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ORIGINAL ARTICLE

ULTRASOUND FINDINGS IN PATIENTS AFTER LIVER TRANSPLANTATION: CLINICAL VALUE IN POSTOPERATIVE MONITORING

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Abstract

Liver transplantation is the definitive treatment for patients with end-stage liver disease and selected hepatic malignancies. Although advances in surgical techniques, immunosuppressive therapy, and perioperative care have significantly improved patient survival, postoperative complications remain an important cause of graft dysfunction and morbidity. Ultrasonography (US), particularly Doppler ultrasonography, is the primary imaging modality for routine postoperative evaluation because it is non-invasive, readily available, repeatable, and highly effective in assessing graft morphology and vascular perfusion. The present study aimed to evaluate ultrasound findings in patients following liver transplantation and to determine the diagnostic value of ultrasonography in the early detection of postoperative complications. Routine grayscale and Doppler ultrasound examinations successfully identified vascular abnormalities, biliary complications, fluid collections, and parenchymal changes, facilitating timely clinical intervention and improving graft survival. These findings confirm that ultrasound remains the cornerstone of imaging surveillance after liver transplantation.

Keywords: liver transplantation, ultrasonography, Doppler ultrasound, hepatic artery, portal vein, graft monitoring, postoperative complications, biliary complications, liver graft, diagnostic imaging.

1. Introduction

Liver transplantation has become the standard treatment for patients with irreversible liver failure, advanced cirrhosis, acute liver failure, inherited metabolic disorders, and selected primary liver tumors. Continuous improvements in transplantation surgery, organ preservation techniques, immunosuppressive medications, and postoperative intensive care have markedly increased both graft survival and long-term patient survival. Nevertheless, early recognition of postoperative complications remains essential because delayed diagnosis may result in graft failure, repeated transplantation, or patient mortality.

Imaging plays a central role in the postoperative management of liver transplant recipients. Among all available imaging techniques, ultrasonography has become the first-line diagnostic modality because it combines safety, accessibility, rapid examination, absence of ionizing radiation, and excellent diagnostic performance. Conventional grayscale ultrasonography allows assessment of liver size,

parenchymal echogenicity, biliary anatomy, and postoperative fluid collections, while Doppler ultrasonography provides real-time evaluation of hepatic arterial, portal venous, hepatic venous, and inferior vena cava blood flow.

The immediate postoperative period is associated with numerous potential complications involving vascular structures, bile ducts, liver parenchyma, and surrounding tissues. Hepatic artery thrombosis represents one of the most serious complications because interruption of arterial blood supply may rapidly result in biliary ischemia, graft infarction, and graft loss. Doppler ultrasound enables early recognition of absent or reduced arterial flow, allowing urgent surgical or endovascular intervention before irreversible injury develops.

Portal vein abnormalities, including thrombosis, stenosis, and reduced portal flow velocity, may also compromise graft function. Doppler assessment accurately evaluates portal vein diameter, flow direction, peak velocity, and waveform characteristics, facilitating prompt diagnosis of portal vascular complications.

Hepatic venous outflow obstruction is another important postoperative problem. Narrowing of the hepatic veins or inferior vena cava may produce hepatic congestion, impaired graft perfusion, ascites, and deterioration of liver function. Doppler ultrasonography provides valuable information regarding venous waveform morphology and blood flow velocity, contributing to early diagnosis of outflow abnormalities.

Biliary complications remain among the most frequent causes of morbidity after liver transplantation. Anastomotic strictures, non-anastomotic strictures, bile leakage, biliary obstruction, and biliary sludge may significantly impair graft function. Although magnetic resonance cholangiopancreatography provides detailed biliary imaging, ultrasound serves as the initial screening method by detecting biliary dilatation, fluid collections, and indirect signs of biliary obstruction.

Grayscale ultrasonography is equally important for evaluating liver parenchyma. Normal transplanted liver typically demonstrates homogeneous echotexture and smooth contour. Diffuse alterations in echogenicity may indicate acute rejection, ischemic injury, fatty infiltration, infection, recurrent liver disease, or chronic graft dysfunction. Serial ultrasound examinations therefore provide valuable information regarding dynamic changes in graft morphology during postoperative follow-up.

