Abstract

Vascular invasion of supra-hepatic veins (SHV) is a major complication of primary liver tumours. The tumorous thrombus, when extended to the vena cava and right atrium, may produce occlusion of the tricuspid valve or pulmonary embolism with sudden cardiac death. The presence of macroscopic vascular infiltration represents an advanced stage of the tumour contraindicating liver transplantation, thus liver resection with thrombectomy is the only therapeutic option in this setting despite the concerns of postoperative liver failure and the dismal results at distance. A 45-year-old male with chronic active hepatitis/cirrhosis was referred to our department for a tumour in the left hemi-liver with infiltration of the left-middle hepatic veins and a tumour thrombus extension to the right atrium. We reported a successful cavo-atrial thrombectomy, along with left hemi-hepatectomy, under hypothermic cardio-circulatory arrest (HCA). To our knowledge, this technique has been used only once for primary liver cancer on chronic liver disease, this being the second case reported in literature. We conclude that this technique should be considered for atrial thrombi removal in patients affected by liver tumours in the presence of a healthy liver or of a well compensated liver cirrhosis in order to prolong the patient’s life span.

Keywords: Liver tumour; Liver resection; Atrial thrombus; Extracorporeal circulation; Hypothermic cardio-circulatory arrest

1. Introduction

Vascular invasion of supra-hepatic veins (SHV) is a major complication which leads to intra-hepatic and systemic diffusion of the liver tumours. Therapeutic options at this stage are few and debatable. In fact, macroscopic vascular infiltration represents a contraindication for liver transplantation and liver resection, even with dismal results in this setting, it remains the only therapeutic option [1]. Furthermore, the presence of a cavo-atrial thrombus may cause the occlusion of the tricuspid valve or may embolize into the pulmonary artery with a sudden cardiac arrest. In case of extension to the right atrium, a liver resection, combined with cavo-atrial thrombectomy using an extracorporeal circulation (ECC), should be considered. ECC with hypothermic cardio-circulatory arrest (HCA) is gaining wide acceptance to remove atrial thrombi due to retroperitoneal malignancies [2], however, a lot of concerns remain about its use in the presence of a diseased liver where the majority of tumours and thrombi usually occur.

We report here the case of a liver tumour, which arose on a diseased liver, extended to the right atrium, treated successfully by means of a left hemi-hepatectomy with cavo-atrial thrombus removal, using HCA.

2. Case report

A 45-year-old male known as a previous heavy alcohol consumer and drugs user, was followed for a chronic hepatitis, C-virus related. An ultrasound scan revealed a tumour in the left hemi-liver (segments I–IV), that a contrast enhanced computed tomography (CT) scan showed to invade the left-middle SHV, and extended toward the suprahepatic vena cava and the right atrium (Fig. 1a, b). Liver function tests were: prothrombin activity 74%, alkaline phosphates 145 U/l, bilirubin 1.11 mg/dl, AST 60 U/l and serum albumin 3.6 g/dl. Indocyanin green retention test at 15 min was 23.5%.

At operation, the patient was placed in supine position and explored through a bilateral sub-costal incision with xifoid extension. The left hepatic artery, portal vein and biliary duct were tied and cut. Parenchymal transection was accomplished using ‘Kelly crush technique’ under intermittent Pringle’s manoeuvre, preserving the middle hepatic vein that was found thrombosed at the level of its junction...
with the left hepatic vein: we cut it between clamps completing the parenchymal resection on the anterior wall of the retro-hepatic vena cava (Fig. 2). Through a median sternotomy, canulation of the ascending aorta and of the right atrium with a ‘vent’ in the right superior pulmonary vein, after systemic heparinization, were carried out in order to perform an ECC.

ECC was started and the body temperature was lowered to 24 °C by systemic cooling and some ice saline slush that was placed in the pericardium and around the right liver in order to protect further these organs. There was no additional brain protection during HCA. Systemic temperature was measured by means of a rectal and a nasopharyngeal probe. During HCA myocardial function monitoring was not used, while during rewarming trans-esophageal echocardiography was instead used. The heart fibrillated only for a few minutes during HCA and was left vented during the procedure. Thirty mg/kg of metilprednisolone, 250 mg of tiopentone and 250 ml of 18% mannitol solution were administrated i.v.

