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Diagnosis of complications in auxiliary heterotopic partial-liver transplant recipients: Spiral CT findings

Yardımcı heterotopik parsiyel karaciğer transplant alıcılarında komplikasyonların değerlendirilmesinde spiral BT görüntüleme

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Background/aims: *Imaging is important after liver transplantation to determine possible complications. The purpose of this study was to evaluate the spiral CT findings in auxiliary heterotopic partial liver transplant recipients and to determine the incidence of these complications with spiral CT imaging.* ***Methods:*** *Twenty-one patients had auxiliary heterotopic partial liver transplantation at our institution during a two-year period. There were 16 males and five females with an age range of 4-58 years. All graft livers were transplanted to the right subhepatic space. Spiral CT was performed at least once after transplantation in twenty of the patients in order to evaluate vascular structures and determine possible complications. The 5mm and/or 8 mm thick sections were obtained through the abdomen before and after TV-contrast at the portal phase. Spiral CT findings were compared with ultrasonography (n=15), digital subtraction angiography (n=8), percutaneous transhepatic cholangiography (n=3) and laparotomy findings (n=2).* ***Results:*** *Complications were detected in fourteen of the twenty-one patients. Spiral CT detected a total of 19/23 (83%) vascular complications in this study. All biliary complications (100%), 13/16 (81%) parenchymal changes and 14/14 (100%) different forms of fluid collections were also detected by spiral CT. In three patients with focal lesions, the infarcts were detected only by CT. It was not able to detect hepatic artery stenosis and one of the pseudoaneurysms of the hepatic artery.* ***Conclusions:*** *It is suggested that SCT in particular should be used in the evaluation of biliary complications, fluid collections and parenchymal changes of graft liver. It could be used in combination with other non-invasive imaging methods for evaluation of vascular structures.*

Keywords: Auxiliary heterotopic partial-liver transplantation, complications, spiral computed tomography.

Amaç: *Karaciğer transplantasyonu sonrası komplikasyonların değerlendirilmesinde radyolojik görüntüleme önemli yer tutar. Bu çalışmanın amacı, yardımcı heterotopik parsiyel karaciğer transplant alıcılarında ortaya çıkan komplikasyonların spiral BT tekniği ile ortaya konması ve bu komplikasyonların insidansının saptanmasıdır.* ***Yöntem:*** *Merkezimizde 2 yıllık bir süre içinde, yaşları 4-58 arasında 16 erkek 5 kadın, 21 hastaya yardımcı heterotopik parsiyel karaciğer transplantasyonu yapıldı. Bütün greft karaciğerler sağ subhepatik bölgeye yerleştirilmişti. Transplantasyon sonrası 20 hastada spiral BT en az bir kere olmak üzere uygulandı. İntravenöz kontrast madde öncesinde ve sonrasında arteriyel ve/veya portal fazlarda 5-8 mm kalınlıkta kesitler alındı. Spiral BT bulguları, ultrasonografi (n=15), anjiografi (n-8), perkütan transhepatik kolanjiografi (n=3) ve laparotomi (n=2) bulguları ile karşılaştırıldı.* ***Bulgular:*** *21 hastanın 14'ünde çeşitli komplikasyonlar tespit edildi. Spiral BT görüntüleme ile damarsal komplikasyonların %83'ü, biliyer komplikasyonların %100'ü, parankimal değişikliklerin % 81'i, ve sıvı kolleksiyonlarının %100'ü tespit edildi. Fokal karaciğer lezyonu olan üç hastada bulgular sadece spiral BT ile gösterildi. Üç hastada hepatik arter stenozu ve bir hastada hepatik arter psödoanevrizması spiral BT ile görüntülenemedi. Sonuç: Spiral BT, özellikle transplantasyon sonrası biliyer komplikasyonlar, parenkimal değişiklikler ve sıvı kolleksiyonlarının gösterilmesinde yararlıdır. Damarsal yapıların değerlendirilmesinde ilk tanı aracı olarak, diğer invaziv olmayan görüntüleme yöntemleri ile birlikte kullanılabilir.*

Anahtar kelimeler: Heterotopik parsiyel karaciğer transplantasyonu, spiral komputerize tomografi.

INTRODUCTION

Liver transplantation is the treatment of choice for patients with uncompensated end-stage liver disease. Auxiliary heterotopic partial liver transplantation (AHPLT), in which the native liver is left in place, is a particularly effective way to temporarily support liver function in patients who are suffering from acute fulminant hepatic failure (1-2). Apart from it's temporary use, this technique has also begun to be used in end-stage liver disease. Liver transplantation is a life-saving procedure and it involves complex surgery. Although surgical techniques and patient follow-up after

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surgery have improved considerably, significant complications may still occur, especially those of vascular origin. It is important to diagnose these complications rapidly to minimize morbidity and mortality in these patients.

