

ultra 

# Hemodynamic Evaluation microV



## Introduction

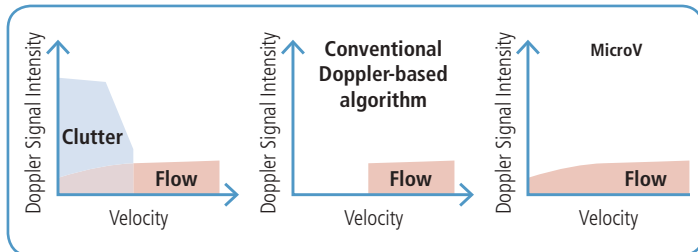
Nowadays, different technologies are regularly used by clinicians to characterize lesion vascularity and to show normal and/or abnormal vascularity in several organs and tissues. Pathology characterization and diagnosis in all clinical applications, in relation to low-velocity flow visualization without interference from hyper-echoic structures and motion artefacts, still represent a tough challenge in everyday clinical practice.

In some cases, CEUS has been used as a Doppler enhancement medium to improve the vasculature echo signals, but the reported results are poorly predictive and inconsistent. The use of CEUS markedly increases costs, time expenditure, and patient discomfort, and is not suitable for large-scale sonographic examination.

Despite favorable initial reports, the presence of intra-nodular vascular signals at conventional color or power Doppler examinations actually offers less-than-optimal information about the risk of malignancy of thyroid lesions. The evaluation of micro-vessels through new technologies and software algorithms is definitely a very promising approach.

## Technical Background

A Doppler signal assessed by ultrasound is generated by flows inside the body and tissue motion (clutter). This Doppler signal can be represented in a spectrum in the velocity domain. Conventional Doppler-based technologies apply a wall filter on the velocity domain in order to remove signals that are not related to flows. The result is a spectrum of flows that excludes the very low flows.

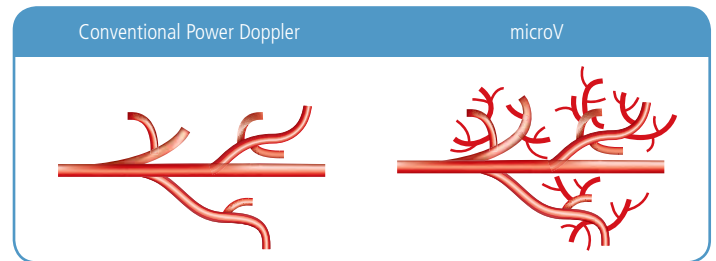


Thanks to special real-time adaptive filtering, the brand-new Esaote clinical solution is able to distinguish signals coming from flows and other sources. The result is very low flow signal preservation.

## The Solution

Esaote developed an adaptive algorithm that effectively separates flow signals from overlaying tissue motion artefacts and background noise.

**microV** is the latest technology by Esaote with an elevated degree of sensitivity even in very small vessels and slow flows detection. This brand-new Doppler technology with a specific algorithm enables advanced hemodynamic evaluation with high sensitivity and high spatial resolution. This technology can be combined with other modalities for pathology characterization in all clinical applications.



**microV** is able to distinguish between signals coming from flows and other sources with very low flow signal preservation in comparison to conventional Doppler techniques.

## Technical Features and Value Proposition

With a very high sensitivity, spatial resolution, and frame rate hemodynamic analysis for micro-vascularization in tissue perfusion, microV is the answer for maximized sensitivity for small vessels and slow flow detection:

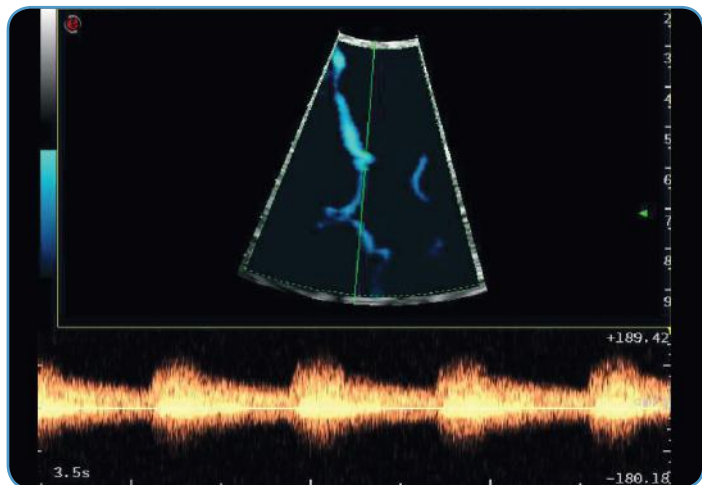
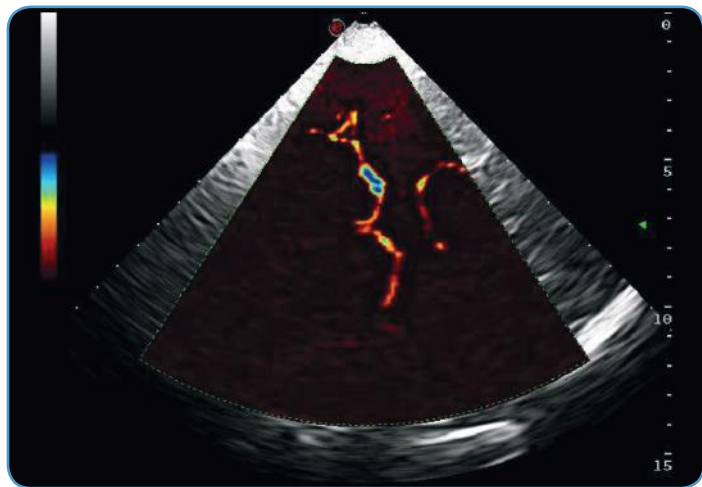
- Top performance for micro-vascularization studies in terms of sensitivity and spatial resolution
- No hyper-echoic structure interference
- Zero background noise
- Available for all probe typologies

With microV it is possible to choose from five different visualization algorithms to enhance spatial resolution, blood volume flow, and signal consistency. B-Mode background suppression can be set in order to enhance the micro-vascularization signal.

## Clinical Applications

microV offers plenty of advantages in comparison with other ultrasound modalities, ensuring the best low-velocity flow visualization with the highest frame-rate and spatial resolution, compensating for motion artefacts and without interference from hyper-echoic structures.

## Stenosis



A comparison has been applied between color technique, power, both with low and high PRF, and microV.

It has achieved not only a higher resolution in the morphological definition of the vessel, but also the different flow velocity, which allowed us to study intracranial stenosis not detected by the conventional Doppler methods currently in use in everyday clinical practice.

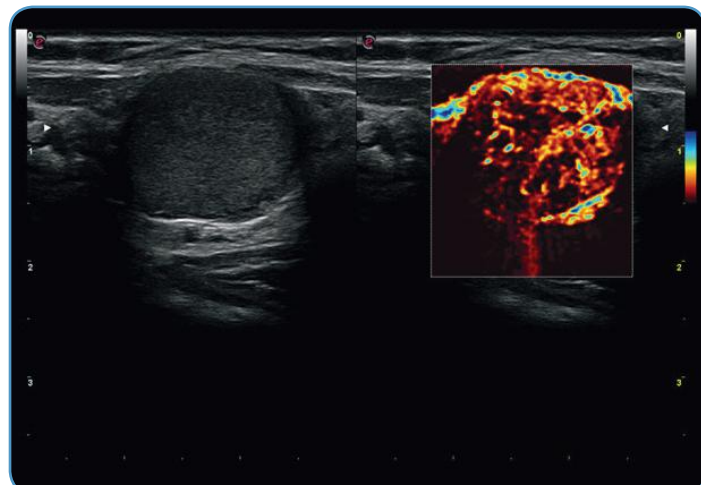
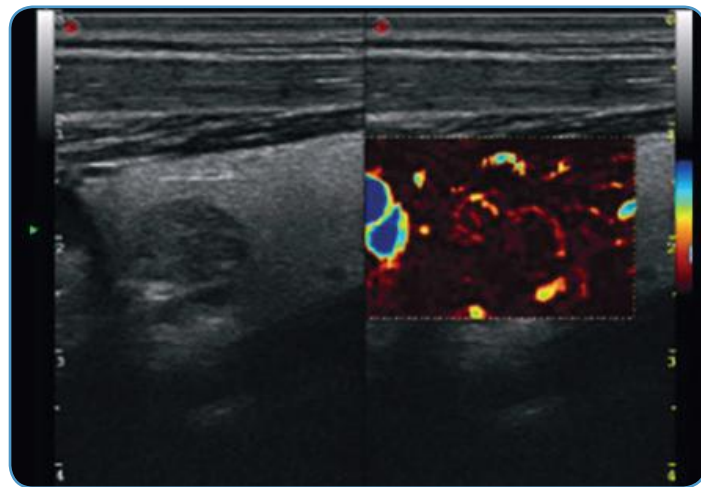
The microV technique, thanks to higher PRF, allowed us to obtain a high depth of study, breaking completely into the other side of the insonance, up to 12 cm deep, in combination with very high spatial resolution (impossible with standard Doppler techniques).

