

Color Doppler and Duplex Study in Assessment of Recipient Patients in Post Liver Transplantation

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ABSTRACT

Background: Liver transplantation is currently accepted as a first line treatment for patients with end-stage acute or chronic liver diseases. Graft survival and overall patient survival have steadily improved since the first transplants were performed in the early 1960s, but a significant percentage of transplants develop complications related to vascular and biliary insufficiency. Graft ischemia after liver transplantation is associated with a high incidence of morbidity and mortality. **Aim of the Work:** was to evaluate the sensitivity of Duplex ultrasound in detection most of vascular complication after liver transplantation in correlation with CT angiography. **Patients and Methods:** The study was done from July 2017 until January 2018, where 20 cases who underwent living donor liver transplantation with post-operative complications. The cases were done at Dar Al Fouad Hospital and National Liver Institutes. The cases were 16 males and 4 females. All cases were admitted to post-transplanting intensive care unit in the postoperative period where a routine full laboratory and radiological assessment were done. The laboratory assessment included full liver function tests, kidney function tests, complete blood picture, and C-Reactive Protein. Immunosuppressant level and bilirubin level in drains had also done. **Results:** The patient age ranges from 43 to 80 years with the mean age of 61.5 years. Eighteen cases had hepatitis C related cirrhosis (90%) One case had veno-occlusive disease related cirrhosis (Budd Chiari syndrome). One case was Wilson disease. About 95% of cases were suffering from end stage liver disease. The results we have reached are that Doppler U/S sensitivity in diagnosis of these complications is about 75%. **Conclusion:** It could be concluded that gray-scale US and color Doppler are the investigations of choice in postoperative liver transplantation. They can be used as routine steps in the assessment of liver transplant graft postoperatively in recipient patient as early as possible within the first 3 days after operation and used as a late follow up, as they are noninvasive, safe, cheap, and accurate. Routine use of gray-scale US and color Doppler showed to minimize the impact of postoperative complications and maximize both graft and recipient patient survival.

Keywords: Color Doppler, Duplex Study, Recipient Patient, Post Liver Transplantation.

INTRODUCTION

Liver transplantation is currently accepted as a first line treatment for patients with end-stage acute or chronic liver diseases ⁽¹⁾.

Graft survival and overall patient survival have steadily improved since the first transplants were performed in the early 1960s, but a significant percentage of transplants develop complications related to vascular and biliary insufficiency. Graft ischemia after liver transplantation is associated with a high incidence of morbidity and mortality ⁽²⁾.

Biliary and vascular complications and rejection of the transplanted liver are the main causes of malfunction and loss of the hepatic graft. Advances in medical therapy over the last few years have led to a more efficient diagnosis and treatment of postoperative complications after orthotopic liver transplantation, thereby increasing the survival rate after liver transplantation ⁽³⁾.

Vascular complications include; hepatic artery stenosis and thrombosis, portal vein stenosis and thrombosis, caval and hepatic veins obstruction,

arterial pseudo aneurysm. Biliary complications include; biliary leakage, stricture and obstruction ⁽⁴⁾.

A multimodality approach including ultrasonography and cross-sectional imaging studies often is most effective for diagnosis. Each imaging modality has specific strengths and weaknesses, and the diagnostic usefulness of a modality depends mainly on the patient's characteristics, the clinical purpose of the imaging evaluation, and the expertise of imaging professionals ⁽¹⁾.

Ultrasound is the initial imaging modality of choice for detection and follow-up of early and delayed complications from all types of liver transplantation. Knowledge of the surgical technique of liver transplantation permits early detection of complications and prevents misdiagnosis ⁽⁵⁾.

Doppler study in the postoperative period is a safe, accurate and non invasive method of demonstrating, evaluating non vascular complications in the hepatic parenchyma and bile

duct abnormalities and extra hepatic tissue in the recipient ⁽⁴⁾.

Color Doppler flow and pulsed Doppler U.S. evaluate vessel patency, and are frequently used to distinguish dilated bile ducts and blood vessels and also can evaluate the extrahepatic portal venous system ⁽⁶⁾.

The aim of this study was to evaluate the sensitivity of Duplex ultrasound in detection most of vascular complication after liver transplantation in correlation with CT angiography.