Radiological imaging techniques are important in the assessment of liver transplantation patients (3-4). To date, reports on imaging have mostly considered orthotopic transplantation (5) and radiological evaluation of AHPLT has not been adequately investigated. As a non-invasive method, spiral computed tomography (SCT) is becoming more widely used for diagnosis of complications after liver transplantation (3,5). The purpose of this study was to evaluate the SCT findings and to determine the incidence of these complications with SCT imaging in AHPLT patients.

MATERIALS AND METHODS

Twenty-one end-stage liver disease patients underwent AHPLT at our institution during a two-year period. There were 16 males and five females aged between four and 58 years. The causes of end-stage liver disease were chronic active hepatitis B infection (n:9), Wilson's disease (n:4), cryptogenic cirrhosis (n:2), chronic Budd-Chiari syndrome (n:2), chronic hepatitis C infection (n:l), autoimmune hepatitis (n:l), Alagille's syndrome (n:l), and methyl malonic acidemia (n:l).

Graft livers were transplanted to the right subhepatic space in all patients. Seven patients received left lobes from living-related donors, five received cadaveric left lobes, and nine received cadaveric right lobes.

In 20 patients, SCT was performed at least once after transplantation to evaluate vascular structures and to determine take the possible presence of complications in patients with various symptoms. One of the patients with fulminant hepatitis did not have SCT imaging because she died days after transplantation. Both 5mm and/or 8 mm thick sections were obtained through the abdomen before and after intravenous contrast administration at the portal phase. When necessary, arterial phase images were also obtained. All SCT findings were evaluated retrospectively for vascular patency of the graft and presence of thrombosis, stenosis, pseudoaneurysm formation, presence of parenchymal changes, fluid collections and biliary complications. Thrombosis in a vessel is demonstrated by the presence of a hypodense thrombus inside the vessel after IV contrast administration. Stenosis can be seen as decreased caliber of the vessel usually accompanied by post stenotic dilatation on CT images. Specific Doppler US findings should be identified for diagnosis of stenosis. Pseudoaneurysm can be defined as saccular outpouching or increase in caliber of that vessel compared to the proximal part, which does not have a true wall. Presence of fluid collections are diagnosed by CT but they are usually nonspecific although the presence of biliary complications with the fluid collection suggests biloma. A thick wall with contrast enhancement and air within the collection suggests an abscess, while hematomas are diagnosed if the collection has high density on precontrast images. Parenchymal changes can be seen as focal or diffuse hypodense areas within the graft liver, usually detected after contrast administration and they are mostly secondary to necrosis or infarction. In this study, SCT findings were compared with ultrasonography (US) in 15 patients, digital subtraction angiography (DSA) in eight patients, percutaneous transhepatic cholangiography in three patients and laparotomy findings in two patients.

RESULTS

Complications were detected in fourteen of the twenty-one patients by SCT, with the graft hepatic artery being the vascular structure mostly affected. The distribution of vascular complications was as follows: nine patients had hepatic artery thrombosis (43%), five had with portal vein thrombosis (24%), four hepatic vein thrombosis (19%), three hepatic artery stenosis (14%), two inferior vena cava thrombosis (10%), two pseudoaneurysm of hepatic artery (10%), and one portal vein aneurysm (5%).

Hepatic artery thromboses were detected in eight out of nine patients by SCT between the first and 180th day post-transplantation (Figure 1). The diagnoses were confirmed by digital subtraction angiography in six patients and at laparotomy in one. In the one patient in whom the diagnosis was not confirmed, SCT was not performed after detection of thrombosis by Doppler US and the patient immediately underwent.

Portal vein thrombosis (Figure 2) was diagnosed in four of the five patients at SCT and two were confirmed at laparotomy. All of them had totally occluded veins. One patient who had undergone cadaveric right HPLT had a partially occlusive

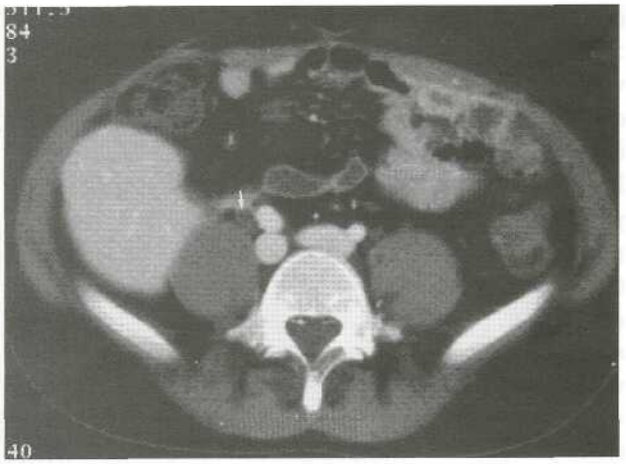

Figure 1. An 18-year-old patient with lifestyle-related AHPLT. Axial post-contrast spiral CT image showing thrombus inside the transplant hepatic artery (arrow).