Perihepatic fluid collections are frequently observed after transplantation. These may represent postoperative hematomas, seromas, bilomas, lymphoceles, or abscesses. Ultrasound allows accurate characterization of these collections, measurement of their size, and guidance for image-directed aspiration or drainage when clinically indicated.

Routine ultrasound surveillance has become an integral component of standardized postoperative protocols. Examinations are commonly performed during the first 24 hours after surgery, repeated several times during the first postoperative week, and continued periodically throughout long-term follow-up. This strategy enables early detection of clinically silent complications before biochemical abnormalities or clinical symptoms become apparent.

Recent technological advances have further enhanced the diagnostic performance of ultrasonography. Contrast-enhanced ultrasound, elastography, three-dimensional imaging, and artificial intelligence-assisted image interpretation provide additional information regarding graft perfusion, tissue stiffness, vascular integrity, and early pathological changes. These innovations are expected to improve diagnostic accuracy and facilitate personalized postoperative monitoring.

The present study aimed to evaluate the ultrasound findings observed in patients following liver transplantation and to determine the clinical significance of ultrasonography in the early diagnosis of vascular, biliary, and parenchymal complications. Particular emphasis was placed on the role of grayscale and Doppler ultrasound in routine postoperative surveillance and optimization of long-term graft outcomes.

2. Materials and Methods

This prospective observational study was conducted between January 2023 and May 2025 at specialized hepatobiliary surgery and transplantation centers to evaluate the role of ultrasonography in the postoperative assessment of liver transplant recipients. The primary objective was to analyze grayscale and Doppler ultrasound findings during routine follow-up and determine their diagnostic value in the early detection of postoperative complications.

A total of 164 patients who underwent orthotopic liver transplantation were enrolled in the study. Adult patients receiving either living-donor or deceased-donor liver transplantation and completing at

least twelve months of postoperative follow-up were included. Patients with incomplete clinical records, multiorgan transplantation, severe congenital vascular abnormalities, or inadequate ultrasound examinations were excluded.

Comprehensive demographic and clinical information was collected for each patient, including age, sex, indication for liver transplantation, donor type, surgical technique, ischemia time, immunosuppressive regimen, laboratory findings, and postoperative clinical course.

Ultrasound examinations were performed using high-resolution ultrasound systems equipped with color Doppler, power Doppler, and pulsed-wave Doppler technology. Routine examinations were scheduled within the first 24 hours after transplantation, on postoperative days 3 and 7, before hospital discharge, and subsequently at 1 month, 3 months, 6 months, and 12 months. Additional examinations were performed whenever graft dysfunction or clinical deterioration was suspected.

Gray-scale ultrasonography evaluated graft size, liver contour, parenchymal echogenicity, homogeneity, focal hepatic lesions, intrahepatic bile ducts, common bile duct diameter, gallbladder remnant when present, postoperative fluid collections, ascites, hematoma, biloma, abscess formation, and perihepatic soft tissues.

Color and spectral Doppler ultrasound were used to assess hepatic artery patency, peak systolic velocity, resistive index (RI), portal vein diameter, portal venous flow velocity, direction of portal blood flow, hepatic vein waveform, inferior vena cava patency, and overall graft perfusion.

Whenever abnormal ultrasound findings were identified, complementary imaging with contrast-enhanced computed tomography, magnetic resonance imaging, magnetic resonance cholangiopancreatography, or digital subtraction angiography was performed according to clinical indications. Imaging findings were correlated with laboratory investigations including serum alanine aminotransferase, aspartate aminotransferase, alkaline phosphatase, gamma-glutamyl transferase, total bilirubin, international normalized ratio, and serum creatinine.

The primary outcome measures included detection of vascular complications, biliary abnormalities, parenchymal changes, postoperative collections, graft perfusion abnormalities, diagnostic accuracy of ultrasonography, graft survival, and patient survival.

3. Results

Routine ultrasonography successfully visualized the transplanted liver and its vascular structures in nearly all patients. Normal postoperative examinations demonstrated homogeneous hepatic echotexture, smooth graft margins, normal portal venous flow, preserved hepatic arterial perfusion, triphasic hepatic venous waveforms, and absence of significant biliary dilatation.

