Right Hepatectomy for Giant Liver Hemangioma Guided with Intraoperative Ultrasound and Indocyanine Green

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ABSTRACT

Background: Hepatic hemangiomas are benign vascular tumors of the liver, most of them asymptomatic. Surgical management includes enucleation, embolization, and liver resection. We present a case with symptomatic hepatic hemangioma susceptible to surgical treatment.

Case Presentation: A 73-year-old man with chronic obstructive pulmonary disease and a history of two small hemangiomas started with pain in the right upper quadrant. Computerized tomography showed multiple hypodense lesions highly suggestive of hepatic hemangioma. Tumor markers were found at normal levels. A right hepatectomy guided with indocyanine green and intraoperative ultrasound was performed minimal bleeding and pulmonary complications.

Conclusion: Hepatectomy for giant hemangiomas combined with ultrasound and indocyanine green is a feasible option in patients with comorbidities, decreasing bleeding risk, and allowing complete and surgical resection.

INTRODUCTION

Hepatic hemangiomas are the most common benign liver tumor, the majority of these lesions are incidental findings and most of them remain asymptomatic.
With an estimated prevalence of 0.4%-4.3% and an incidence of 0.4%-20% in the general population. It is typically observed in middle age patients, females rather than males ratio of 5:1.

The etiology is unclear and its growth pattern is secondary to dilation, hypotheses suggest hepatic hemangiomas result from abnormal angiogenesis and pro-angiogenic factors such as Vascular Endothelial Growth Factor (VEFG). Hormones such as estrogens play an important role in growth since they appear more frequently during pregnancy, hormone replacement therapy, and oral contraceptive pill intake supporting the higher prevalence in women [1].

Histologically three subtypes have been described: capillary hemangioma, sclerosed hemangioma, and cavernous hemangioma being this last one the most typical [1]. At microscopy, they appear as dilated vascular ducts upholstered by a single layer of endothelial cells.

They may be confined to one lobe, usually the right lobe, or extend throughout the liver. When symptoms occur, abdominal pain is predominant; other symptoms are usually nonspecific such as nausea, vomiting, early satiety, and cholestasis. Symptomatic hemangiomas are associated with larger lesions and distension of the liver capsule, according to their dimension they can be small or giant (>5 cm).

Surgical management includes enucleation, embolization, and liver resection. Tumor size is not a strict indication for resection, clinical follow-up is recommended in most patients, while surgical treatment is reserved for patients with progressive abdominal symptoms, high grade of rupture, rapidly enlarging lesions, and risk of intramural thrombosis or Kasabach-Merrit syndrome [2].

**CASE PRESENTATION**

**Chief Complaints**

A 73-year-old man with Chronic Obstructive Pulmonary Disease (COPD) and pulmonary hypertension with two previous small asymptomatic hemangiomas started with oppressive pain in the right upper quadrant, an ultrasound of the liver and biliary tract showed a giant liver lesion with heterogeneous characteristics.

The patient was referred to our team with hepatocarcinoma suspicious, specific tumor markers and imaging were realized revealing a hepatic hemangioma.

**Imaging Examination**

A Quadriphasic CT evidenced solid and hypodense lesions, in the arterial phase present discontinuous globular enhancement and with a tendency to show centripetal filling. The largest lesion was found in segment 7 with dimensions of 9.8x6.8 cm, while those corresponding to segments 5, 4, and 3 segments with a size of 3.6x2.7 cm, 2.5x2 cm, 4x2.7 cm (Figure 1).

![Figure 1: A, C, D: Computed Tomography Dynamic Angio in 3D at late arterial phase; B: Volumetry of giant hemangioma corresponding to 155.3 ml and 9.8 cm x 6.8 cm.](image-url)
Table 1: Biochemical evolution of liver function test.

