Spinal Dural Arteriovenous Fistula: Is There a Role for Intraoperative Contrast-Enhanced Ultrasound?

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CNS 2017 ANNUAL MEETING
BOSTON, MASSACHUSETTS
OCTOBER 7–11, 2017

Introduction

Intraoperative imaging during surgical ligation of a spinal dural arteriovenous fistula (SDAVF) is usually based on fluorescence angiog- raphy, intraoperative Doppler ultrasound, and intraoperative digital subtraction angiography. We investigated the potential role of contrast-enhanced ultrasound (CEUS) during surgical management of SDAVF. The main features of SDAVF on CEUS before treatment are described as well as their modifications after surgical ligation.

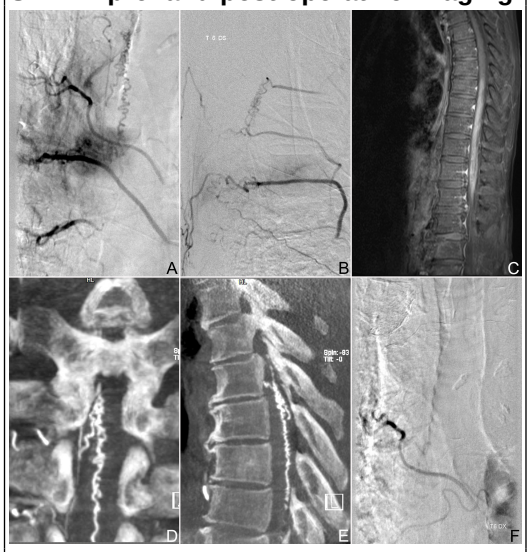
Methods

CEUS was performed using harmonic imaging with a second-generation ultrasound contrast agent in a case of right D6 SDAVF.

Results

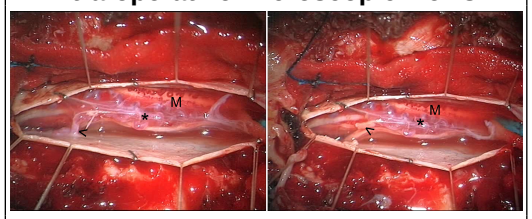
Initial CEUS scan demonstrated the location of the arterialized vein draining in the dilated perimedullary plexus and augmented enhancement of the spinal cord secondary to intramedullary capillary congestion and augmented flow. The postligation scan demonstrated interruption of the arterialized vein and restoration of normal blood flow in spinal cord and perimedullary plexus.

SDAVF pre- and post-operative imaging.



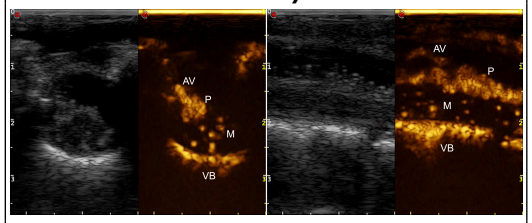
A) and B) pre-operative angiography, SDAVF is supported by the right D6 intercostal artery. C) pre-operative sagittal T1 gadolinium MRI, the medulla enhancement is consequence of capillary engorgement. D) and E) CT angiography. F) post-operative angiography.

intra-operative microscopic views.



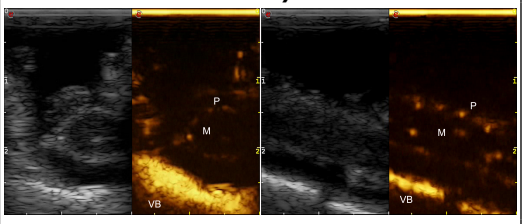
On the left pre-ligation and on the left the post-ligation appearance. Legend: arterialized vein - arrow head. peri-medullary plexus - *. Medulla – M.

Pre-ligation CEUS scan of D6 dorsal SDAVF (left - axial scan; right - sagittal scan)



These images demonstrate the location of the arterialized vein (AV) that ends in the dilated peri-medullary plexus (P). The medulla (M) CEUS signal is stronger than in physiological condition because of intra-medullary capillary congestion and augmented flow. The medulla is displaced against the vertebral body (VB)

Post-ligation CEUS scan of D6 dorsal SDAVF (left - axial scan; right - sagittal scan).



The arterialized vein is no more visible. The formerly dilated peri- medullary plexus (P) now is less congested and less visible in CEUS. The medulla (M) CEUS signal is still visible but less the before and more similar to physiological aspect. The medulla is no more displaced against the vertebral body (VB)

Conclusions

CEUS allowed real-time visualization before and after liga- tion of the site of the fistula and blood flow changes occurring in the spinal cord and perimedullary plexus. CEUS is a valuable tool in SDAVF surgery without the limitations of Doppler imaging and possibly can be integrated with other imaging modalities such as fluorescence angiography.

Learning Objectives

To understand the potential benefits of intraoperative contrast-enhanced ultrasound (CEUS) application in SDAVF surgery, presenting principal features before treatment and the modifications after surgical ligation.