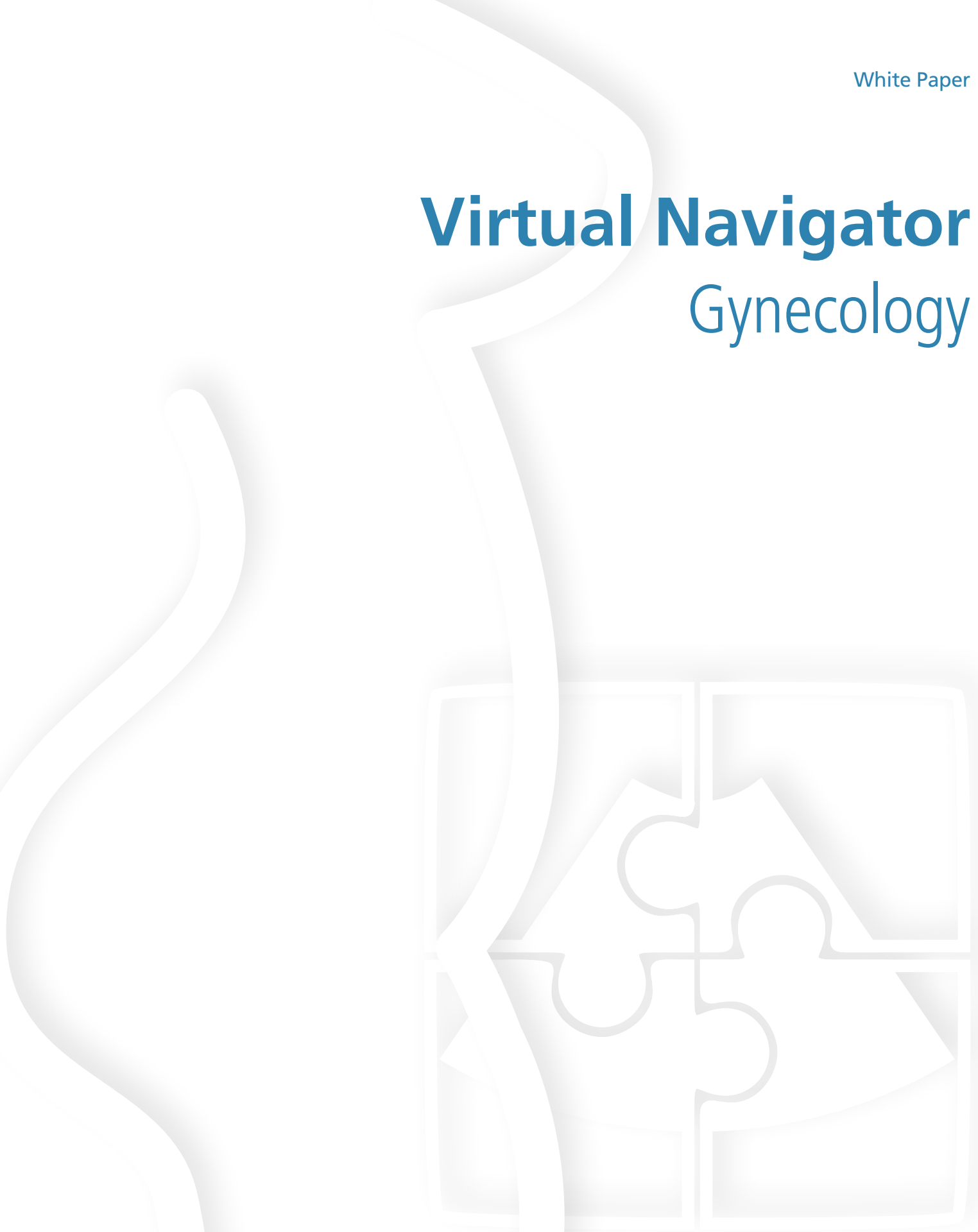
White Paper

Virtual Navigator

Gynecology



esaote
Creativity in Healthcare

"A multidisciplinary approach to the patient is crucial for an oncological referral

Valentina Chiappa, MD, IRCCS, National Cancer Institute (INT) Milan, Italy

Introduction

Ultrasonography is the first-choice imaging technique for gynecological pathologies. Over the last decade, its role has grown thanks to ultrasound (US) collaborative research groups such as International Ovarian Tumor Analysis (IOTA), International Endometrial Tumor Analysis (IETA), Morphological Uterus Sonographic Assessment (MUSA), and International Deep Endometriosis Analysis (IDEA).

