

**Intraoperative Color Doppler assessment of hepatic vasculature integrity: A Case Report****Ahmad Mokhtar Abodahab<sup>a\*</sup>, Ebtsam Ahmed Mohammed Abdelbary<sup>a</sup>**<sup>a</sup>Department of Radiology, Faculty of Medicine , Sohag University, Sohag, Egypt**Abstract**

**Background:** Color Doppler is an important, noninvasive, non-ionizing imaging modality for assessment of vascular system of most parts of the body "Neck, limbs, hepatic vasculature ....etc.". It is commonly used to assess patient either before medical or surgical treatment but less common to be used intraoperative. Color Doppler assessment of hepatic vasculature in the daily work is commonly used to assess patency of portal vein and hepatic artery and to assess the hemodynamics of hepatic blood flow. Intraoperative assessment of hepatic vasculature integrity is not a common use of Doppler. It can help the surgeon to complete his operation on the usual steps with confirming non injury of hepatic vasculature.

**Case Report:** We present a case who presented to Sohag University Hospital outpatients clinics by repeated right hypochondrial pain. Ultrasound was done and revealed that he has chronic calcular cholecystitis with a stone obstructing cystic duct the surgeon decided to do cholecystectomy. During the operation a sudden profuse bleeding at the site of hepatic hilum occurs, the surgeon doubt that a major vessel "Hepatic artery or portal vein was injured ", so he asked for urgent color Doppler assessment of hepatic vasculature integrity.

**Conclusion:** Color Doppler examination is an important tool for assessment of vascular system of different organs including liver. It can be used intraoperatively to confirm integrity of blood vessels and exclusion occurrence of iatrogenic complication during the operation itself, guiding the surgeon to make a suitable decision during the same setting and avoiding re-exploration of the patient.

**Keywords:** Color Doppler; Intraoperative Color Doppler; Hepatic vascular injury.

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## Introduction

Color Doppler is an important diagnostic imaging modality for vascular system. It has many advantages like being noninvasive, non-ionizing, imaging of vessel cavity, wall and surrounding structures, live imaging and good assessment of hemodynamics parameters of each vessel examined (Castro-Santos et al., 2021). Like ultrasound it has also its limitations in use such as gases masking (as in surgical emphysema or GIT gases masking abdominal vessels). It needs patient's cooperation and operator must be understanding physics of Doppler as using of unsuitable angle (especially 90 degree) can give miss leading finding (Sharipov et al., 2016).

Vascular injury is a common complication, which may be fatal if the injury involving major vessels or associated with excessive bleeding with improper or delayed management. Unhealthy vessels are more liable to injury (eg. atherosclerotic) and repair or control may be more difficult. Bleeding especially

when profuse can mask the source vessel especially if deeply located. Minor vascular injury usually needs no therapy other than stop bleeding either by diathermy or ligation, while major vessels injury requires specific treatment and repair according to site of the vessel and organ supplied by it. Option of total ligation is impossible for major vessels supplying life depending organs like liver, so the surgeon must confirm its integrity intraoperative if injury of it is suspected (Jeremy S. et al., 2000).

## Presentation of the case report

**Clinical history and examination:** A male patient 67 years was complaining of severe repeated right hypochondrial pain, who presented to Sohag University Hospital outpatients' clinics. Clinical examination, Lab investigations and abdominal Ultrasound was done and revealed that he has chronic calculous cholecystitis (Fig.1) with a stone obstructing cystic duct causing severe pain for the patient. The surgeon decided to do cholecystectomy to the patient.