microV allows us to understand that the high velocities we initially attributed to a hypothetical stenosis of the cerebral media at the origin are actually due to the tortuosity of the vessel.

This technique allows us to combine high spatial resolution with high sensitivity. Above all else, this technique is very easy to use.

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## Thyroid Nodules



Color enhancement of the US images that delineates the vasculature is essential.

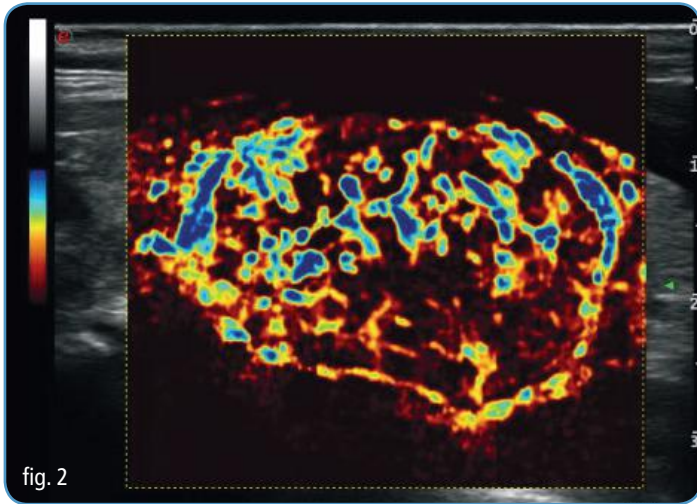
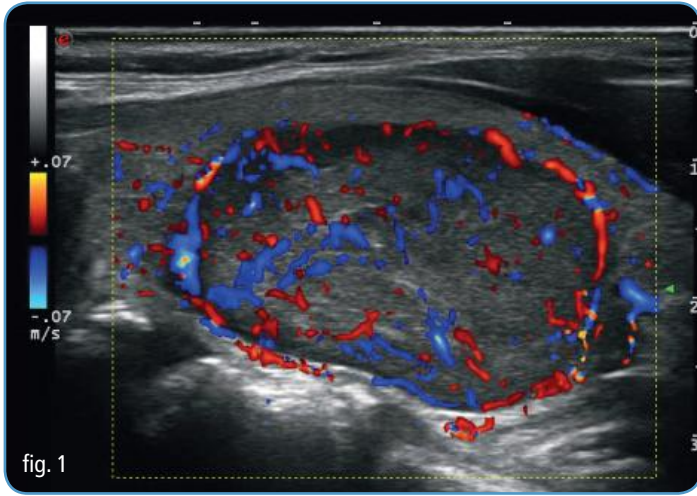
Comprehensive understanding of the local anatomy and the specific disease process is possible only with microV in case of low and weak flows.

microV provides elevated sensitivity for slow flow detection in thyroid lesions with a clear depiction of the small vessel architecture. This brand-new technology is rapid, not invasive, and inexpensive.