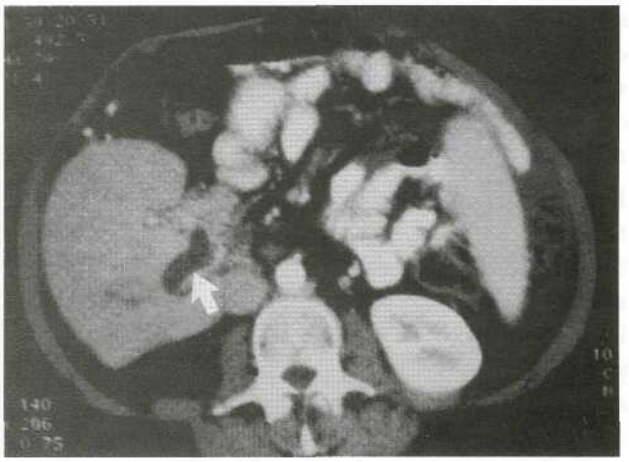

Figure 2. A 20 year-old patient with cadaveric AHPLT. Axial post-contrast portal phase spiral CT image showing portal vein thrombus totally occluding the lumen (arrow).

thrombus and SCT was not performed after Doppler US.

Thrombosis of the hepatic vein was detected in three of the four patients with SCT. The patient who had undergone cadaveric right AHPLT had a partially occlusive thrombus, but the three other thrombi were totally occlusive. One patient had laparotomy and one had hepatic venography to confirm the diagnosis. In one patient, SCT was not performed after the last US which showed the thrombus. In one patient with IVC thrombus, there was a totally occlusive thrombus, but Doppler US was negative and the diagnosis was made only by SCT. In the second, both Doppler US and CT revealed a partially occlusive thrombus (Figure 3).

The SCT was not able to detect any of the three hepatic artery stenosis. They were diagnosed by Doppler US and confirmed with angiography.

Pseudoaneurysm of the hepatic artery was detected in one of the two patients at SCT, at seven months post-transplantation (Figure 4). The diagnosis was confirmed by DSA, and the aneurysm was occluded with coils during the DSA session. In

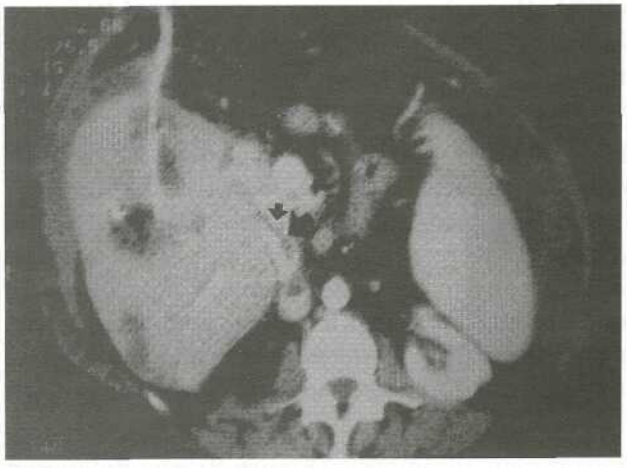

Figure 3. A 29-year-old patient with cadaveric AHPLT. Hepatic vein thrombosis extending to inferior vena cava (arrow) is demonstrated on post-contrast axial spiral CT. There is also abscess formation within the liver with a drainage catheter.

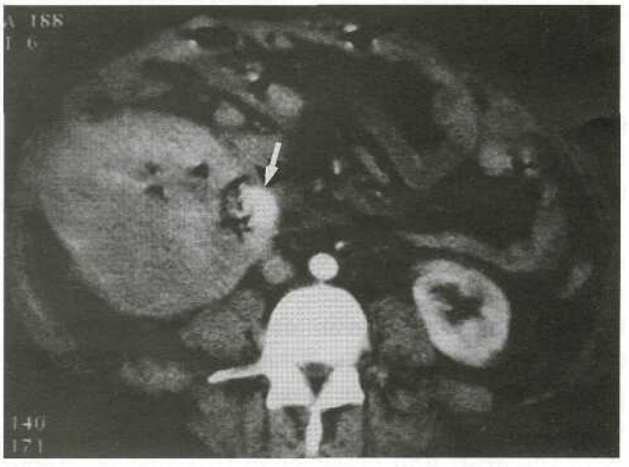

Figure 4. A 44-year-old patient with cadaveric AHPLT. Axial arterial phase spiral CT image after contrast demonstrating hepatic artery pseudoaneursym (arrow), which was also confirmed with DSA.