PATIENTS AND METHODS

This retrospective study included a total of 20 cases with post-operative liver transplantation complications, attending at Dar Al Fouad Hospital and National Liver Institutes. Approval of the ethical committee and a written informed consent from all the subjects were obtained. This study was conducted between July 2017 until January 2018.

The cases were 16 males and 4 females. All cases were admitted to post transplanting intensive care unit in the postoperative period where a routine full laboratory and radiological assessment were done. The laboratory assessment included full liver function tests, kidney function tests, complete blood picture, and C-Reactive Protein. Immunosuppressant level and bilirubin level in drains had also done.

The routine radiological assessment was ultrasound and duplex assessment of the patient as well as chest X ray, both were done on daily basis. CT angiography is ordered in the following cases:

Inclusion criteria:

- Portal vein thrombosis in the ultrasound study
- Increased resistive index of hepatic artery
- Signs of portal hypertension
- Evidence of IVC or hepatic vein thrombosis
- Clinical signs of graft failures or rejection (fever, elevated TLC, etc..)

Ultrasound and duplex assessment:

The ultrasound and duplex assessment were done by GE LOGIC P5 – PHILIPS CLEAR VUE 850 machines using the curved 3.5-5 MHz probe with color and spectral facilities. The liver is first assessed for size and abnormal echogenicity such as area of infarctions or congestions. Assessment of the presence of dilated biliary system was done to exclude biliary strictures, also assessment for any collections and biloma were done and any collection mentioned by site and estimated volume.

Technique of Triphasic CT and CT angiography:

Seventeen cases were examined by CT either for abnormal ultrasound Doppler finding or abnormal clinical and laboratory findings. CT scans were done with a dual 64 channel multi-detector row CT scanner (GE 660 – 64 SLICES).

Image processing and reconstruction:

All phases of the study were assessed using maximum intensity projections with volume rendering techniques with zooming on areas of abnormal findings.

The statistical methodology:

Data were statistically described in terms of mean \pm standard deviation (\pm SD), median and range, or frequencies (number of cases) and percentages when appropriate. Comparison of numerical variables between the study groups was done using Student *t* test for independent samples. For comparing categorical data, Chi square (χ^2) test was performed. Within group comparison was done using McNemar test while agreement was done using kappa statistic. *p* values less than 0.05 was considered statistically significant. All statistical calculations were done using computer programs SPSS (Statistical Package for the Social Science; SPSS Inc., Chicago, IL, USA) version 15 for Microsoft Windows.

RESULTS

Vascular complications were assessed in the examined patients; it has been found that portal vein thrombosis is the most common complications, followed by hepatic artery stenosis.

Table (1): The incidence of each complication.

| Complication | Number of cases | Percentage |
|---|-----------------|------------|
| Portal vein thrombosis | 9 | 45% |
| Hepatic artery stenosis and total occlusion | 5 | 25% |
| Hepatic artery- portal vein fistula | 3 | 15% |
| Hepatic artery aneurysm | 2 | 10% |
| IVC and hepatic vein thrombosis | 2 | 10% |
| Total | 20 | 100 % |

hepatic artery complications were seen in 5 patients , the sensitivity of duplex in such cases turned to be about 60 %

Table (2) shows that cases with normal Doppler study were normal by CTA. However, cases with undetectable Doppler signals in HA were related to arterial thrombosis, attenuated flow, spasm or technical difficulty as declared by CTA.

Table (3): The difference between CTA and duplex study in detecting patency of the hepatic artery.

| | Patent | Stenosed/occluded |
|--------------------|--------|-------------------|
| CT Angiography | 15 | 5 |
| Duplex | 17 | 3 |
| Duplex Sensitivity | 60 % | |

Portal vein thrombosis is seen in 9 cases , 6 cases could be identified by duplex study, with sensitivity of about 67 %

Table (4): The difference between CTA and duplex study in detecting portal vein thrombosis.

| | Patent | PV Thrombosis |
|--------------------|--------|---------------|
| CT Angiography | 11 | 9 |
| Duplex | 14 | 6 |
| Duplex Sensitivity | 66.6 % | |

Hepatic artery – portal vein fistula as well as hepatic artery aneurysm and IVC thrombosis, all of the cases could be diagnosed by duplex, giving a 100% sensitivity and declaring the duplex as the gold standard in such cases.