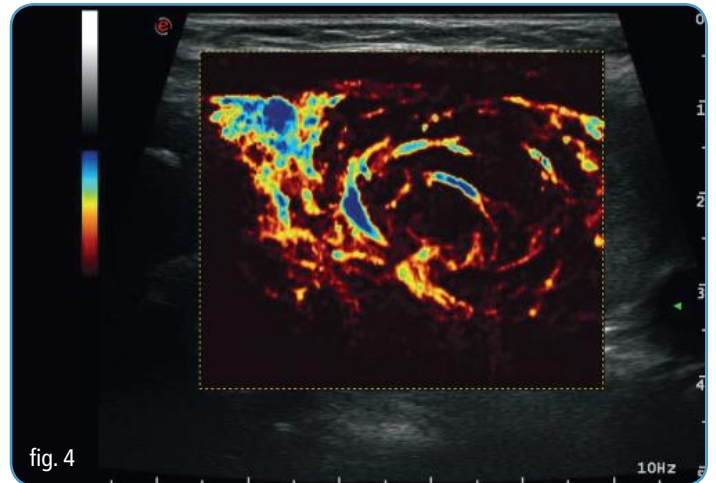
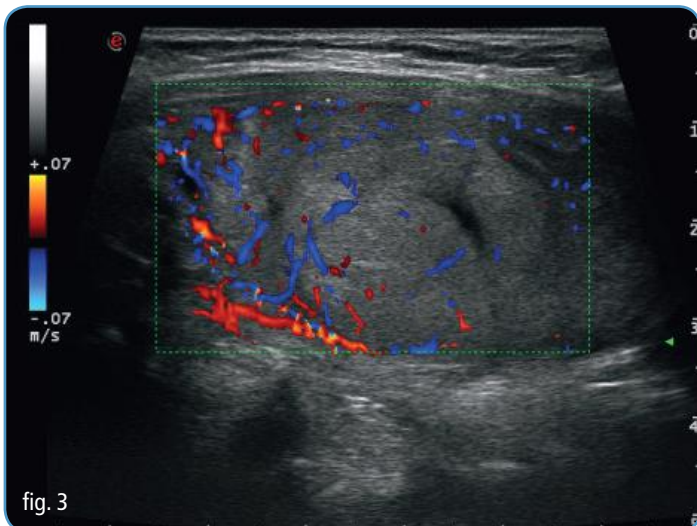
These characteristics allow its use as a further diagnostic tool in routine sonographic examination of thyroid nodules with suspicious ultrasound features or with indeterminate cytology at fine needle aspiration biopsy.

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## Thyroid Adenoma



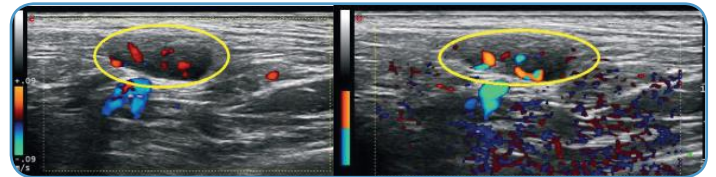
The thyroid adenoma was analyzed with both Color Flow Map (fig. 1) and microV (fig. 2) technologie. Side-by-side comparison of the transverse and vertical section confirms that microV can reveal more surrounding and crossing micro-vascularization. The microV technology can replace part of the CEUS to evaluate micro-perfusion.



The thyroid adenoma was analyzed with Color Flow Map (fig. 3), Power Doppler and microV (fig. 4) technologies. Side-by-side comparison of the three color Doppler modes confirms that microV's spatial resolution and sensitivity is the best. It can reveal more micro-vessels.

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## Cervical Lymph Nodes

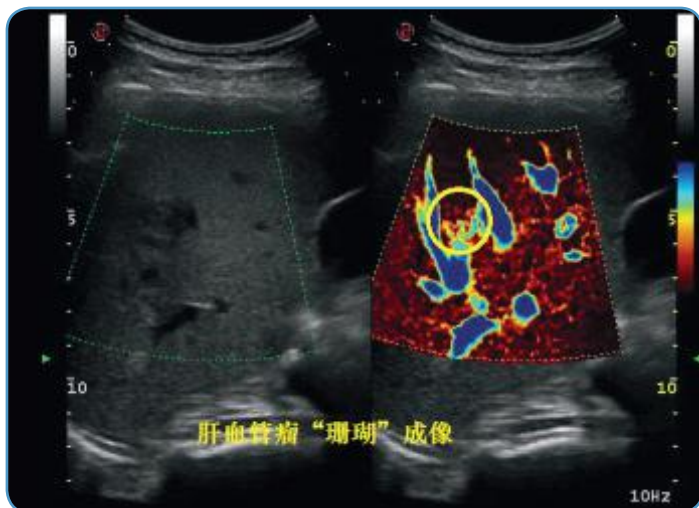
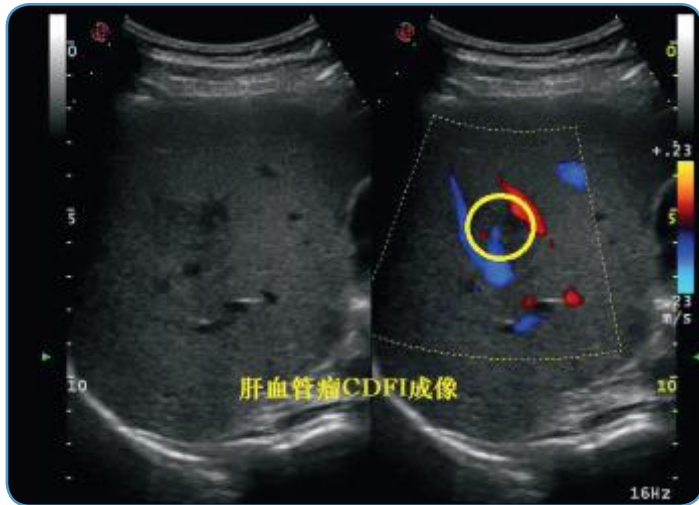


