative time and blood loss [5]. More to the point, short hepatic vein ligation almost routinely performed during liver mobilization may predispose to segmental liver congestion after sacrifice of the RHV. To alleviate these difficulties, we developed a transthoracic transdiaphragmatic approach for combined lung and liver resection of Couinaud's segments VII and VIII. Regardless of the direct exposure to the liver dome, TTA may offer early ambulation and fast-tracking surgery due to less paralytic ileus and ascites. In addition, we did not detect a positive margin after metastasectomy with this technique in our cases, although it was challenged by some regarding hepatocellular

carcinoma [6]. A drawback of TTA is the difficulty to use IOUS for detection of synchronous liver lesions distant to the exposed area, and the inability to inspect the whole peritoneal cavity. However, a PET scan is imperative to exclude extra-hepatic disease before the application of this technique. In addition, patients with poor lung function and high risk for pulmonary morbidity may not tolerate this approach, because of the chest wall trauma, diaphragmatic disruption and concomitant lung resection.

Conclusion

Although this study has a limited number of patients to make concrete conclusions, we believe that an exclusive transthoracic approach is feasible and efficient for combined lung and subdiaphragmatic liver metastasectomy in cases of previous multiple abdominal interventions.

Conflicts of interest

None to declare.

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