<table>
<thead>
<tr>
<th></th>
<th>TB</th>
<th>DB</th>
<th>IB</th>
<th>AP</th>
<th>GGT</th>
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<td></td>
<td></td>
</tr>
<tr>
<td>Day -1</td>
<td>1.13</td>
<td>0.56</td>
<td>0.57</td>
<td>44</td>
<td>50</td>
<td>174</td>
<td>168</td>
</tr>
<tr>
<td>Postoperative</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>0.72</td>
<td>0.37</td>
<td>0.35</td>
<td>49</td>
<td>64</td>
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<td>308</td>
</tr>
<tr>
<td>5</td>
<td>1.17</td>
<td>0.52</td>
<td>0.65</td>
<td>85</td>
<td>126</td>
<td>25</td>
<td>64</td>
</tr>
<tr>
<td>12</td>
<td>1.07</td>
<td>0.45</td>
<td>0.62</td>
<td>125</td>
<td>144</td>
<td>33</td>
<td>85</td>
</tr>
<tr>
<td>24</td>
<td>0.6</td>
<td>0.2</td>
<td>0.4</td>
<td>166</td>
<td>111</td>
<td>21</td>
<td>27</td>
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<tr>
<td>74</td>
<td>0.6</td>
<td>0.3</td>
<td>0.3</td>
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<td>138</td>
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<td>42</td>
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<td>102</td>
<td>0.8</td>
<td>0.3</td>
<td>0.5</td>
<td>143</td>
<td>103</td>
<td>25</td>
<td>37</td>
</tr>
<tr>
<td>127</td>
<td>0.8</td>
<td>0.3</td>
<td>0.5</td>
<td>125</td>
<td>88</td>
<td>24</td>
<td>29</td>
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</tbody>
</table>


Laboratory Workout

Preoperative laboratories include tumor markers such as alpha-fetoprotein, Carcinoembryonic Antigen (CEA), and carbohydrate antigen 19-9 (CA19-9) with the main objective of ruling out hepatocellular carcinoma finding these in normal values. Preoperative assessment was carried out with an initial liver function test and postoperative progression over time, as shown in Table 1.

Surgical Treatment

Due to the findings of the tomography as well as the symptoms, it was decided as a preparation for surgery to establish a program for pulmonary conditioning and diaphragmatic strengthening, with a high oxygen flow, corticosteroids nebulization and breathing exercises, due to the severity of COPD to avoid atelectasis.

Laparotomy was carried out throughout Kocher incision and as an anatomic right hepatectomy was planned, cholecystectomy was done as part of the conventional technique. After incising Glisson’s capsule with cautery the transection of the parenchyma was carried out using Cavitron Ultrasonic Surgical Aspirator (CUSA, Tyco)

Figure 2: A, C, D: Indocyanine green with perfusion of complete liver remnant and partially de-vascularized liver haemangioma; B: Giant hepatic haemangioma.
Healthcare, Mansfield, MA) and the guidance of a T-Shaped Intraoperative Transducer of the BK 5000 ultrasound equipment assist us to define the plane between the hemangioma and the normal parenchyma, as well as the main portal and hepatic veins and the vascular supply of the lesion [3].

Bile ducts were ligated and vessels of less than 4 mm were sealed with the use of the radiofrequency sealer Aquamantys, Medtronic Co. Ltd., Portsmouth NH, USA (Aquamantys). In order to document and maintain the perfusion of the remnant liver and devascularization of the vascular tumor, we scanned several times along the surgery with indocyanine green [4] shown in Figure 2. Surgical parameters are described in Table 2.

Pathology Diagnosis

Table 2: Surgical Parameters.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Result</th>
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<tbody>
<tr>
<td>Size/volumetry of hemangiom-</td>
<td>9 cm/155 cc</td>
</tr>
<tr>
<td>ma</td>
<td></td>
</tr>
<tr>
<td>Type of resection</td>
<td>Anatomical</td>
</tr>
<tr>
<td>Number of segments resected</td>
<td>4</td>
</tr>
<tr>
<td>Blood loss</td>
<td>350 cc</td>
</tr>
<tr>
<td>Operative time</td>
<td>235 min</td>
</tr>
<tr>
<td>Total days of Hospital stay</td>
<td>14 days</td>
</tr>
<tr>
<td>Type of complication</td>
<td>Grade I (Clavien-Dindo)</td>
</tr>
</tbody>
</table>

The review of the surgical specimen confirmed the diagnosis of cavernous haemangioma at the right liver of 9.0 cm, the gallbladder with chronic cholecystitis and no malignant neoplasm identified.

Outcome and Follow Up

The immediate postoperative course underwent surveillance in the intensive care unit without mechanical ventilation, surgical drainage load was less than 100ml/24h, urinary output more than 50ml/h, with no requirements of vasoactive drugs and after 22 hours patient was discharged to the surgery floor. Urinary drainage was removed at Postop Day (POD) 2 and surgical drainage 96 hours after surgery with less of 20 cc and no evidence of biliary leakage. Oral intake started and ambulation at postop day 3 with bowel movements on day 4, pain was controlled with a combination of intravenous opioid and non-steroidal anti-inflammatory drugs and shifted to oral painkillers once the patient had oral intake.