Here is a comparison of blood flow visualization inside the cervical lymph node with three different techniques: CFM, bidirectional Power Doppler, and Advanced Hemodynamic Evaluation with High Sensitivity and High Spatial Resolution.

The microV image demonstrates more well-characterized blood flow inside the lymph node than the color Doppler image and directional power Doppler imaging. In addition, microV ensures the best low-velocity flow visualization, compensating for motion artefacts and without any interference from hyper-echoic structures or background noise.

*Prof. Zhang Guangchen, Ultrasound Medical Department, The first affiliated Hospital of Harbin Medical University*

## Hepatic Hemangioma



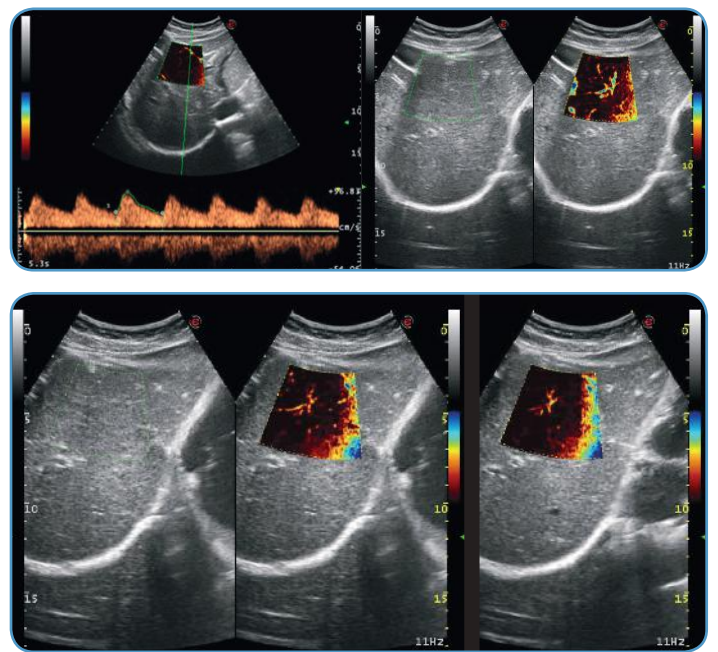
Advanced hemodynamic analysis with microV compared to standard Doppler techniques could aid the diagnosis of hepatic tumors with ultrasound.

The hemangiomas exhibited a pattern when compared to other tumors that do not exhibit any specific patterns.

Here is a comparison between color Doppler flow map and microV, which can show fine and very low velocity blood flow inside the hepatic hemangioma (not detectable even on directional power Doppler imaging). Higher sensitivity without background noise and a high frame rate allows the characterization of features and pattern details among different types of hepatic tumors.