Efforts aimed to standardize the terminology used during US examinations and build models for less experienced ultrasound examiners in order to improve their diagnostic accuracy and to identify patients who should be referred to oncological/second level centers.

Experienced ultrasound examiners can take advantages of new US tools such as advanced hemodynamic algorithms, Elastosonography, and Fusion Imaging, that all allow a multidisciplinary approach to the patients' conditions.

Advanced Hemodynamic Evaluation and Elastography

With a very high sensitivity, spatial resolution, and frame rate, **Hemodynamic Analysis** for micro-vascularization in tissue perfusion (known as **microV**) is the answer to improving sensitivity for small vessels and slow flow detection. microV offers plenty of advantages compared to other US Doppler software, ensuring the best low-velocity flow visualization with the highest frame rate and spatial resolution, and compensating for motion artifacts and without interference from hyperechoic structures. In gynecological oncology, US microV can be used in DUAL-V mode to better visualize the vascular tree of a lesion and to detect slow flow vessels typical on tumoral angiogenesis.

Elastosonography technology allows the US examiner to assess the tissue stiffness by associating different chromatic patterns to the different tissue responses after being stimulated with gentle probe compressions. This tool could have many potential applications in gynecological US, but very few experiences are present in literature. Elastosonography could be used, for example, to assess the stiffness of an atypical myoma or to evaluate myometrial infiltration in endometrial cancer (the infiltrated myometrium seems to be *'harder'*) or parametrial infiltration in cervical cancer ('harder' pericervical tissue in locally advanced cases).

Fusion Imaging

Virtual Navigator is Esaote's revolutionary technology for fusion imaging that allows the US examiner to work with real-time ultrasound side-by-side with CT scan and MR volumes, PET and other imaging modalities (eg. lymphoscintigraphy).

US	Real-time Low cost examination No patient irradiation	**MR** **CT** **PET**	Extended field of view No patient depending Easy image interpretation

Virtual Navigator takes all the advantages of different modalities and provides a real-time, low-cost and radiation-free solution that aims to guide operators in diagnosis, everyday clinical practice, interventional procedures, research and teaching.

Fusion imaging allows the merging of real-time US capabilities such as Doppler, microV, and elastosonography with information from other imaging modalities.

The Role of Fusion Imaging in Gynecologic Oncology

The approach to oncologic patients needs to be multidisciplinary. A continuous collaboration between all team members (including surgeon, US examiner, radiologist, radiotherapist, oncologist, nuclear medicine) is paramount.

Fusion imaging could simplify the dialogue between the different study team members, and has great educational value for US examiners because they can improve their ability to evaluate imaging examinations other than ultrasound.

Fusion imaging could have many possible applications in patients with gynecologic cancers:

Ovarian cancer

Ovarian cancer usually spreads through the peritoneal cavity. Before defining patient management, it's important to stage the disease and to know its local and distant extension, in order to drive surgical procedures.

CT scan is usually the first imaging technique performed on a patient with suspected ovarian cancer, but its resolution for the pelvis is extremely poor. Fusion imaging with real-time US could merge the wide field of view in the CT scan with the high resolution of

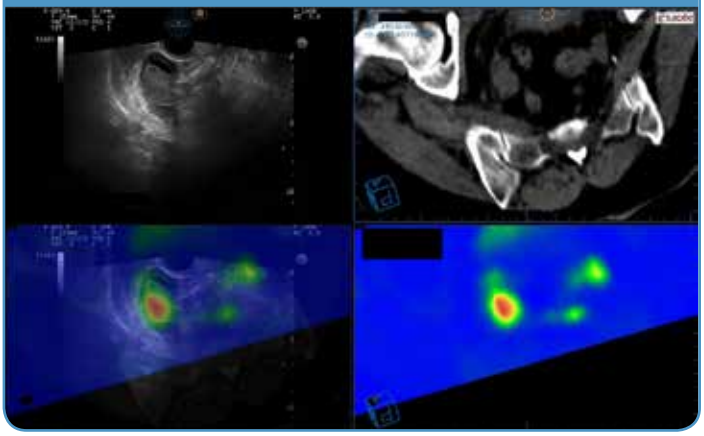
center: fusion imaging makes it easier and adds a great educational value"

ultrasound, in order to give a better picture of carcinomatosis and the relationship between the masses and adjacent organs.

