Use of Transvaginal Superb Microvascular Imaging in Uterine Disorders

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Abstract

Aim and objective: To present our first experience of using superb microvascular imaging (SMI) and three-dimensional SMI (3D-SMI) to assess the microvasculature of uterine disorders.

Materials and methods: Three cases of uterine disorders [missed abortion, cervical adenocarcinoma (gastric-type mucinous carcinoma: GAS), and uterine arteriovenous malformation (AVM)] were studied to assess the microvasculature using the latest transvaginal SMI. Comparison between conventional color Doppler and SMI for detection of uterine vascularity was conducted in a postmenopausal woman.

Results: Myometrial-rich microvasculature was clearly demonstrated using SMI compared with conventional color Doppler in the postmenopausal woman. In the case of missed abortion, tiny blood vessels could be clearly identified in the contents of the uterine cavity. Only a few tiny blood vessels were noted in the bulky tumor in the cervix of the GAS. In the case of uterine AVM, tortuous structures of AVM were clearly recognized using SMI and 3D-SMI.

Conclusion: Superb microvascular imaging provides more detailed information regarding the microvasculature in uterine disorders, compared with conventional color Doppler. Transvaginal SMI can depict tiny uterine blood vessels without blooming. Further studies involving a larger sample size are needed to confirm the usefulness of SMI to assess the microvasculature in uterine disorders.

Keywords: Cervical adenocarcinoma, Color Doppler, Missed abortion, Superb microvascular imaging, Three-dimensional SMI, Transvaginal probe, Uterine arteriovenous malformation.

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Introduction

Superb microvascular imaging (SMI) is a new Doppler technology that uses a unique algorithm to minimize motion artifacts by eliminating tissue motion (clutter) and can depict low-velocity blood flow in small vessels with high frame rates.[1,2] There have been several studies on SMI assessment of normal and abnormal placental microvasculature,[1–7] and fetal heart and peripheral blood vessels.[8–12] However, there have been only two reports on SMI assessments of the microvasculature in gynecologic disorders.[13,14] In both studies,[13,14] the devices used may have been too outdated to detect small vessels in the endometrial carcinoma, endometrial polyps, and submucosal fibroids. In the second study,[14] the authors concluded that SMI may be insufficient for depicting the microvasculatures of endometrial polyps and submucosal myomas. However, these authors used a transabdominal probe even in overweight postmenopausal women. This study aimed to present our first experience of using the latest transvaginal SMI and three-dimensional SMI (3D-SMI) to assess the microvasculature of uterine disorders.

Case Description

One postmenopausal woman and three cases of uterine disorders [missed abortion, cervical adenocarcinoma (gastric-type mucinous carcinoma: GAS), and uterine arteriovenous malformation (AVM)] were studied to assess the microvasculature using two-dimensional (2D) SMI and 3D-SMI (Aplio i800; Canon Medical Systems, Tokyo, Japan) with a high-resolution transvaginal probe (PVT-781VTE, 3.6-11.0 MHz). Volume data for 3D-SMI were acquired by fanning the routine 2D transducer. Smart 3D technology was used to display 3D images without using a 3D transducer.[2]

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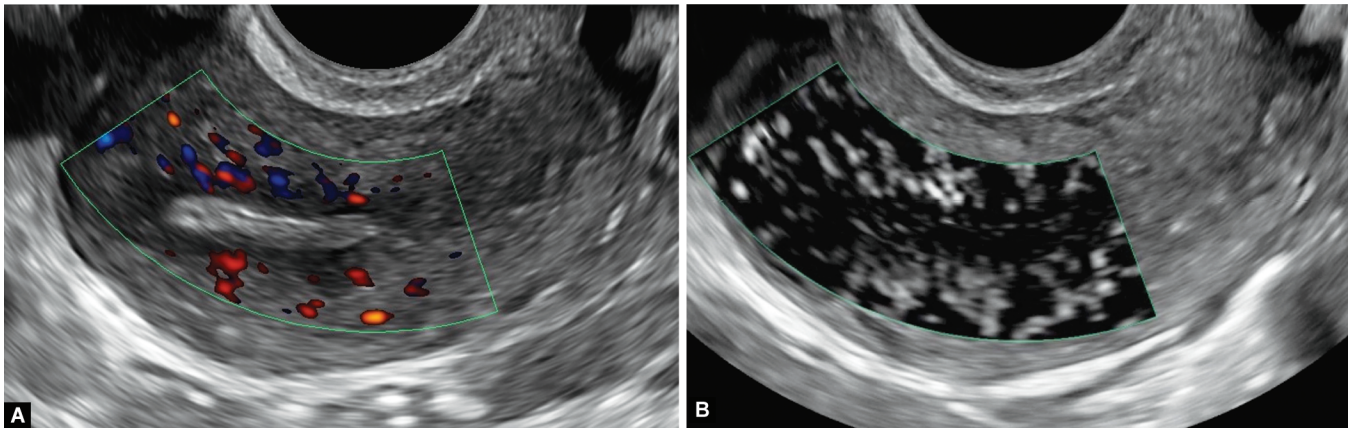
Comparison between Color Doppler and Superb Microvascular Imaging

