

# Liver Transplantation for Growing Teratoma Syndrome: Report of a Case

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**Liver transplantation is a well-established treatment for liver failure and for a selected group of patients with hepatic tumors. The growing teratoma syndrome refers to the phenomenon whereby germ cell tumors enlarge after chemotherapy despite complete eradication of malignant cells and normalization of serum tumor markers. We present the case of a young patient with rapidly growing teratomatous masses in his liver who was treated with liver transplantation from a live donor. We discuss his postoperative management, follow-up, and briefly review literature on the subject. (*Liver Transpl* 2003;9:1222-1224.)**

The growing teratoma syndrome (GTS) is characterized by the enlargement of mixed nonseminomatous germ cell tumors (NSGCTs) after successful chemotherapy with normalization of tumor marker values.<sup>1,2</sup> This syndrome includes patients with enlarging masses in the retroperitoneum or mediastinum and, rarely, liver containing mature teratoma cells. Despite their benign nature, continuous growth of these tumors can potentially cause significant morbidity and possible mortality secondary to their encroachment on adjacent structures in the chest or abdomen. Radical surgical excision of tumors is the only curative option.

Involvement of the liver by NSGCTs and transformation to GTS, although rare, has been reported.<sup>3,4</sup> Unfortunately, because of the diffuse involvement of the liver, in some cases, liver resection and other recent modalities for treatment of hepatic tumors are not effective. Liver transplantation (LT) may be the only option with potential for cure in these patients. We report the first case of LT for GTS.

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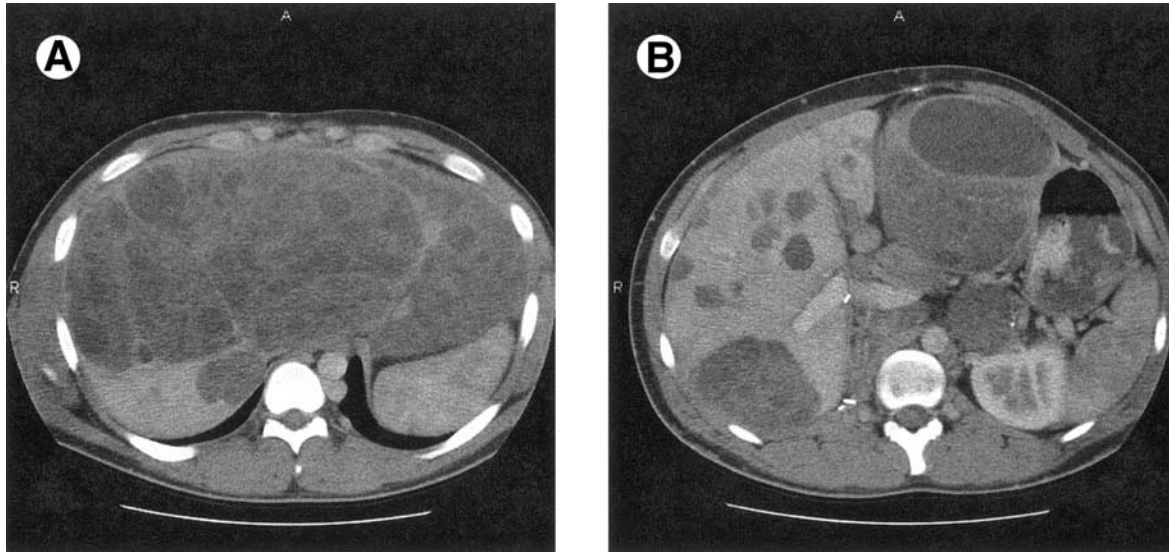
## Case Report

A 22-year-old man initially presented with a right testicular mass, which he had ignored for 6 months, followed by increasing abdominal girth, right upper-quadrant fullness, and a more than 30-pound weight loss. At evaluation, he was found to have a large testicular mass, as well as multiple metastatic deposits in the liver, hydronephrosis in the right kidney, and retroperitoneal adenopathy with moderate ascites on an abdominal computed tomographic (CT) scan.