Fig. 1: Fusion of CT scan and US: the blue and yellow dots identify the omentum infiltrated by the tumor

In recent years, **PET-CT** has grown in importance when it comes to staging ovarian cancer, but sometimes it's difficult to anatomically localize capitations defined as aspecific (lymph node versus ovary versus peritoneal nodule) and the co-registration CT has poor resolution. The fusion of PET, co-registration CT, and US could help to correctly localize capitation and to define structures affected by the disease.

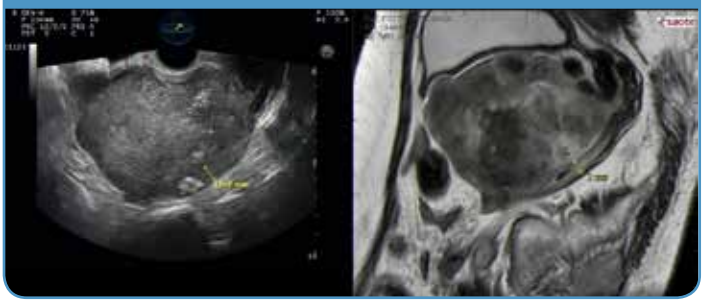
Fig. 2: Fusion of US, CT and PET in a patient with peritoneal carcinomatosis and suspected ovarian cancer: the captation in PET overlaps the ovary on US and CT



Endometrial cancer, sarcomas and cervical cancer

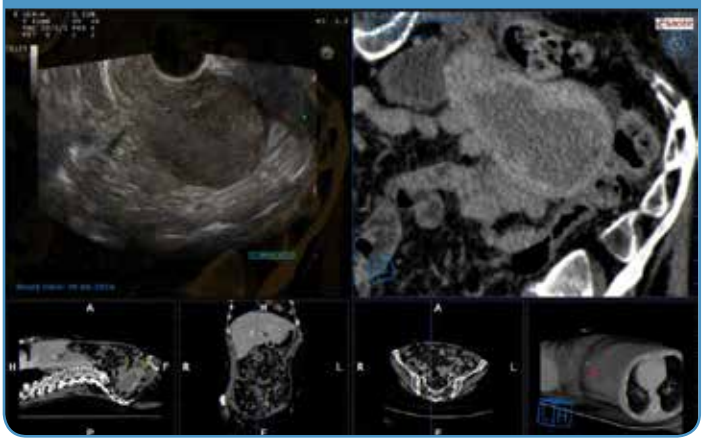
MRI is considered the gold standard of imaging techniques worldwide, but in the last 10 years many Italian and European studies have come to light in literature that explore the role of US, where it has a similar, and sometimes better, level of accuracy in defining myometrial infiltration and cervical stromal invasion in endometrial cancer and in describing tumor characteristics and the local extent of the disease in cervical cancer patients. The fusion of MRI and ultrasound could enable real-time agreement in cases with discrepancies between radiological and ultrasonographic evaluation.

Fig. 3: Fusion of US and MRI in a patient affected by endometrial cancer to define the minimum free myometrium



The same procedure (fusion) can also be used between US and CT scans and PET for patients affected by endometrial or cervical cancer or sarcoma.