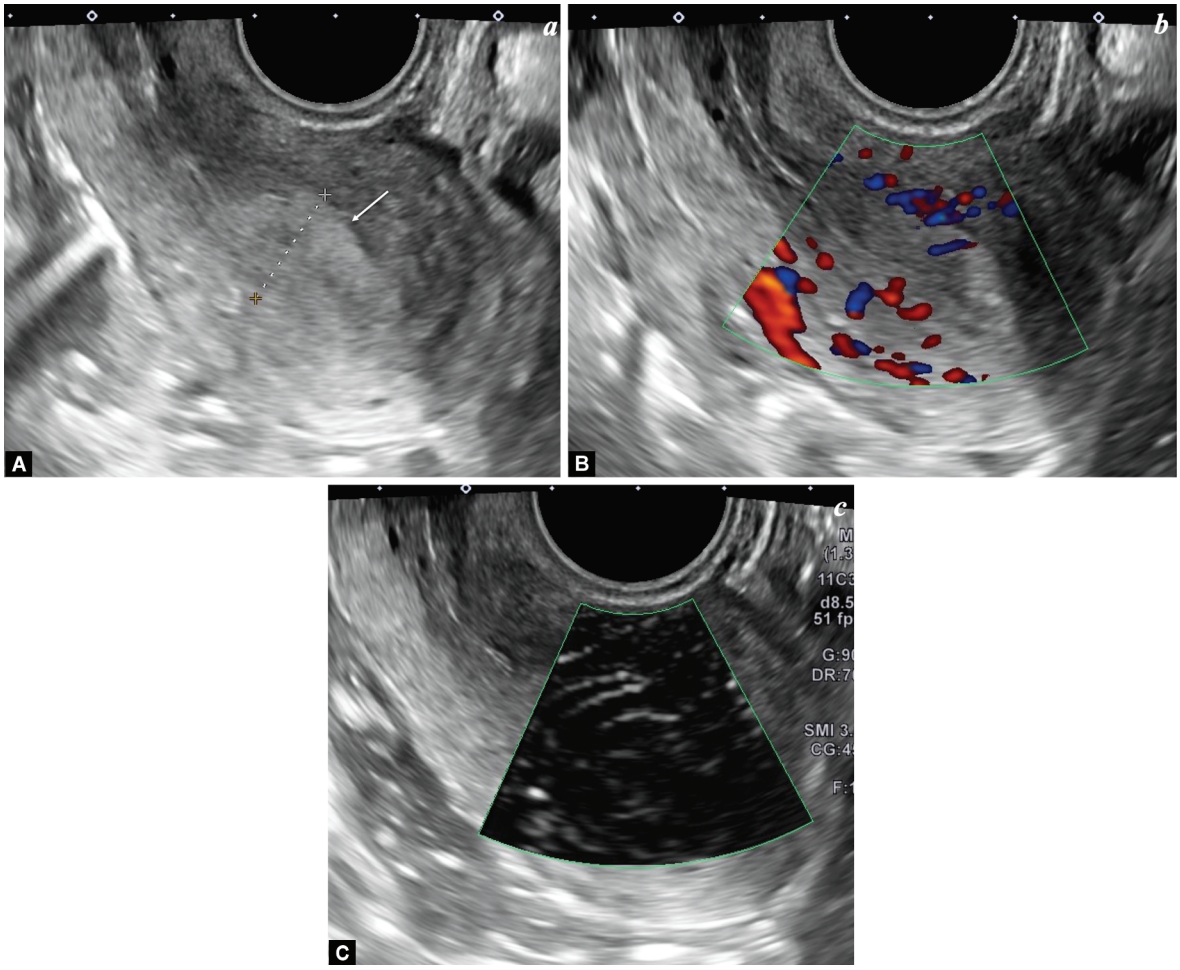
Rich myometrial microvasculature was clearly demonstrated using SMI compared with conventional color Doppler in the postmenopausal woman (Fig. 1).