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## Liver FNA

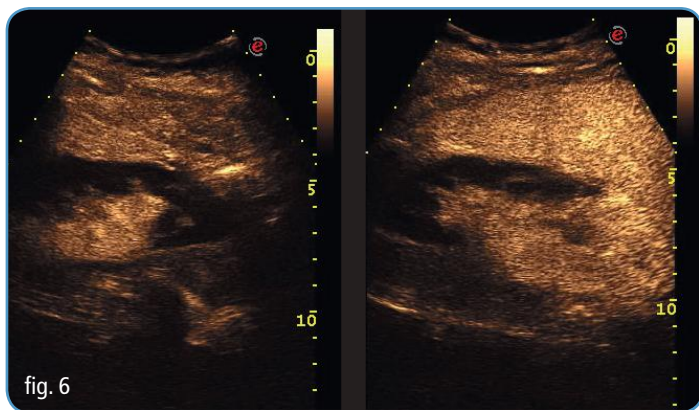
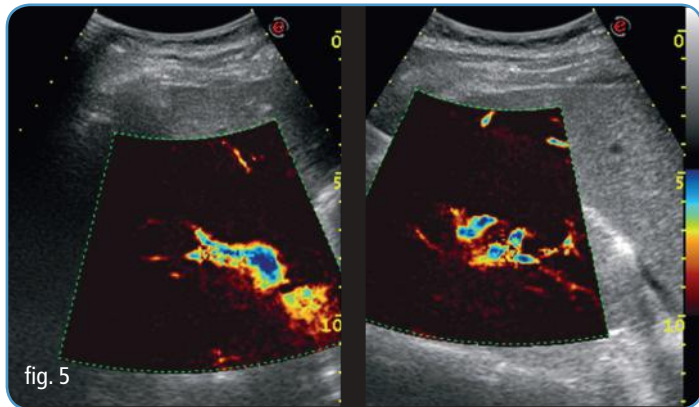


Patient follow-up on already diagnosed focal nodular hyperplasia (FNH) of the hepatic right lobe.

The advanced hemodynamic analysis with microV in combination with standard power Doppler technology highlights the typical presence of low-impedance central arterial blood vessels within the lesion's margins. The microV study clearly shows the typical "wagon wheel" vascularization of the FNH nodule, the afferent central vessel, and in real-time scans, the centrifugal flow pattern.

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## Kidney



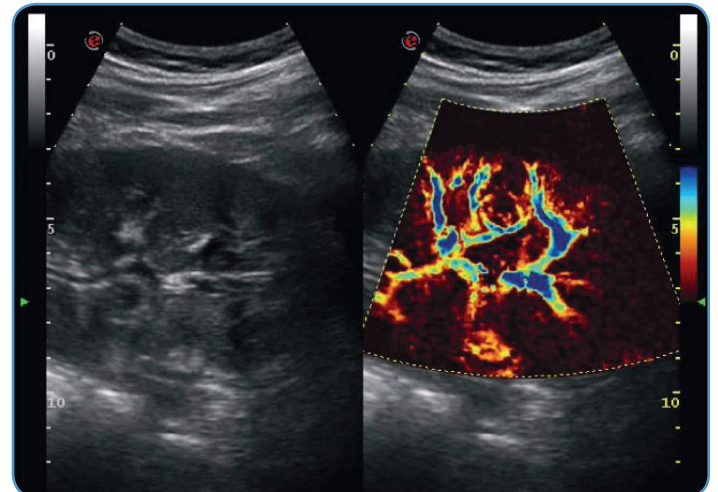
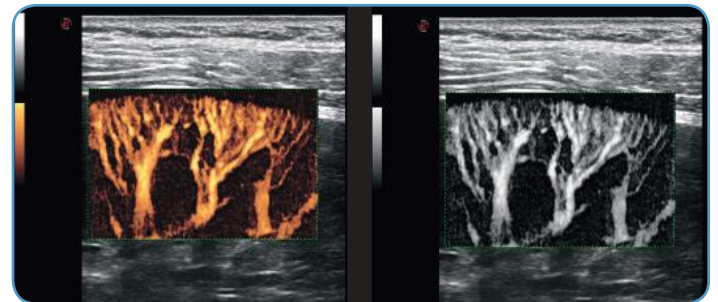
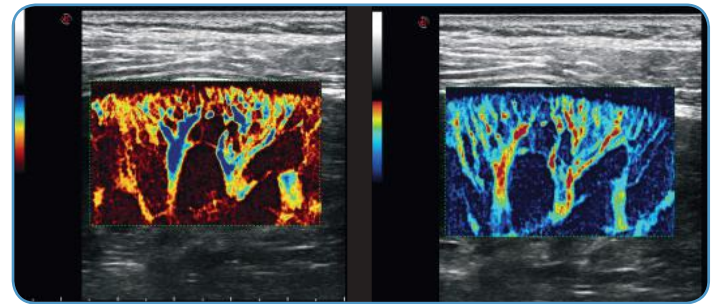
Monitoring and follow-up in a patient who underwent an aneurysmectomy with right renal artery replantation. The microV study was used to highlight the viability of the renal artery in the holo, in absence of residual aneurysms (fig. 5).

