Stereotactic navigation for external ventricular drain placement in the ICU

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Learning Objectives

By the conclusion of this session, participants should be able to: 1) critically evaluate the use of image guidance in placement of EVDs 2) compare outcomes in relationship to complications 3) consider the value of newer technology in routine practices

Introduction

Placement of an external ventricular drain (EVD) is essentially a blind procedure based on landmarks, where there are small but real risks of neurologic injury. Rates of inappropriately located ventricular catheters range from 6% to 20% [1-5], with a frequency of approximately one in eight patients (11-13%) in larger series that specifically addressed location of catheters [6-8]. The large number of EVDs placed annually for a variety of indications, inevitably will also produce a substantial number of unintended injuries, repeated procedures, and delays in lifesaving therapy. In 2006, according to procedural data published by the American Association of Neurological Surgeons, 42,446 intracranial pressure monitoring procedures were performed, which, even at the most conservative estimates, equates to thousands of inappropriately placed catheters. Despite adequate training and significant experience, problems with placement do occur.

Surgeons have been known to underestimate their rate of complications; a survey performed by O'Neil et al. [9] indicated that surgeons believe that they cannulated the ipsilateral frontal horn 72-84% of the time, despite evidence ranging from 40% to 77% (see table).

	Number of procedures/scans graded	Grade 1 or Ipsilateral frontal horn	Grade 2 or Other CSF containing space	Grade 3 or Intraparenchymal or non-functioning	Hemorrhage-associated
Toma et al (2009)	183	39.9%	50.2%	9.8%	
Huyette et al. (2008)	98	56.1%	21.4%	22.4%	18.0%
Saladino et al. (2008)	212			12.3%	7.1%
Kakarla et al. (2008)	346	77.0%	10.0%	13.0%	4.9%
Anderson et al. (2004)	68			8.8%	17.6%
Bogdahn et al. (1992)	100			11.0%	
This study	**35**	**94.1%**	**5.9%**	**0.0%**	**2.9%**

Methods

35 patients were consecutively enrolled in a single arm trial evaluating the radiographic accuracy and complications from ventriculostomies performed at the ICU bedside using image guidance technologies.

Results

There were no unacceptably placed ventriculostomy catheters, and only two catheters not perfectly placed in the ipsilateral frontal horn. In terms of grading, there were 33 Kakarla grade 1 placements (94.1%) and two grade 2 placements (5.9%). 28 of the catheters were placed with one pass (80%) and 7 catheters were passed multiple times (20%).

There were two registration failures which were converted to traditional technique (5.7%). There was one case of tract hemorrhage (2.9%). The use of image-guidance technology added approximately 36 minutes to the time from identified need to successful drainage (p= 0.002) and only 4 minutes of additional operative time (p = 0.12).

The weighted average rate of unacceptably placed EVDs with free-hand technique is 12.7% (see table). The number needed to treat to eliminate one unacceptably placed EVD is 8 (p value = 0.02). Furthermore, we also noted a significant reduction in the frequency of procedure related hemorrhages, 2.9% versus meta-analysis estimates of 12.1%[10], which may in part be due to purposeful avoidance of sulci by the surgeon when passing the catheter or the unintended consequence of a slower descent of the catheter while observing the navigation monitors.

Conclusions

Image guidance technology eliminated unacceptably placed catheters and reduced the risk of catheter-associated intracerebral hemorrhages

References

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