Missed Abortion

Tiny blood vessels could be clearly identified in the contents of the uterine cavity, whereas conventional color Doppler only showed blood vessel buds at the base of the endometrium (Fig. 2).



Figs 1A and B: Sagittal view of the uterus in a postmenopausal woman. Superb microvascular imaging (SMI) clearly depicts abundant tiny myometrial vessels compared with conventional color Doppler in the postmenopausal woman. (A) Color Doppler; (B) SMI



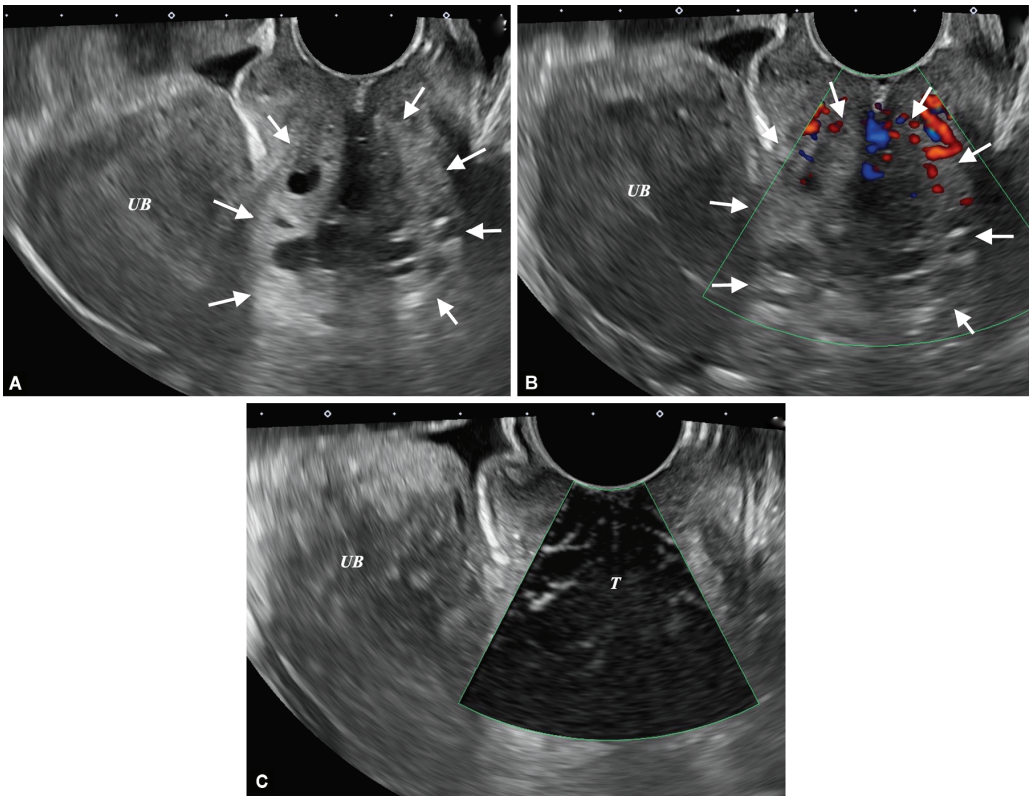
Figs 2A to C: Sagittal view of the uterus with missed abortion (arrow). Tiny blood vessels can be clearly identified in the contents of the uterine cavity by superb microvascular imaging (SMI), whereas conventional color Doppler only shows blood vessel buds at the base of the endometrium. (A) Two-dimensional sonography; (B) Color Doppler; (C) SMI