ECC was then stopped. The right atrium was opened longitudinally and the trunk of the left-middle SHV sectioned. Using a combined manoeuvre, inserting the index finger through the atriotomy that pushed the thrombus caudally, the thrombus was removed entirely from the caval ostium of the left-middle SHV (Video 1). The atriotomy and the vena cava were closed and the patient was rewarmed to 37 °C, resuming a spontaneous heart beat without the need of defibrillator. While the patient rewarmed we reconstructed the continuity of the middle hepatic vein by means of an interposition PTFE ringed graft of 8 mm in diameter anastomosed to the inferior vena cava. HCA lasted 14 min.

The canulae were removed and we corrected any coagulator deficiency with the infusion of protamine sulphate and fresh frozen plasma. Liver function tests in postoperative day-one were as follow: prothrombin activity 47%, bilirubin 7.13 mg/dl, AST 396 U/l, ALT 164 and serum albumin 1.7 g/dl.

The patient recovered uneventfully except for a right pleural effusion that had to be drained and he was discharged from the hospital three weeks later. Postoperative computed tomography scan images are shown in Fig. 1 (a1–c1). Pathology of the specimen showed a moderate to poor differentiated hepatocellular carcinoma with vascular invasion occurring on a chronic active hepatitis. All liver func-

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**Fig. 1.** Preoperative CT-scan showing the presence of a caval/atrial thrombus (a) originating from a left liver tumour invading the middle-left supra-hepatic veins (b). Postoperative images show the clearance of right atrium/inferior vena cava along with the absence of the left hemi-liver (segment I–IV) (a1–b1). The presence of a prosthesis between the middle hepatic vein and the vena cava is evident in c1. CT, computed tomography.

**Fig. 2.** Schematic drawing that shows the intraoperative field at the end of the liver resection just before the opening of the chest. Please note that the left hemi-liver, containing the tumour, has been left to hang only by means of the thrombosed left-middle hepatic vein.

**Video 1.** The atrio-caval thrombus has been removed using a combined approach. From the longitudinal atriotomy the thrombus is pushed caudally with an index finger and extracted from the caval ostium of the left-middle supra-hepatic veins.
tions tests returned within normal range by one month from the operation.

The patient is alive at six months with pulmonary metastases.

3. Discussion

The natural history of HCC complicated with macroscopic vascular invasion shows a median survival time of only 9–10 weeks [3]. The presence of atrial thrombosis contraindicates liver transplantation and palliative treatments with systemic chemotherapy, intra-arterial chemotherapy or radiofrequency ablation resulted in a dismal survival at one year ranging from 7 to 18% [4–6]. Thus, hepatic resection remains the only therapeutic option for these patients that recent studies have showed to live longer, compared to those not resected, with a five-year survival rate of 10% [7, 8].

Furthermore, acute pulmonary embolism or congestive heart failure may complicate tumour’s thrombi in the inferior vena cava/right atrium [9]. This latter situation represents a life-threatening condition that should be surgically treated as soon as possible [10].

Atrial thrombus removal may be achieved under ECC and cardiopulmonary bypass. ECC with HCA has been increasingly used to remove atrial thrombi due to retroperitoneal malignancies since one of the first descriptions [2], but to our knowledge it has been used only once in cirrhotic patients [10] because of the fear of postoperative liver failure and poor outcome.

In our patient, liver function tests and indocyanine green retention test showed a good functional reserve even in presence of an occluded major SHV. Furthermore, the short lasting hypothermic circulatory arrest had been shown to be safe in compensated liver cirrhosis [9]. We conclude that this technique should be considered for the removal of atrial thrombi in patients affected by primary liver tumours also in presence of a compensated liver cirrhosis in order to prolong the patient’s life span.

References