At presentation serum, alpha-fetoprotein level was 18,300 ng/mL (normal, 0 to 15 ng/mL), and  $\beta$ -human chorionic gonadotropin level was 3,840 MIU/mL (normal, 0 to 5 MIU/mL). The patient underwent a right radical orchiectomy. A pathological diagnosis of mixed germ cell tumor (embryonal carcinoma, 50%; yolk sac tumor, 30%; immature teratoma, 10%; and seminoma, 10%) was established. There was extratesticular extension of the tumor with invasion of the epididymis and focal lymphovascular invasion with negative resection margin. The patient was started on a cisplatin-based chemotherapeutic regimen. After 4 months, the patient underwent retroperitoneal lymphadenectomy, right nephrectomy, and liver biopsy. The specimens showed residual mature teratoma cells without evidence of malignant components in any resected tissue. The patient continued to undergo chemotherapy for another 4 months. Serum tumor marker levels stayed normal, but the hepatic lesions continued to grow, confirming the diagnosis of GTS. Because of the size and multifocal nature of the hepatic lesions (Fig. 1), the patient was sent to our center for possible LT.

After a thorough evaluation, the patient was accepted for LT. Because he had normal liver function test results, his Model for End-Stage Liver Disease score was too low to anticipate a timely cadaveric LT, and his mother served as the living donor. Total hepatectomy was performed and facilitated by the use of venovenous bypass. To retain the inferior vena cava for subsequent reimplantation, the native liver had to be removed by splitting the liver in an anteroposterior fashion (Fig. 2). During the procedure, the retroperitoneum was completely cleared of any potential residual tumors by way of radical lymphadenectomy. The right-lobe liver from his mother was implanted by way of end-to-side right hepatic venous drainage to the vena cava, recipient main portal vein to donor right portal vein, right hepatic artery of the donor to the recipient common hepatic artery, and biliary drainage with a Roux-en-Y hepaticojejunostomy. The allograft functioned immediately.

Both patients did well after the operation. The donor had



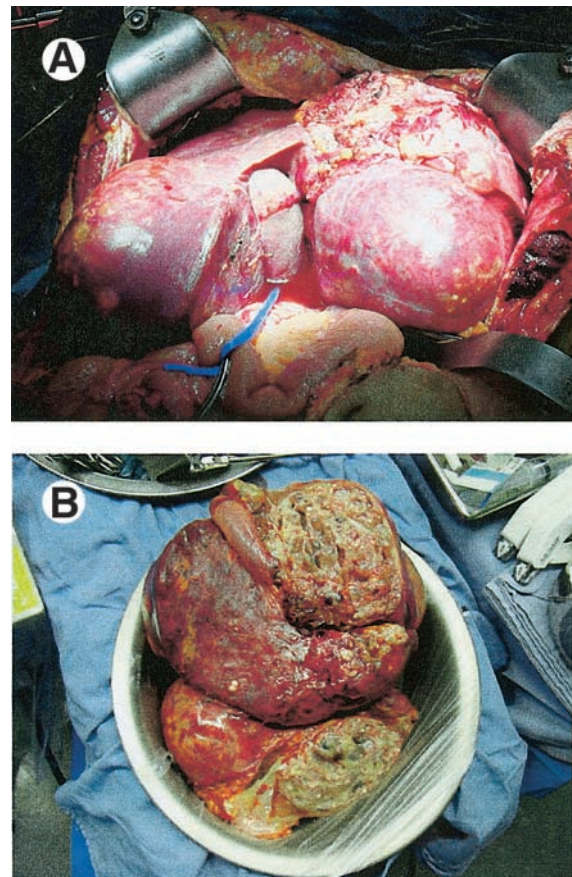
**Figure 1.** Preoperative CT scan of the abdomen showing (A) extent of hepatic involvement and (B) retroperitoneal involvement.

transient hyperbilirubinemia and was discharged in 12 days. She was followed up for 1 year with no problem. The recipient was discharged on the third post-LT week on a maintenance immunosuppressive regimen with tacrolimus and prednisone (prednisone was tapered off in 3 months). Follow-up CT scans (Fig. 3) and serum tumor marker levels have been negative for any new growth for up to 15 months post-LT, and the patient is fully employed.