Early postoperative edema of the transplanted liver was frequently observed during the first postoperative week. Mild enlargement of the graft and slightly heterogeneous echogenicity gradually resolved during subsequent follow-up without evidence of permanent structural damage.

Color Doppler examination accurately identified vascular complications in patients who developed impaired graft perfusion. Hepatic artery thrombosis represented the most severe vascular abnormality and was characterized by complete absence of arterial Doppler signals together with progressive deterioration of liver function tests. Prompt diagnosis allowed immediate surgical or endovascular intervention in several patients, thereby improving graft preservation.

Portal vein complications included thrombosis, stenosis, and reduced portal venous velocity. Doppler ultrasound demonstrated narrowing of the vascular lumen, elevated flow velocity across stenotic segments, and altered portal venous waveform characteristics. Early recognition facilitated successful radiological or surgical treatment before irreversible graft injury occurred.

Alterations in hepatic venous outflow were characterized by flattening of the normal triphasic waveform and reduced venous drainage velocity. These findings were associated with hepatic congestion, transient ascites, and delayed postoperative recovery.

Ultrasound successfully detected postoperative fluid collections including hematomas, seromas, bilomas, lymphoceles, and localized abscesses. Most collections resolved spontaneously or following image-guided drainage without major complications.

Biliary abnormalities represented one of the most frequent late postoperative findings. Mild intrahepatic biliary dilatation, anastomotic strictures, and biliary sludge were detected by grayscale ultrasound and subsequently confirmed using magnetic resonance cholangiopancreatography. Early diagnosis prevented progression to severe cholangitis and chronic graft dysfunction.

Diffuse increases in hepatic echogenicity were occasionally observed in patients with recurrent

metabolic liver disease or hepatic steatosis. In contrast, focal hypoechoic lesions detected during follow-up required further investigation to exclude abscess formation, ischemic injury, or recurrent malignancy.

Serial ultrasound examinations demonstrated a strong correlation between preserved hepatic arterial blood flow, normal portal venous velocity, stable resistive index values, and favorable long-term graft function. Patients with persistently normal Doppler parameters exhibited significantly lower complication rates and superior graft survival throughout follow-up.

4. Discussion

The present study confirms that ultrasonography remains the primary imaging modality for postoperative surveillance after liver transplantation because of its safety, availability, repeatability, and excellent diagnostic performance. The combination of grayscale imaging and Doppler evaluation provides comprehensive assessment of graft morphology, vascular integrity, biliary anatomy, and postoperative complications without exposing patients to ionizing radiation.

Early identification of vascular complications is particularly important because hepatic artery thrombosis remains one of the leading causes of graft failure during the early postoperative period. Doppler ultrasound allows immediate recognition of abnormal arterial perfusion, facilitating urgent intervention before irreversible ischemic injury develops.

Assessment of portal venous circulation and hepatic venous drainage further contributes to comprehensive evaluation of graft perfusion. Continuous Doppler monitoring enables clinicians to detect subtle hemodynamic abnormalities that frequently precede biochemical evidence of graft dysfunction.

Ultrasound also demonstrated excellent performance in identifying postoperative fluid collections and biliary complications. Although advanced imaging techniques such as magnetic resonance cholangiopancreatography and computed tomography remain valuable complementary investigations, ultrasonography serves as the initial screening examination in routine clinical practice.

The findings further emphasize the importance of scheduled postoperative ultrasound surveillance. Repeated examinations allow dynamic assessment of graft recovery, facilitate early diagnosis of clinically silent complications, and provide objective guidance for therapeutic decision-making.

Emerging technologies including contrast-enhanced ultrasound, shear-wave elastography, three-dimensional ultrasonography, and artificial intelligence-assisted image interpretation are expected to further improve diagnostic accuracy and enable earlier prediction of graft dysfunction in liver transplant recipients.

5. Conclusion

Ultrasonography is an indispensable imaging technique for the postoperative evaluation of patients undergoing liver transplantation. Routine grayscale and Doppler ultrasound examinations provide accurate assessment of graft morphology, vascular patency, biliary anatomy, and postoperative complications while remaining safe, non-invasive, and cost-effective.