During the microV study, the medullary vascular branches of the kidney are visualized, while no cortical vascularization is observed in the upper third of the right kidney (fig. 6).

In the hypothesis of cortical hypoperfusion, the study is then completed with CEUS, confirming the presence of cortical ischemia well demarcated to the upper third of the kidney. The bone marrow is well fused as the lower third of the cortex.

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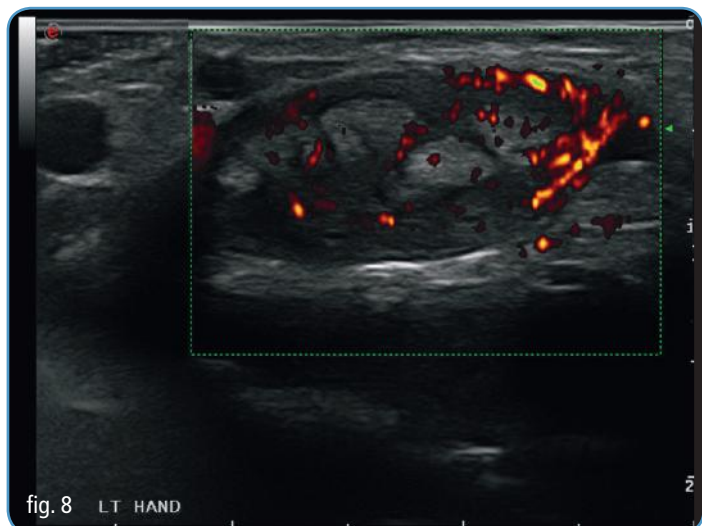
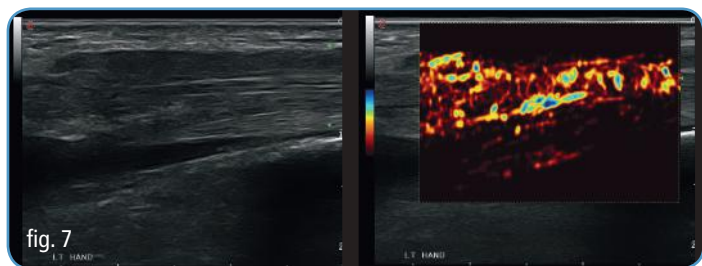
## Cortex



Color and power Doppler are limited in their ability to evaluate perfusion of the renal cortex. Furthermore, the distal micro-vasculature of the renal parenchyma can be clearly demonstrated with microV Advanced Hemodynamic Evaluation technology. The best results can be achieved with microV, thanks to the several different palette patterns available.

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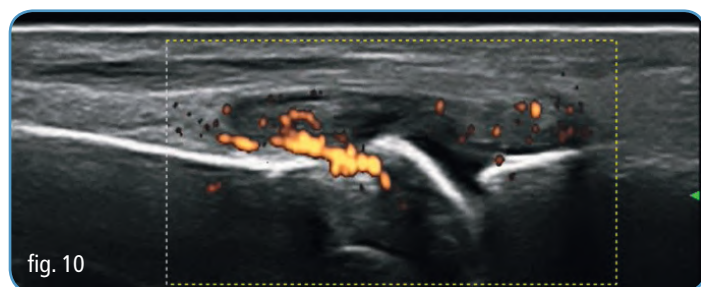
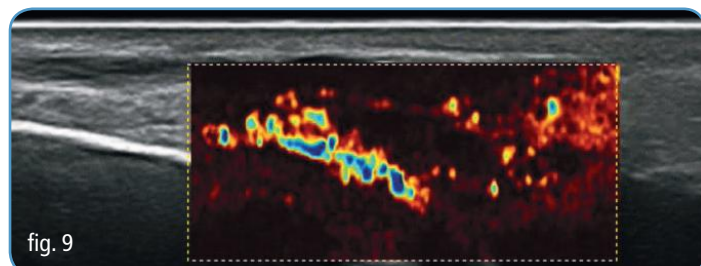
## Extensor Digitorum Sheath



