# UPDATE IN PORTAL VEIN IMAGING AND EMBOLIZATION

**EASSY**
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**IN RADIODIAGNOSIS**

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# INTRODUCTION

The portal venous system comprises all of the veins draining the abdominal part of the digestive tract, including the lower esophagus. The portal vein conveys blood from viscera and ramifies at the liver ending at the sinusoids. Tributaries of the portal vein, which make up the portal venous system are the splenic, superior mesenteric, left gastric, Para umbilical, cystic and inferior mesenteric veins. **(Gray H., 2004)**

Knowledge of the normal anatomy, most frequent variants, congenital and acquired anomalies of the portal venous system is of great importance for liver surgery and interventional procedures. Among the most common variants of the portal vein are trifurcation, right anterior portal branch arising from the left portal vein and right posterior portal branch arising from the main portal vein. Agenesis of the right or left portal vein is the most frequently reported congenital anomaly.**(Chevallier et al., ٢٠٠٢)**

Radiologic evaluation of the portal vein and its anomalies is usually performed with color Doppler ultrasonography (CDUS), helical computed tomography ( CT ), magnetic resonance (MR), Multi detector CT and MR portography. Arterial

porotgraphy and direct portography may also be used. **(Bolondi et al., 2001)**

Color Doppler ultrasonography (CDUS) provides rapid, comprehensive, and accurate evaluation of the portal vein and flow direction. This versatile technique can be performed at the patient's bedside, intraopertively, or immediately postoperatively. **(Bolondi et al., 2001)**

In helical dynamic computed tomography (CT), images are rapidly and continuously acquired during a single breath hold, resulting in improved spatial resolution and the elimination of motion artifacts. Multi-detector row CT is the latest advancement in CT technology and is now more readily available than in the past. The increased speed and narrower collimation of multi-detector row CT, together with the use of intravenously administered contrast material, improves visualization of the portal vein. **(Kang et al., 2002)**

MR venography after administration of gadolinium contrast material is highly accurate in mapping the portal vein anatomy and identifying its anomalies. The accuracy of delineating the anatomy is increased by using multiplanar reconstruction. MR venography is considered a non invasive procedure.**(Prince et al., 2003)**

Proper imaging of the portal vein is an important step which allows further intervention in the portal venous system. These interventions include the portal vein embolization (PVE). **(Madoff et al., 2003)**

Portal vein embolization (PVE) is gaining acceptance in the preoperative management of patients selected for major hepatic resection. PVE redirect portal blood flow to the intended liver remnant to include hypertrophy of the non diseased portion of the liver and thereby reduce complication and shorten hospital stays after resection. **(Madoff et al., 2005)**

# AIM OF WORK

The aim of this work is to review the state of the art of different imaging modalities of the portal vein and portal vein intervention.

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# Acknowledgment

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# *Abastract*

Recent less or even non invasive imaging modalities for portal vein are available nowadays including ultrasound and Doppler assessment of the portal vein, Multislice CT portography and MR portography.

Ultrasound & Doppler study of the portal vein is the dominant first line investigation & assessment of the portal vein pathology & direction of blood flow within because of its non invasive and comparatively accessible nature. It is also helpful for intra-operative assessment and scanning the whole of the upper abdomen focusing particularly on the relevant areas, but also excluding or identifying any other significant pathology.

Although it is relatively inexpensive, portable, and non-invasive, is operator dependent and may be handicapped by fatty change in the liver causing beam attenuation, bowel gas obscuring parts of the upper abdomen and limited access for Doppler insonation in obese patient.

MSCT angiography study of the portal vein (CT portography) with post processing of the imaging data with a variety of three-dimensional reformatting techniques (e.g., MIP,SSD,VR) is the latest advancement in CT technology and is now more readily available than in the past.

It allow creation of vascular maps whose quality equals the classic angiography for many application such as preoperative planning for hepatic resection, preoperative evaluation and planning for liver transplantation , pretreatment planning for patients considered for hepatic arterial infusion chemotherapy, and pre-treatment evaluation of portal vein patency for a variety of reasons. It also helps in the evaluation of vascular anatomical information, vascular invasion of tumors; provide supplemental information in patients with cirrhosis, upper gastrointestinal tract bleeding due to varices, or primary extrahepatic neoplasms.