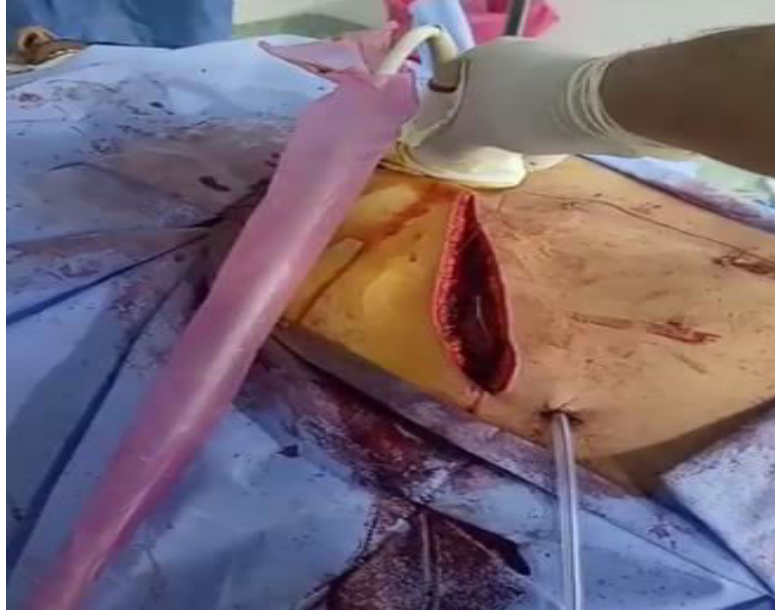
**Fig. 1.** Gross picture of surgical removed gall bladder & cut section showing significantly thick wall, and a large stone is seen adjacent.

During the operation after removing of gall bladder a sudden profuse bleeding occurred at the site of hepatic hilum and did not stop with their surgical measures, the surgeon doubted that a major vessel "Hepatic artery or portal vein was

injured" so he asked one from the operative team to call the radiologist urgently for consultation. Within minutes the radiologist was with him inside the operative theater after applying sterilization measures.

**Imaging findings:** After transient intraoperative hemostasis surgical measures, Color Doppler machine of radiology department was transmitted urgently to operative theater, Color Doppler Sonar was done using a GE Logiq P9 with a convex transducer (frequency: 5.5 MHz) for intraoperative examination. The linear

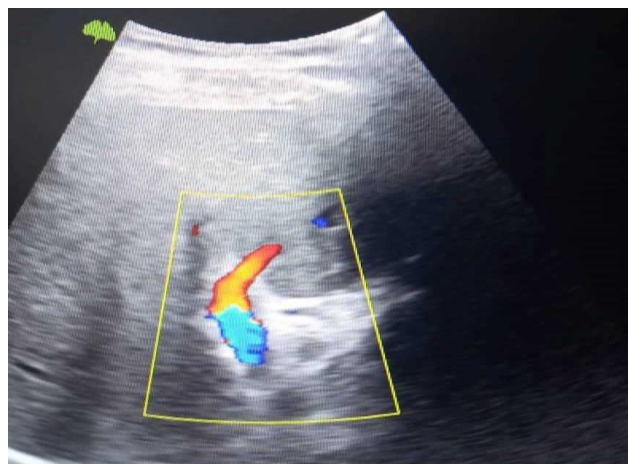
probe used for scan is highly disinfected by alcohol and covered by disposable sterilized latex cover. Scan of hepatic hilum and vessels was done by applying probe percutaneous intraoperative intercostal (as subcostal region was inappropriate for scan due to incision) (**Fig.2**).