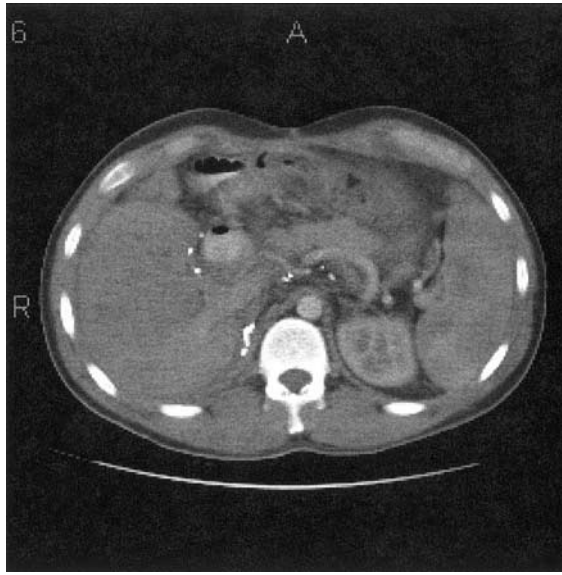
The native liver was 6,400 g and  $22.5 \times 38 \times 28.5$  cm. The capsular surface appeared markedly enlarged and distorted, firm to rubbery, and tan-red with bulging masses on the anterior and posterior surfaces consisting of tan-gray nodules ranging from 1.5 to 20.0 cm. There were no immature teratoma or germ cell components. Surgical margins were free of tumor, and nonneoplastic portions of the liver showed minimal portal fibrosis and no significant steatosis. The resected retroperitoneal and hilar nodes and masses were free of neoplastic activities.

### Discussion

With the advent of cisplatin-based chemotherapy in the last 20 years, cure rates for NSGCT have increased from 10% to more than 80%.<sup>5,6</sup> The presence of serum markers alpha-fetoprotein and  $\beta$ -human chorionic gonadotropin by these tumors is useful for diagnosis and assessment of response to therapy. However, continuous growth of the tumor after successful chemotherapy in the face of normal levels of these tumor markers may indicate the possibility of GTS. The distinction between GTS and recurrence of the primary malignant neoplasm is usually with the presence of



**Figure 2.** Teratomas in the liver (A) at the time of hepatectomy and (B) after removal of the liver.



**Figure 3.** CT scan of the abdomen 1 year after LT showing the liver and retroperitoneum.

abnormal serum marker levels and lack of germ cell elements on biopsy. The mature teratoma, despite its histologically benign appearance, has the propensity to be clinically aggressive, with increased morbidity and possible mortality secondary to encroachment of adjacent organs and vital structures. These tumors are unresponsive to chemotherapy or radiation, and aggressive surgical treatment is the only potential for cure.

GTS, sometimes also referred to as mature teratoma syndrome, is characterized by radiographic evidence of enlarging masses after chemotherapy for NSGCT with normal levels of serum tumor markers and histological confirmation of mature teratoma cells without malignant elements. It accounts for 4% to 8% of patients with NSGCT in reported series.<sup>4,7</sup> The entity was first described in 1881 by Carr et al.<sup>2</sup> In 1882, Logothetis et al<sup>1</sup> described six cases of this tumor, gave the current name to the syndrome, and described its characteristics. These lesions usually are located in sites where metastasis of the original NSGCT of testicular or ovarian origin<sup>8</sup> would present. For this reason, GTS has a greater propensity for the retroperitoneal space through the retroperitoneal lymphatic system. Pulmonary involve-

ment and, after that, involvement of the mediastinum and liver have been reported.<sup>4</sup> Liver involvement in germ cell tumors has been extremely rare. In a cohort of 2,219 patients with NSGCT, 57 patients underwent hepatic resection after chemotherapy for metastatic testicular cancer.<sup>3</sup>

Radical surgical excision of the mature teratoma is the only curative option for these patients. In a series of 30 patients, 24 patients underwent complete excision with only one recurrence compared with recurrences in five of six incompletely removed tumors.<sup>9</sup> Survival of patients with complete excision has been 100% in different reports.<sup>1,9,10</sup> In our patient with bilobar and multiple hepatic lesions, liver resection or other modalities for treatment of hepatic tumors was not a possibility, and LT with removal of all retroperitoneal spots was the only treatment option.

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