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# Multimodality Imaging of Tumour Thrombus

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**Abstract**

Vascular thrombosis occurs commonly in cancer patients. Once the diagnosis of thrombosis is established, it is important to characterize the nature of thrombus, tumoural versus bland, as each have a different prognosis, clinical significance, and management. This review paper discusses the imaging spectrum of tumour thrombus and its clinical significance emphasizing the role of imaging in differentiating tumour from bland thrombus.

**Résumé**

Les patients atteints de cancer présentent souvent des thromboses vasculaires. Une fois le diagnostic de thrombose établi, il importe de caractériser le thrombus (de nature tumorale ou non-tumorale), puisque le pronostic, l'importance clinique et la prise en charge diffèrent selon cette nature. Dans cet article de synthèse, nous analysons un éventail d'images et l'importance clinique des thrombus tumoraux, en mettant l'accent sur la capacité à distinguer les thrombus tumoraux des thrombus non-tumoraux grâce à l'imagerie.


*Key Words:* Thrombus; Tumoural thrombus; Bland thrombus; Imaging

Much has been written about venous thromboembolic disease in literature, but data is sparse on tumour thrombus imaging and its implications. Since the time Trousseau described unexpected or migratory thrombophlebitis as a forewarning of occult visceral malignancy, and Virchow described the triad of stasis, hypercoagulability, and vessel wall injury in the late 18th century, as contributing to thrombosis, the association of thrombosis and cancer has come a long way [1,2].

Tumour thrombus is important in cancer patients, as affected patients have adverse outcomes and surgical planning is more complex. Incidence of tumour thrombus varies depending on the type of cancer. Malignant involvement of the portal vein in hepatocellular carcinoma (HCC) occurs in approximately 35% of cases, is associated with poorer prognosis and is a contraindication to liver transplantation [3]. Incidence of involvement of inferior vena cava (IVC) in renal cell carcinoma (RCC) is reported to be between 4%-10% of patients [4]. Depending on the level and extent of tumour thrombus in RCC, surgical planning is altered with rates of adverse events proportionately higher depending on the stage of tumour thrombus with complication rates ranging from 12.4%–46.9% [5].

Identification of tumour thrombosis is challenging, as many patients are asymptomatic, with thrombosis detected on routine staging and follow up scans. Multimodality imaging plays a vital role in the diagnosis of tumour thrombosis using an armamentarium of ultrasound, color Doppler, computed tomography (CT), magnetic resonance imaging (MRI), and combined fluorodeoxyglucose/positron emission tomography/CT (FDG PET/CT) studies.

## Imaging

Distinguishing tumour thrombus from bland thrombus is important from a management and prognostic standpoint. A high index of suspicion should be kept when dealing with renal cell carcinoma, hepatocellular carcinoma, and lung and pancreatic cancer, known to be associated with tumour thrombus. Irrespective of the site of origin, certain common

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Table 1
Imaging features of bland and malignant thrombosis

| Venous thrombosis | | | |
|---|---|---|---|
| Category | Ultrasound and Doppler | Computed tomography findings | Magnetic resonance imaging findings |
| Bland thrombus | • Non contiguous with the primary tumour<br>• Normal lumen diameter.<br>• No intraluminal vascularity. | • Homogenous appearing.<br>• No contrast enhancement. | • Low signal intensity on T2 weighted sequences.<br>• No contrast enhancement. |
| Malignant/tumoural thrombus | • Continuity of the tumour with the adjacent vein.<br>• Abnormal arterial vascularity.<br>• Irregular and expanded venous lumen. | • Contiguity with the tumour mass.<br>• Adherent to the vessel wall.<br>• Variable degrees of enhancement similar to the primary mass. | • Intermediate to increased signal on T2 weighted sequences.<br>• Contrast enhancement.<br>• Direct extension from the tumour.<br>• Vessel lumen expansion. |

features help differentiate malignant from bland thrombus (Table 1). In a subset of patients, both bland and tumour thrombus may coexist [6–8].

### *Ultrasound and Doppler Findings*

Tumour thrombus can be distinguished from bland thrombus by identifying continuity of the tumour with the adjacent vein, abnormal arterial vascularity (low resistance arterial signal), and irregular venous lumen expansion [9,10] (Figure 1). Rossi et al. [11] used contrast-enhanced ultrasonography in the characterization of portal vein thrombosis complicating HCC, using enhancing tissue within the vessel lumen in the early arterial phase. This differentiation is particularly important in HCC patients as tumoural involvement of the portal vein deems patients unsuitable for liver transplantation and often other therapeutic options such as surgical resection and chemoembolization [3,12].

An important pitfall to avoid is cavernous transformation of the portal vein since it can be confused with tumour thrombus. Cavernous transformation is evidenced by the development of prominent periportal collaterals with hepatopedal flow, without the presence of venous expansion or a parenchymal mass seen adjacent to the tumoural thrombus [9] (Figure 2). Typical patients with cavernous transformation develop portoportal venous channels at the porta hepatis in addition to intrahepatic venous channels and portosystemic collaterals [13].

### *CT Findings*

An important consideration for the detection of tumoural or bland thrombosis on CT is good bolus of contrast for

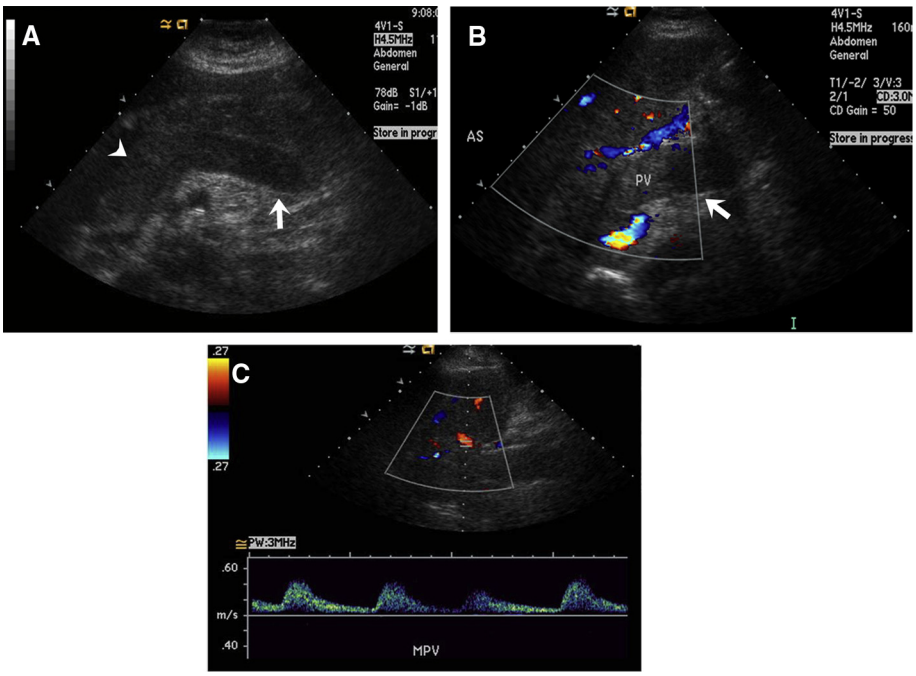


Figure 1. An 84-year-old male with pancreatic cancer. (A) Transverse grayscale ultrasound image showing echogenic tumour thrombus with expanded portal vein (PV; arrowhead) and splenic veins (arrow). Transverse color Doppler image showing absence of flow in the PV (arrow,B) and low-resistance arterial waveform seen in the main PV (C).