3D CE MR Portography becomes available as one of the minimally invasive imaging modalities of portal venous system. It does not carry the risk of ionizing radiation or the potential hazards of iodinated contrast media. It eliminates the drawbacks and fallacies of non enhanced MR angiographic

studies performed with time of flight (TOF) and phase contrast (PC) techniques.

Reconstruction of images by means of MIP post-processing, and a subtraction technique can be employed to eliminate arterial enhancement and demonstrate Porto-systemic shunts. The source images simultaneously demonstrate parenchymal lesions of the liver, pancreas, biliary tract and spleen.

PVE is a safe and effective method for inducing selective hepatic hypertrophy in the appropriate clinical setting. This technique usually reserved for those patients whose FLR is too small to allow safe resection, may reduce complications and shorten hospital stays after resection. The beauty of the reversible PVE is both the short term liver regeneration and potential preservation of the embolized liver recovers after recanalization, at least three clinical outcomes would be expected.

In addition, the indications and contraindications for PVE, the methods for assessing hepatic lobar hypertrophy, the means of determining optimal timing of resection and the possible complications of

PVE need to be fully understood before undertaking the procedure.

Technique may vary among operators, and further research is necessary to determine the best embolic agents available and the expected rates of liver regeneration for PVE. Nevertheless, as hepatobiliary surgeons become more experienced at performing extended hepatic resections. PVE may be requested more frequently.

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# *List of abbreviations*

| Abbreviations | Description |
|---|---|
| **CT** | Computed tomography. |
| **CTA** | CT angiography. |
| **٣D** | Three dimensional. |
| **MIP** | Maximum intensity projection. |
| **SSD** | Surface Shaded. |
| **RHA** | Right hepatic artery. |
| **RRA** | Right renal artery. |
| **LHA** | Left hepatic artery. |
| **CHA** | Common hepatic artery. |
| **SMA** | Superior mesenteric artery. |
| **GDA** | Gastro-duodenal artery. |
| **I.V.C** | Inferior vena cava. |
| **SV** | Splenic vein. |
| **RPV** | Right portal vein. |
| **RAPV** | Right anterior portal vein. |
| **RPPV** | Right posterior portal vein. |
| **LGA** | Left gastric artery. |
| **PV** | Portal vein. |
| **SMV** | Superior mesenteric vein. |
| **PVP** | Portal venous phase. |
| **DSA** | Digital subtraction angiography. |
| **٢D** | Two dimensions. |
| **٣D** | Three dimensions. |
| **MRI** | Magnetic resonance imaging. |
| **MPV** | Main portal vein |
| **PC** | Phase contrast. |
| **HU** | Hounsfield unit. |
| **Gd** | Gadolinium. |
| **Gd-DTPA** | Gadopentate dimeglumine. |

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|---|---|
| **Gd-BT-DO3A** | Gadolinium-DO3A-butriol. |
| **Gd-DOTA** | Gadoterate meglumine. |
| **Gd-BOPTA** | Gadobenate dimeglumine. |
| **T1** | Longitudinal relaxation time. |
| **T2** | Transverse relaxation time. |
| **TR** | Repetition time. |
| **TE** | Echo time. |
| **VENC** | Velocity encoding. |
| **FLR** | Future liver remnant. |
| **HGF** | Hepatocyte growth factor. |
| **TGF** | Transforming growth factor. |
| **TELV** | Total estimated liver volume. |
| **ROI** | Region of interest. |
| **NBCA** | N-butyl-2-cyanoacrylate. |
| **HCC** | Hepatocellular carcinoma. |
| **PVA** | Polyvinyl alcohol particles. |
| **CDUS** | Color Doppler ultrasound. |
| **US** | Ultrasound. |
| **PH** | Portal Hypertension. |
| **IVC** | Inferior Vena Cava. |
| **BCS** | Budd Chiari Syndrome. |
| **PVT** | Portal Vein Thromboses. |