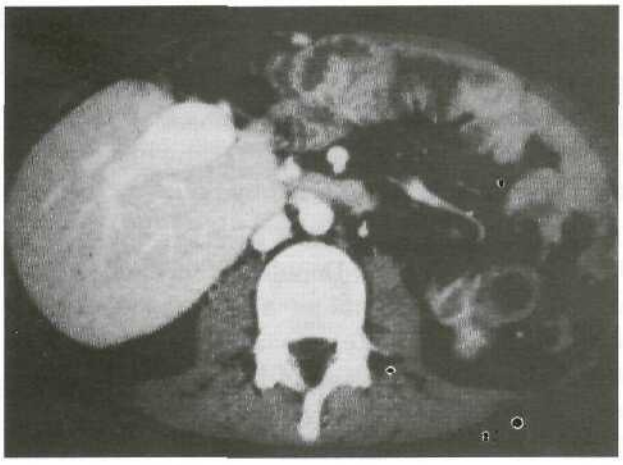

Figure 5. A 17-year-old patient with living-related AHPLT. There is a fusiform aneurysmatic dilatation of the portal vein on post-contrast spiral CT image.

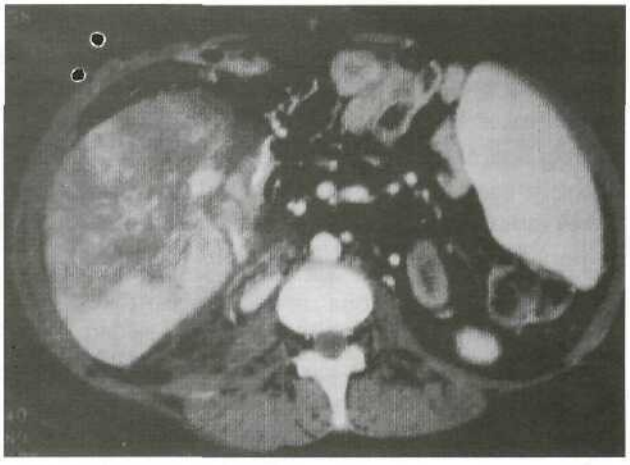

Figure 6. A 17-year-old patient with cadaveric AHPLT. There is a large area of necrosis within the liver on post-contrast spiral CT image.

the other patient, the pseudoaneurysm was not detected by SCT but seen on angiography.

Portal vein pseudoaneurysm (Figure 5) was detected in a patient in the second postoperative week by SCT, and was confirmed by MR angiography.

Seven different biliary complications were detected in five individuals (33%) and all of them were diagnosed by SCT. All five of these patients' operations had involved a hepaticojejunostomy-type anastomosis. In one patient, air within the intrahepatic bile ducts and multiple cholangitic abscesses were observed at various sites in the transplanted liver after hepatic artery thrombosis. Two patients had dilatation of intrahepatic bile ducts. Bilioma developed in three patients secondary to biliary leakage at the anastomosis site, and this problem was diagnosed by SCT. One of the these leakage cases was confirmed at laparotorny.

Sixteen patients exhibited various degrees of focal or diffuse parenchymal necrosis and infarction (Figure 6), although four of them had no detectable vascular pathology. SCT was used to diagnose the changes in 13 patients' graft livers and all of them were demonstrated by SCT. In the other three patients, US was used to diagnose the parenchymal changes and at that time, SCT had not been performed. In three patients with focal lesions, US was negative and the infarcts were only visable on SCT.

Fourteen patients developed various forms of fluid collections, including hematoma (n=6), bilioma (n=3) and abscess (n=5) formation (Figure 7). These problems were all detected by SCT.