A patient with inflammatory arthritis presented with wrist swelling and pain (clinically swollen dorsum of the wrist). The swelling moved with finger flexion and extension. A B-mode exam in orthogonal planes revealed hypoechoic distension of the sheath extending from proximal to the dorsal retinaculum to the dorsum of the hand. In addition, short axis views revealed tendon splitting. Advanced hemodynamic analysis microV technology revealed marked vascularity with intercommunicating meshwork of blood vessels on long axis dual-view (fig. 7). On short axis views (fig. 8), a network of vasculature is seen on the right side of the image. microV allows a more detailed depiction of the blood vessels with high sensitivity, especially at high Doppler frequencies.

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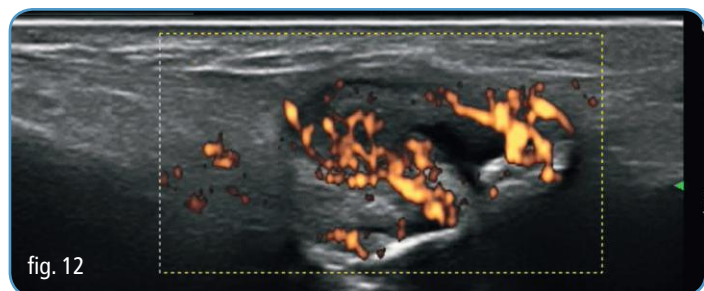
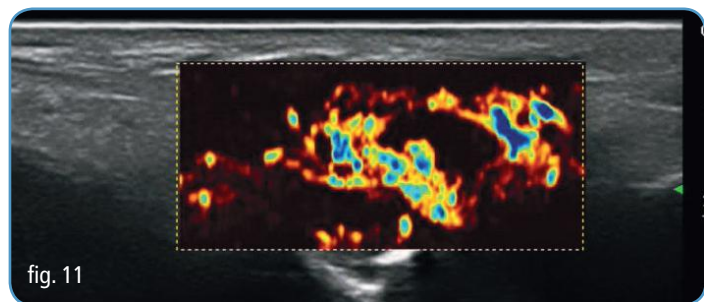
## Synovitis



Erosive active synovitis in a patient affected by rheumatoid arthritis was analyzed with both microV (fig. 9) and power Doppler (fig. 10) technologies. Side-by-side comparison of the second metacarpophalangeal joint confirms that microV reveals more blood flow at the level of the inflamed synovial pannus.

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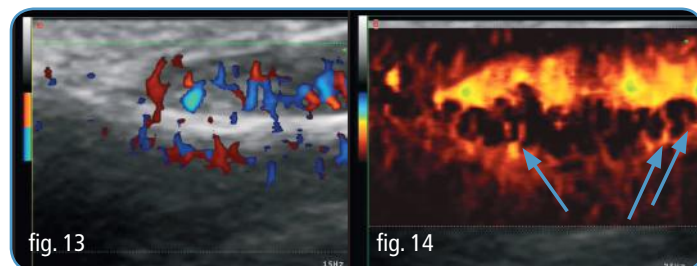
## Metatarsophalangeal



The microV technology (fig. 11) used for analyzing the fourth metatarsal-phalangeal joint of an active rheumatoid arthritis patient revealed more blood flow than power Doppler techniques (fig. 12) at the level of the thickened synovial membrane, also thanks to the fact that the Advanced Hemodynamic Evaluation is bi-directional and with High Sensitivity Spatial Resolution.

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## Nail bed



The microV technology (fig. 14) used for analyzing the normal nail bed revealed more blood flow than standard power Doppler techniques (fig. 13). Evidently, the sensitivity and resolution of microV is much higher than CFM. Advanced hemodynamic analysis technology can display the micro-vascularization between the upper and lower nail bed, which is very useful for evaluating early rheumatoid arthritis.

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## Conclusions

microV with high sensitivity, spatial resolution and frame rate in hemodynamic analysis for micro-vascularization in tissue perfusion, represents the state-of-the-art sensitivity for superficial and deeper vessels for improved spatial resolution in real-time hemodynamic analysis.