Section: **Ultraschall und Intervention**

ID: 136

Abstract-Title:
ENDO-NEURO-SONOGRAPHY (ENS) : TECHNIQUE AND EQUIPMENT, ANATOMY AND IMAGING, CLINICAL APPLICATION

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Abstract-Text:
Objective:
The step from micro-neurosurgery to endo-neurosurgery meant a change to a minimally invasive technique, but at the same time the new technique is less safe, which limits its applicability. Further development therefore had to be aimed at making neuroendoscopy safer. An idea, therefore, was to equip the endoscope with a sonographic guidance system. As it stands, endo-neuro-sonography is now a technique that can make a huge contribution to the elaboration of minimally invasive techniques in neurosurgery, as described below.

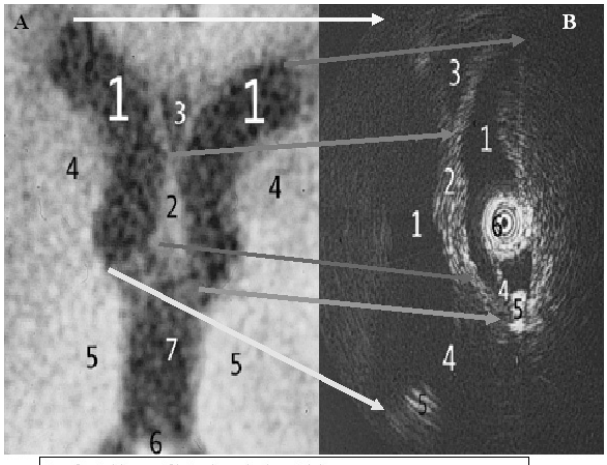
Materials and methods:
A trans-endoscopic sono-catheter (Aloka Deutschland GmbH, Düsseldorf/Germany) with a diameter of 1.9 mm (6F) and 2.5 mm (8F) was used and introduced into the working canal of an endoscope. The image produced by the probe is a 360° scan („brain radar“) displayed on a monitor. Rigide endoscopes with a working canal of at least 2 mm in diameter and 5° and 30° lenses were prefered (Wolf, Knittlingen, Germany). Preclinical study : The sonographic anatomical aspects of ENS were established on 21 specimens. The examinations were done on fresh specimens by different neurosurgical approaches and burr holes. The nonfixed specimens offered the best model, regarding surgery and sono-echo characteristics of tissue.
Clinical study: Intraoperative endo-neuro-sonographic imagings prepared during surgery on 70 selected patients between1996 and 2004 were examined.

Results:
In clinical use the sono-catheter has superior imaging and navigation abilities to those seen in anatomical laboratory work. Real-time and online characteristics represent changes such as shifting, pulsation, CSF flow, and change of size and form of structures. The easiest application was the navigation of the endoscope into the ventricles. Another use in the ventricular system was for assistance in third ventriculocisternostomy. Cystic lesions are always ideal for endoscopy: in cases of multiple cysts, and intraparenchymal cyst walls, and narrow and complex borders of lesions, the sono-catheter can give additional information and increase safety by intraoperative imaging and navigation support. Ventricular tumors frequently present as cysts on MRI or CT. In all cases the sono-catheter correctly predicted the difference between cyst and tumor. In patients with colloid cysts, the viscosity of the content could be predicted. Tumors are very different in their echo signal, which enhanced detection and differentiation versus normal tissue or

CSF. Due to the imaging of blood flow, vessels are well visible in the sono-scan. They are even seen through the walls of the ventricular system, while being invisible to the endoscope.
Aneurysms are detected within a blood clot by visualizing the flow inside the sac, presenting turbulances and the size of the neck as well. Thereby the patency of parent vessels can be proved by a real-time imaging methode. Cavernomas are precisely reflected and localized because of their strong echo-signal. Even small remnants will be recognized as well as outer shape and internal structure and architecture. In most cases intraoperative imaging was the main reason for the investigation, while in 13 neuronavigation was the focus of interest. When tumor resection was to be checked, even if there were no particular navigation problems the problem of targeting an already visualized remnant still had to be overcome. In 18 imaging cases, targeting a previously imaged lesion or an area of interest was necessary and was successfully achieved.

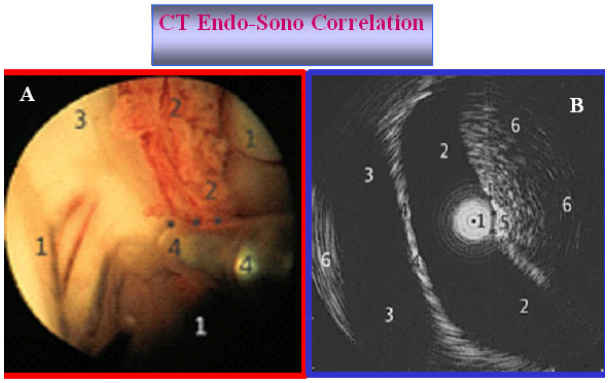
Conclusion:
Summarizing the clinical results of transendoscopic ultrasound imaging in neurosurgery, one can conclude that while in other fields a great deal of experience has already been collected, in neurosurgery we are still just on the threshold. In contrast to all other disciplines using transendoscopic ultrasound, we have one additional benefit of intraoperative imaging, which is the neuronavigation capacity. The routine use of ENS in this first clinical series has shown the capabilities of this technique in different lesions and problems and highlighted its benefits making neuroendoscopy safer.

Bild 1/JPG



1 frontal horns of lateral cerebral ventricles
2 pellucid septum
3 small septum cyst (anat. variation)
4A caudate nuclei
4B foramina of Monro
5A thalamus
5B choriod plexus
6 pineal gland
7 third ventricle

Bild 2/JPG



1A	ependymal veins cella media of right lateral cerebral ventricle
4A+1B	trans-endoscopic sono-probe
2A+5B	chorioid plexus
2B	right lateral ventricle
3A+4B	pellucid septum
3B	left lateral ventricle
6	right thalamus

Bild 3/JPG