Table (5): The difference between CTA and duplex study in detecting Hepatic artery – portal vein fistula.

| | Patent | AV - Fistula |
|--------------------|--------|--------------|
| CT Angiography | 17 | 3 |
| Duplex | 17 | 3 |
| Duplex Sensitivity | 100 % | |

Table (6): The difference between CTA and duplex study in detecting Hepatic artery aneurysm

| | Patent | Hepatic artery aneurysm |
|--------------------|--------|-------------------------|
| Ct Angiography | 18 | 2 |
| Duplex | 18 | 2 |
| Duplex Sensitivity | 100 % | |

Table (7): The difference between CTA and duplex study in detecting IVC and hepatic vein thrombosis

| | Patent | Hepatic Veins and IVC Thrombosis |
|--------------------|--------|----------------------------------|
| CT Angiography | 18 | 2 |
| Duplex | 18 | 2 |
| Duplex Sensitivity | 100 % | |

From the above numbers we can conclude that Duplex US sensitivity in detecting vascular complications in post liver transplantation patients is 75 %. with highly positive predictive value and positive like-hood ratio which mean that positive findings in duplex study is usually indicative of the presence of complication while the negative findings in duplex study doesn't always mean the absence of complications.

DISCUSSION

Liver transplantation is lifesaving treatment for patient with liver cell failure. Improvement of preoperative selection, surgical techniques, immunosuppressive therapy, postoperative care and follow up has resulted in increased patient graft survival after the transplantation (7).

There are two sources for liver graft which are cadaveric liver and a hepatic segment from a living donor. The former one isn't available at our country because of ethical and social issues. Also, we still haven't a law that allows organ retrieval from recently dead donors. In the 1980s, partial liver transplantation was slowly developed to become a feasible option in the treatment of end stage liver disease depending on the knowledge of segmental liver anatomy. Particularly the systematic description done by Couinaud contributed very much to liver surgery. Based on this knowledge, anatomical liver resections, respecting the vascular perfusion of the remaining segments, could be performed. The practical feasibility of split-liver transplantation as well as the increased safety of conventional liver surgery suddenly opened up the idea of removing part of the liver from a living donor to transplant it in a smaller recipient (8).

The complications rate for living donor liver transplantation is higher than the cadaveric whole liver transplantation, although the survival is comparable (8).

Despite the improvement in the liver transplantation surgical techniques and post-

operative management, there are still significant and life threatening complications that can lead to graft failure and increased patient morbidity and mortality. Imaging is very important in early diagnosis and management of these complications⁽⁹⁾.

In our retrospective study, we gathered data from the examined 20 patients with multiple pathologies related to liver transplantations.

The results we have reached are that Doppler U/S sensitivity in diagnosis of these complications is about 75%.

This finding is supported by other researches as **Lomas *et al.***⁽¹⁰⁾ who concluded that the sensitivity of color coded duplex sensitivity if detecting post operative vascular complications of liver transplantations approach 69 %.

In our study, the most common post operative complication was portal vein thrombosis (45 %).

This is comparable to other researches as **Lukšaitė *et al.***⁽¹¹⁾ who found that hepatic artery stenosis is the most common complication.

This could be due to the fact that portal vein thrombosis will almost invariably occur in end stage cirrhosis and most of our cases were in end stage condition.

In our study, we concluded that duplex study has a sensitivity of 60% in detecting hepatic artery stenosis.

This finding could be correlated with **Nolten and Sproat**⁽¹²⁾ who concluded that the sensitivity of duplex is detecting hepatic artery stenosis is around 54 %.

In our study, we concluded that duplex study has a sensitivity of 66.6 % in detecting portal vein thrombosis.

This is comparable to other researchers **Bhargava *et al.***⁽¹³⁾ who concluded that the sensitivity of duplex is 73 %.

CONCLUSION

It could be concluded that gray-scale US and color Doppler are the investigations of choice in postoperative liver transplantation, they can be used as a routine steps in the assessment of liver transplant graft postoperatively in recipient patient as early as possible within the first 3 days after operation and used as a late follow up, as they are noninvasive, safe, cheap, and accurate. Routine use of gray-scale US and color Doppler showed to minimize the impact of postoperative complications

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