Fig. 4: Fusion of US and CT scan in a patient affected by endometrial cancer



“With fusion of PET CT and US, it’s possible to correctly locate aspecific capitations in patients with ovarian cancer”

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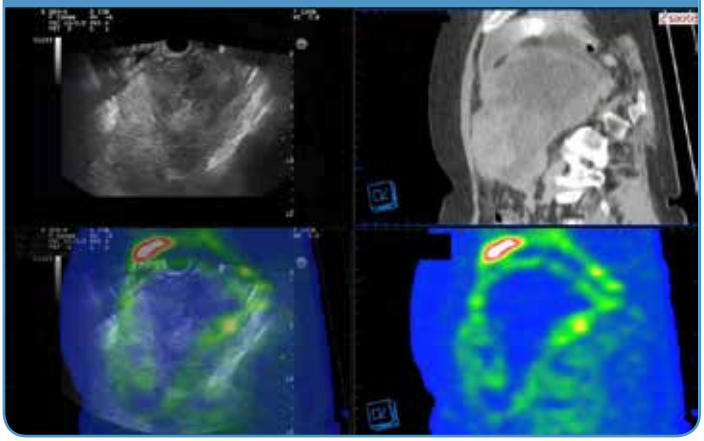
Vulvar cancer

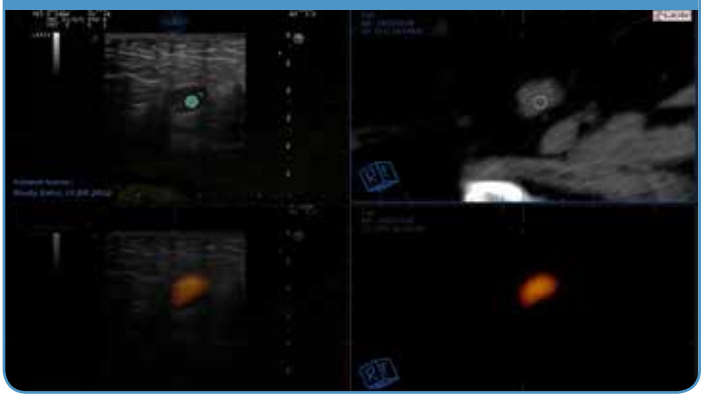
Fig. 5: Fusion of US, CT and PET in a patient affected by uterine sarcoma



The sentinel node biopsy is widely accepted as the nodal status assessment in patients with suitable vulvar cancers. The patient undergoes a SPECT-lymphoscintigraphy after a 99m-technetium peritumoral injection and the sentinel nodes are identified.

With fusion imaging, it’s possible to merge data from a SPECT-lymphoscintigrapy and ultrasound, to recognize the sentinel nodes in real time and to selectively remove them.

Fig. 6: Fusion of US, CT and SPECT/ lymphoscintigraphy in a patient affected by vulvar cancer to identify sentinel nodes



Virtually Guided Biopsy Procedures

Virtual Biopsy combined with Intelligent Positioning increases confidence during real-time ultrasound biopsy procedures. Thanks to the virtual tracking of the needle, the target can be reached quickly, precisely, and safely. The physical needle is highlighted by a virtual needle directly on the real-time ultrasound image with a proper 3D representation of the probe, scanning plane, and path to the target.

Colored targets with regular and irregular shapes can be visualized as well. The needle path is also visualized before the real needle is inserted, in order to plan in advance the best path of insertion so as to avoid critical structures.

Intelligent Positioning represents the needle tip as a fixed point in space, with the target as a moving object seen by the view point from the needle tip: the needle will become a gunshot viewfinder.

Fig. 7: Virtual needle to guide the biopsy of a peritoneal nodule in a patient affected by peritoneal carcinomatosis and suspected ovarian cancer

References

[1] Toshitaka et al. **Detection of prostate cancer using magnetic resonance imaging/ultrasonography fusion targeted biopsy in African-American men**. BJU Int 2017. Doi: 10.1111/bju.13786.

[2] Kitajima et al. **Value of fusion of PET and MRI for staging of endometrial cancer: comparison with 18F-FDG contrast-enhanced PET/CT and dynamic contrast-enhanced pelvic MRI**. Eur J Radiol 2013; 82:1672-6.

[3] Stecco et al. **Comparison of retrospective PET and MRI-DWI (PET/MRI-DWI) image fusion with PET/CT and MRI-DWI in detection of cervical and endometrical cancer lymph node metastasis**. Radiol Med 2016;121:537-45.

[4] Bluemel et al. **Fusion of freehand SPECT and ultrasound: first experience in preoperative localization of sentinel lymph nodes**. Eur J Nucl Med Mol Imaging 2016:43:2304-12.

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