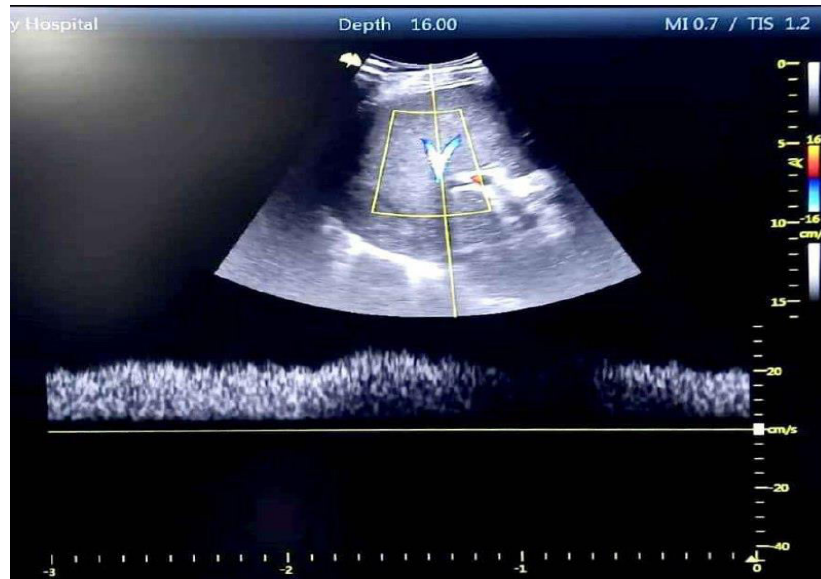
**Fig. 2.** Color Doppler examination of the patient during operation inside operative room under complete aseptic measures.

In B mode (Gray scale) vessels was intact and patent with anechoic lumen, no abnormality was detected, PV diameter was 11 mm. The color

Doppler scan revealed intact patent Portal vein with peak velocity below 20 cm / sec (**Fig.3&4**).



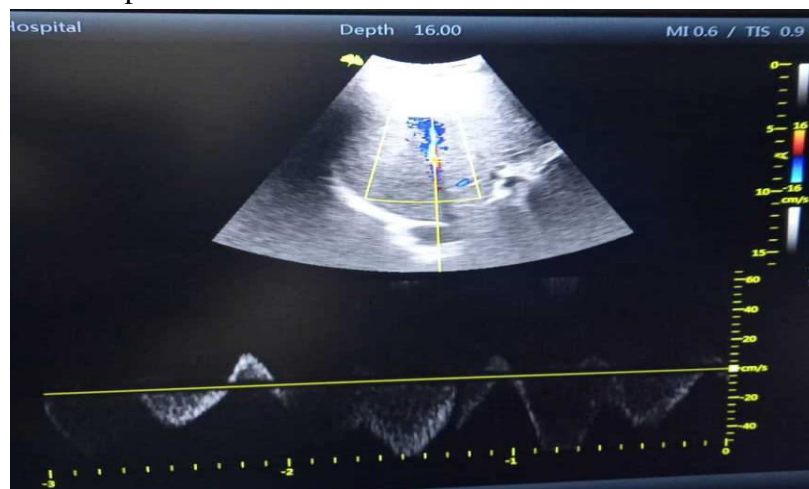
**Fig. 3** Color Doppler examination, portal vein showing complete color filling of portal vein and main branch.



**Fig. 4.** Color Doppler examination, Pulsed wave Doppler scan of Portal vein showing intact vessel with minimally fluctuant venous blood flow with respiration of maximal velocity < 20 cm.

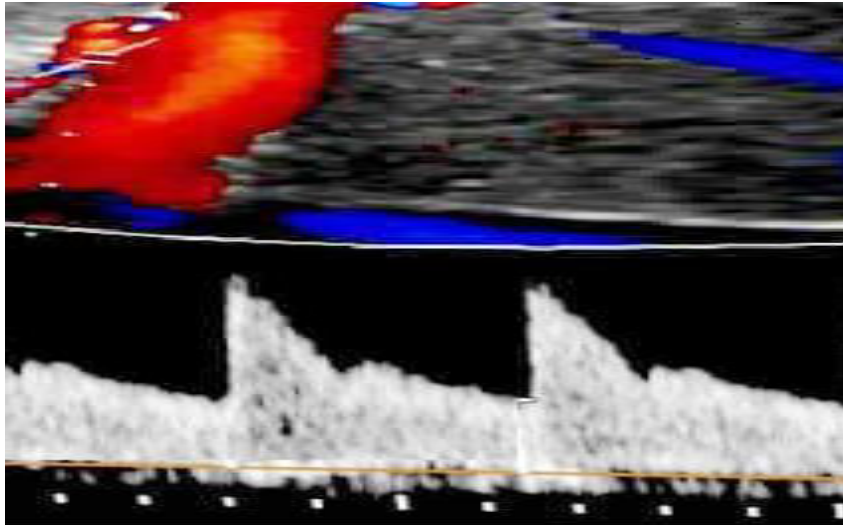
Hepatic vein and hepatic artery also was intact and showing normal blood flow which fluctuant with average hemodynamic parameters (**Fig.5&6**). After scanning of hepatic main vessels more than one time under the limited circumstances inside operative room of a patient under anesthesia with an opened Rt subcostal incision, the discission was to complete the operation without additional or exceptional steps (**Fig.7**) after integrity of main hepatic vessels and