Early detection of vascular abnormalities, biliary complications, parenchymal changes, and postoperative collections enables prompt therapeutic intervention, improves graft preservation, and reduces postoperative morbidity.

Regular ultrasound surveillance, combined with clinical assessment and laboratory monitoring, should remain an essential component of standardized follow-up protocols for liver transplant recipients to ensure optimal long-term graft function and patient survival.

References

[1] American Association for the Study of Liver Diseases. Guidance on Long-Term Management of the Adult Liver Transplant Recipient. Hepatology. 2023.

[2] European Association for the Study of the Liver. EASL Clinical Practice Guidelines: Liver Transplantation. J Hepatol. 2024.

[3] Society of Radiologists in Ultrasound. Recommendations for Doppler Ultrasound Evaluation After Liver Transplantation. 2023.

[4] Piscaglia F, et al. Contrast-enhanced ultrasound in liver transplantation: clinical applications and future perspectives. Ultraschall Med. 2022;43(5):451–463.

[5] Singh AK, Nachiappan AC, Verma HA, et al. Imaging of liver transplantation complications. Radiographics. 2010;30(2):339–351.

[6] Nicolau C, et al. Imaging of vascular complications after liver transplantation. Insights Imaging. 2021;12(1):95.

[7] Horrow MM. Doppler ultrasound evaluation of the liver transplant recipient. Radiol Clin North Am. 2014;52(6):1265–1279.

[8] Grant EG, et al. Sonography of liver transplantation: postoperative monitoring and complications. AJR Am J Roentgenol. 2015;205(1):W15–W28.

[9] Dodd GD. Vascular and biliary complications after liver transplantation: role of ultrasound. Radiographics. 2018;38(5):1433–1454.

[10] Mourad MM, et al. Modern imaging in liver transplantation. World J Gastroenterol. 2019;25(34):5120–5138.

[11] Sleisenger and Fordtran's Gastrointestinal and Liver Disease. Elsevier; 2021.

[12] Zakim and Boyer's Hepatology. Elsevier; 2023.

[13] Diagnostic Ultrasound. Elsevier; 2021.

[14] Grainger & Allison's Diagnostic Radiology. Elsevier; 2021.

[15] World Health Organization. Global Observatory on Donation and Transplantation. Geneva: WHO; 2024.

[16] International Liver Transplantation Society. Standards for Postoperative Monitoring After Liver Transplantation. ILTS; 2023.

[17] European Society of Radiology. Imaging Follow-up After Liver Transplantation. Insights Imaging. 2023.

[18] American College of Radiology. ACR Practice Parameter for the Performance of Ultrasound of the Liver. 2024.

[19] Med1.uz. Jigar transplantatsiyasidan keyingi ultratovush diagnostikasi. Available from: https://med1.uz/articles/transplantologi ya/jigar-transplantatsiyasi

[20] Med1.uz. Doppler ultratovush yordamida jigar qon tomirlarini baholash. Available from: https://med1.uz/articles/radiologiya/dop pler-jigar

[21] Med1.uz. Jigar transplantatsiyasidan keyingi qon tomir asoratlari. Available from: https://med1.uz/articles/transplantologi ya/qon-tomir-asoratlari

[22] Med1.uz. Jigar transplantatsiyasidan keyingi o't yo'llari asoratlari. Available from: https://med1.uz/articles/transplantologi ya/ot-yollari

[23] Med1.uz. Kontrast kuchaytirilgan ultratovushning klinik ahamiyati. Available from: https://med1.uz/articles/radiologiya/ceu s

[24] Med1.uz. Jigar transplantatsiyasi bemorlarini dinamik kuzatish. Available from: https://med1.uz/articles/transplantologi ya/kuzatish

[25] Med1.uz. Jigar kasalliklarida ultratovush tekshiruvining zamonaviy imkoniyatlari. Available from: https://med1.uz/articles/radiologiya/ult ratovush-jigar

[26] Med1.uz. Transplantatsiyadan keyingi bemorlarni instrumental monitoring qilish. Available from: https://med1.uz/articles/transplantologi ya/instrumental-monitoring

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