Gastric-type Mucinous Carcinoma

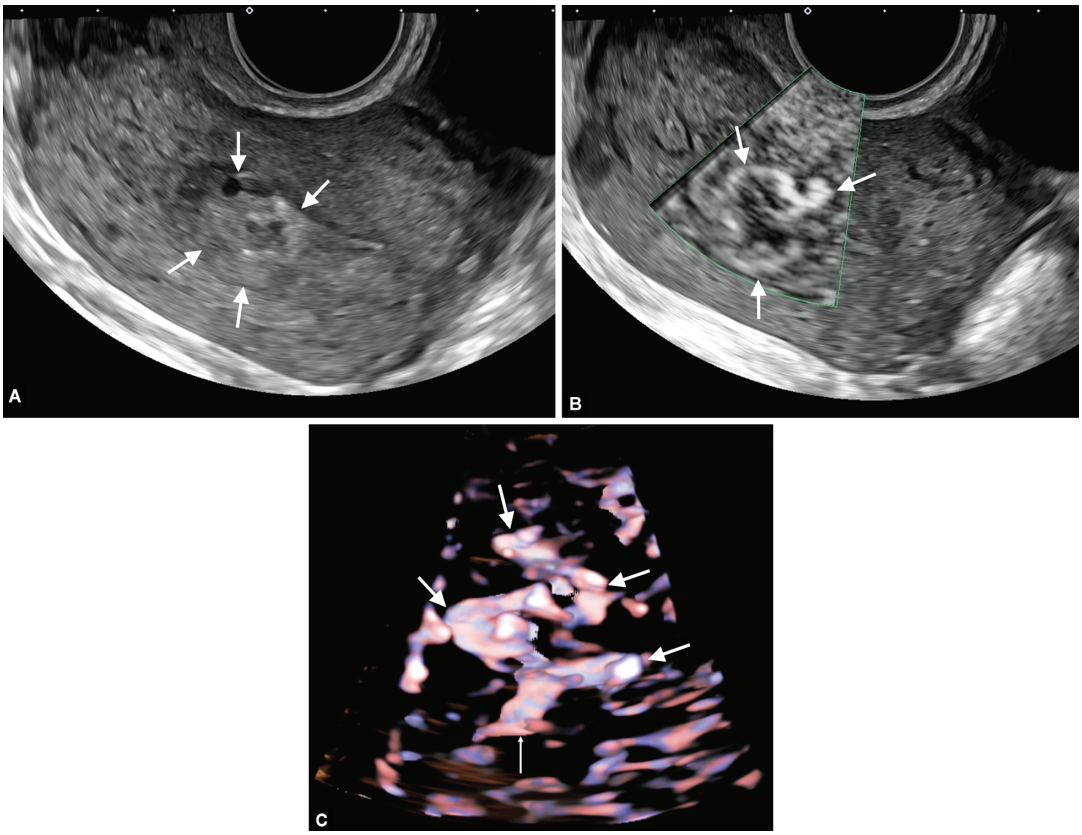
Conventional color Doppler showed some blood vessels around the tumor, whereas SMI clearly revealed some tiny blood vessels in the bulky tumor (5 cm in diameter) in the cervix of the GAS (Fig. 3).

Uterine AVM

Transvaginal 2D sonography depicted an ill-defined, inhomogeneous lesion with a small hypoechoic cyst in the uterine cavity (Fig. 4A). Tortuous structures of AVM could be clearly



Figs 3A to C: Sagittal view of the cervical adenocarcinoma (gastric-type mucinous carcinoma: GAS). Conventional color Doppler shows some blood vessels around the tumor (arrows), whereas superb microvascular imaging (SMI) clearly reveals some tiny blood vessels in the bulky tumor (5 cm in diameter) in the cervix of the GAS. T, tumor; UB, uterine body. (A) Two-dimensional sonography; (B) Color Doppler; (C) SMI



Figs 4A to C: Sagittal view of the uterus with uterine arteriovenous malformation (AVM). (A) Transvaginal two-dimensional sonography depicts an ill-defined, inhomogeneous lesion with a small hypoechoic cyst (arrows) in the uterine cavity; (B) Tortuous structures of AVM (arrows) could be clearly recognized using SMI; (C) Three-dimensional (3D)-SMI generates a spatial 3D image of a fine AVM vascular tree

recognized using SMI (Fig. 4B), and 3D-SMI generated a spatial 3D image of a fine AVM vascular tree (Fig. 4C).

Discussion

Previously, SMI was mainly used to assess the microvasculature of normal and abnormal placentae.[1–7] Recently, fetal cardiac blood flow, fetal peripheral blood vessels, and intra-abdominal organ microvasculature were assessed using SMI.[8–12] In the gynecologic field, to the best of our knowledge, there has been no study on transvaginal SMI assessment of the microvasculature of uterine disorders using the latest device with a high-resolution transvaginal probe. In the present study, transvaginal SMI using the latest device with a high-resolution transvaginal probe could clearly depict tiny blood vessels in postmenopausal uterus and uterine disorders, and transvaginal 3D-SMI also showed the spatial structure of the uterine AVM. Therefore, transvaginal SMI provides novel information on the microvasculature of uterine disorders in clinical practice. Further studies involving a larger sample size are needed to confirm the usefulness of transvaginal SMI to assess the microvasculature in uterine disorders.

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