DISCUSSION

One of the main purposes of using partial liver transplantation techniques is to decrease surgical complications. Radiologic evaluation of patients after the procedure is an important part of the fol-

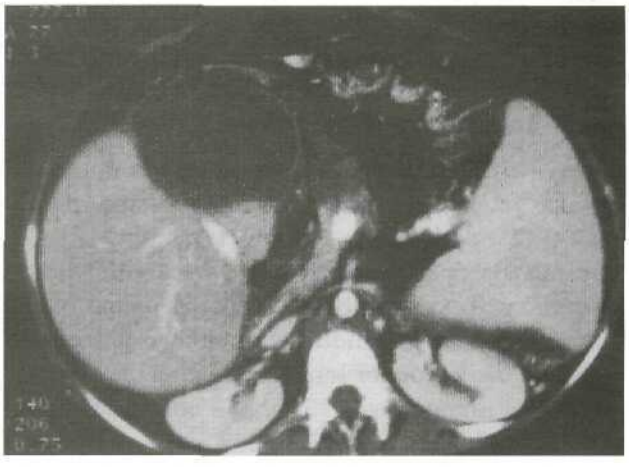

Figure 7. A 17-year-old patient with cadaveric AHPLT. There is a collection situated anteriorly next to the graft liver with rim enhancement and air within the collection. Findings were consistent with an abscess.

low-up, and the goal is early and definitive diagnosis of any complication that may arise. The SCT technique is an important part of radiologic evaluation after liver transplantation, being a noninvasive, fast and effective method (3,5). Doppler US is the initial imaging method but in cases when US is indeterminate, other methods are needed to demonstrate certain complications (5).

Vascular complications are important determinants of graft survival since they are the most common cause of graft loss, and arterial complications alone cause 7% of graft loss (6). Although angiography is still considered the gold standard technique for detecting vascular complications (7,8), SCT, as a non-invasive technique, detected 19 out of 23 (83%) vascular complications in this study.

Hepatic artery thrombosis is the most common and significant vascular complication found in AHPLT recipients, with a prevalence of 4-12% (5). It usually occurs secondary to rejection, infection, heart failure, sepsis and slow flow due to stenosis or hypotension (3,7,8). The clinical presentation varies considerably so early diagnosis depends on effective imaging. In this study all hepatic artery thromboses were detected when SCT was performed. In one patient, the thrombus was detected by Doppler US and SCT had not been performed after formation of the thrombus. Hepatic artery stenoses are not as common as thrombosis and they usually occur at the anastomosis site (9). In this study SCT technique was not able to detect hepatic artery stenosis. Hepatic artery pseudoaneurysms are one of the rare vascular complications, which may rupture and cause hemorrhages (5,6). We detected one of the two hepatic artery pseudoaneurysms.

Portal vein complications are not as common as hepatic artery problems and are detected in only 1-3% of orthotopic liver transplants (5). Thrombosis or stenosis of the portal vein occurs secondary to coagulation disorders or problems due to surgical technique, and is also associated with the use of longer lengths of veins or vascular grafts for anastomosis (5,7). We observed portal vein thrombosis in 24% of our patients. Portal vein thrombosis was detected in all the patients in whom SCT was performed at the time of diagnosis. Only one patient, with a diagnosis of portal vein thrombosis detected by Doppler US, did not undergo SCT after US.

The reported incidences of IVC and hepatic vein complications range from 0.8% to 2.6% (3,7). Occlusive complications occur mainly in the early postoperative period while stenoses occur after one month (10). In this study IVC and hepatic vein thrombosis were all detected by SCT.

Thromboses of main hepatic vessels were successfully detected by SCT. Doppler US is another noninvasive imaging technique and it was used along with SCT to evaluate vascular patency. It was especially useful in cases of hepatic artery stenosis, which SCT was not able to detect. Although the detection rate of vascular complications was high in this study (83%), it is known that Doppler US and DSA have high sensitivity rates in the detection of vascular complications, and SCT can therefore be used with other imaging methods for detecting vascular complications.

SCT imaging was particularly useful for detecting parenchymal changes secondary to vascular complications, such as areas of infarction, sites of necrosis, and intraabdominal fluid collections such as abscess, hematoma and biloma. We mainly preferred SCT to evaluate parenchymal changes and fluid collections with leakage from different organs because detection of parencymal changes are very high with SCT when compared to other imaging methods.

Biliary complications are the second most common postsurgical problem in liver transplant recipients, following acute rejection with a reported incidence of 15-25% (11). The most frequent complications are bile duct obstruction due to stones or sludge, and biliary leakage due to anastomotic defects (3). Biliary complications occurred in 33% of our patients, the most common problem being biliary leakage at the hepaticojejunostomy site, with the formation of biloma (three patients). It was found that SCT successfully diagnosed all biliary complications occurring after AHPLT.

The goal of diagnostic imaging in AHPLT recipients should always be early and definitive diagnosis of any postsurgical problem. The present outhors suggest that SCT should be used mainly in the evaluation of biliary complications, fluid collections and parenchymal changes secondary to leakage and vascular complications. It can be used in combination with other non-invasive imaging methods to evaluate the vascular structures and to select cases requiring DSA.

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