Laboratory tests were checked every other day during the first week POD and then twice the second postoperative week as previously discussed. Chest x-ray were performed three times after surgery with no evidence of pneumonia and major pulmonary complications, while pulmonary and physical therapy was being given and finally, patient was discharged on POD at day 10.

During the out hospital follow up patient developed a minor complication according to the Clavien-Dindo classification as type I, clinically manifested as wound seroma that was open drained at the office and no surgical re-interventions were needed. At 5.6 months of follow up, patient is fully reincorporated to his daily routine and with normal function liver tests.

DISCUSSION

The main differential diagnosis for hepatic hemangiomas includes focal nodular hyperplasia, hepatocellular carcinoma, and metastatic disease predominantly from the colon. The biopsy is not recommended since there is a high risk of bleeding, specialized imaging techniques and tumor markers are sufficient for preoperative diagnosis. The

![Figure 3: 73-year-old patient multiphasic CT showing the pattern of peripheral nodular enhancement in the early phase, followed by a centripetal pattern or “filling in” during the late phase.](image-url)
radiological approach includes ultrasound, CT, and magnetic resonance; as in this case, the diagnosis was initially made with ultrasound and confirmed with multiphasic CT and surgical planning purposes.

The characteristic findings of CT in hepatic hemangioma are peripheral nodular enhancement in the arterial phase, followed by partial or complete centripetal fill-in in the portal phase [5,6] (Figure 3) and in contrast to hepatocarcinoma which is hypodense in the simple phase, hypo or hypervascular with intense enhancement in the arterial phase and with a rapid washout in the portal venous phase [7-10].

All symptomatic hepatic hemangiomas should receive treatment. There are several treatment options, such as embolization, enucleation, and surgical resection or combination of both, [11,12] as described in Table 3.

The treatment of choice must be individualized depending on the characteristics of the tumor as well as the patient’s Table 3: Comparative of therapeutic options.

<table>
<thead>
<tr>
<th>Therapeutic</th>
<th>Advantages</th>
<th>Complications/Dis-advantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Embolization</td>
<td>Adjunct therapy to ablation Reduce the risk of intraoperative bleeding</td>
<td>Collateral circulation after embolization with risk of recurrence</td>
</tr>
<tr>
<td></td>
<td>Reduce the hemangioma volume</td>
<td>Embolism of the portal vasculature leading to ischemia</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Biloma</td>
</tr>
<tr>
<td>Enucleation</td>
<td>Safe with peripheral lesions Preserves more parenchyma</td>
<td>Major parenchyma involvement than embolization</td>
</tr>
<tr>
<td></td>
<td></td>
<td>More risk of seroma and biloma</td>
</tr>
<tr>
<td>Resection +/- embolization</td>
<td>Decreases intraoperative bleeding Easier and safe dissection Less risk of embolism</td>
<td>Incisional hernias</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Postoperative pain</td>
</tr>
</tbody>
</table>

Multiphase CT allows to visualize the lesion characteristics, perform volumetric analysis of the hemangioma, the resected parenchyma, and remnant, as well as establish a relationship with the portal and hepatic venous drainage vessels that allow preoperative surgical planning.

Indocyanine green fluorescence during open or laparoscopical resections enables the visualization of the lesion, providing effective identification of the hepatic segments while monitoring the perfusion of the residual liver parenchyma and the gradual devascularization of the hemangioma [4]. A combination of CUSA dissector and Aquamantys as a coagulative device, gives better vascular control, minimizing blood loss and transfusion requirements while improving transection speed.

In patients with pulmonary comorbidities and large tumor sizes, open surgery is a better surgical option rather than a laparoscopic approach, as an attempt to avoid pulmonary complications and multiple embolization attempts in larger lesions.

**CONCLUSION**

Giant hepatic hemangiomas are susceptible of surgical management when symptoms appear, not just related with it size but considering the risk of rupture. Therapeutics must be individualized as we report in this successfully treated giant hemangioma with open anatomical resection, with the low rate of pulmonary and surgical postoperative complications. Surgical planning is an essential part of the evaluation of these large lesions to obtain an adequate parenchymal sparing liver resection with a multiphasic CT and 3D reconstructions and volumetry. In order to preserve the healthiest functional liver, we consider that the use of intraoperative ultrasound guidance and indocyanine green has to be taken into consideration as essential and necessary tools in hepatobiliary surgery as we experienced in this particular case.

**AUTHOR’S CONTRIBUTIONS**

LM is the first author, LM and AR wrote the manuscript, AR designed the study. All authors read and approved the final manuscript.

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**CONFLICT OF INTEREST**

The authors declare that they have no conflicts of interest.
References