preserved blood supply of the liver has been confirmed. Clinical and lab follow up of the patient was done with the days after operation. The patient was improved and discharged later. Figures in this article was obtained by direct photographing of Ultrasound machine screen by an assistant as PACS in Sohag University hospital is not connected to ultrasound machines (**Abodahab et al., 2020**).



**Fig. 5.** Color & Pulsed wave Doppler scan of Hepatic vein showing intact vessel with minimally fluctuant venous blood flow of maximal velocity < 20 cm





**Fig. 6.** Color & Pulsed wave Doppler scan of Hepatic artery showing intact vessel with normal low resistance biphasic flow, other indices (RI & PI) wasn't assessed as the purpose of the scan was just emergency assessment of vascular integrity.



**Fig. 7.** Finishing the operation after confirming the integrity of hepatic vessels.

### Discussion

Color Doppler phenomenon was discovered by Christian Doppler at 1840s . Emitted US waves reflects from the moving object and changes the frequency. Difference between the two frequencies is called Doppler shift and is proportional to the speed of the moving object, the most important point that at 90° angle no Doppler signal, so Doppler operator must

understand these basics to avoid misdiagnosis. Normal Portal vein Doppler Velocity 15-30 cm/s , Velocity decreases in inspiration (due to increase in diameter > 20%). Mild oscillation with cardiac cycle and hepatoportal direction (i.e. toward the liver) . Normal portal vein diameter up to 13 mm. Hepatic artery Diameter up to 3 mm, with blood flow velocity 30-60 cm/s, Low-resistance Doppler waveform (McNaughton et

al., 2011 & Grgurevic et al., 2017). Intra operative color Doppler examination is not a common technique neither in general radiological practices nor in Sohag University Hospital. It can be indicated when a suspected intra operative vascular complication is suspected and Doppler is able to diagnose it. Color Doppler has its own advantages like being portable, non-ionizing, non-invasive and real time imaging of vascular wall, cavity and hemodynamics (Grgurevic et al., 2017). The color Doppler is totally noninvasive method in assessment of vascular injuries, so No doubt that our research is strongly agreeing with Many researches even if done decades ago (as J. M. Gilsbach & W. E. Hassler 1984 ) which approve the role of color Doppler in assessment of vascular injury in neurosurgery operations. Our study is agreeing with Okeke et al about the important role of color Doppler of intra operative vascular assessment. Intraoperative role of color doppler other than hepatic was discussed in other researches as (Salah E. Shebl 2023).

### Conclusion

Color Doppler examination is an important tool for assessment of vascular system of different organs including liver. It can be used intraoperatively to confirm integrity of blood vessels and exclusion occurrence of iatrogenic complication during the operation itself, guiding the surgeon to make a suitable discission during the same setting and avoiding re-opening of the patient and exposing him for more surgical hazards. Intraoperative Doppler is a dependent tool for confirming or excluding.

### Abbreviations

**PV** Portal Vein

**GIT** Gastrointestinal Tract

**PACS** Picture Archiving & Communication System

**CDS** Color Doppler Sonography

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