Fossa Navicularis: Literature Review, Diagnosis and Management

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Introduction

The fossa navicularis is an anatomical skull base variant. It represents a bony notch in the skull base, thought to be very rare and benign until recently, when 3 separate cases of intracranial infection associated with this finding have been reported.

Methods

We reviewed the scientific searches – PubMed Central, EMBASE, Google Scholar, Scopus database, Cochrane database and Science Research, using the key words: fossa navicularis; canalis basilaris medianus; and pharyngeal fossa. We identified the papers where these terms were used, and described the unique features and clinical importance of this distinctive skull base radiological finding.

Figure 1

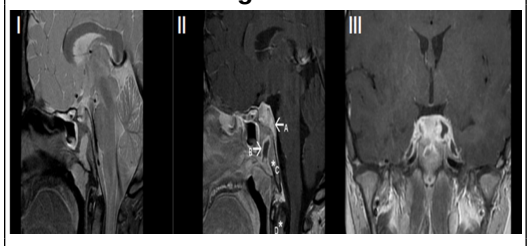

Fig 1. I: Sagittal fat-saturated Gd-enhanced T1-weighted MR image demonstrating fossa navicularis magna within the clivus. II: Sagittal T2-weighted MR image showing dural thickening (A) posterior to the clivus with associated enhancement. There is a rim-enhancing collection/abscess (B) within the canal in the body of the clivus. Enhancement of the marrow of the clivus (C) is greater than in the marrow elsewhere, e.g., of the odontoid process (D), in keeping with an associated osteomyelitis. III: Coronal MR image demonstrating involvement of the cavernous sinus.

Learning Objectives

This will help to highlight the importance of diagnosing this skull base anatomical variant especially in the pediatric population, and prevent the possible clinical consequences.

Figure 2

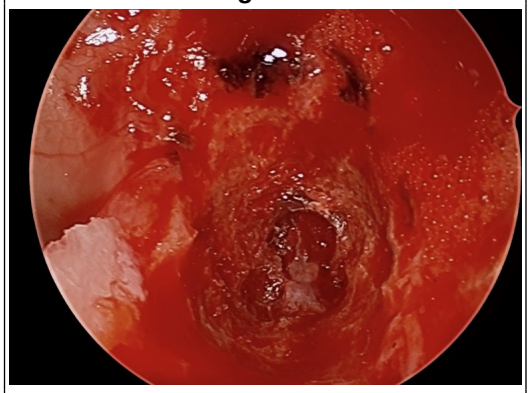

FIG 2. Photograph obtained via an endonasal endoscopic approach, showing the fossa navicularis defect on the anterior wall of the clivus.

Results

Our literature search covered papers from the 19th century till modern day literature. The earlier authors described 'fossa navicularis' as a very rare skull base finding. However more recently, 3 cases have been reported with associated clival or intracranial infection. To the best of our knowledge, this will be the 4th case reported in the literature and the only one that has been surgically repaired via an endonasal endoscopic approach. We present a 9 year old female who had presented with prior recurrent episodes of meningitis and was diagnosed with fossa navicularis. This skull base morphological anomaly should be considered in the differential diagnoses for unexplained skull base infective pathology.

Discussion

The reported incidence of the fossa navicularis in the anatomical literature is 0.9%–5.3%, with measurements ranging from 1.1 to 5.5 mm in depth and 1.5–8 mm in width. The finding was first reported in the early 19th century—Rossi reported it in 1.5% of the 3712 dried skulls he studied, Romiti reported it in 0.9% of 990 skulls,14 and Rizzo reported it in 2.1% of 335 skulls. More recently, Cankal et al looked at 492 dry skulls and the CT images of 525 patients to determine the incidence of fossa navicularis.

TABLE 1. Literature summary of cases with clinical presentation, radiographic findings, treatment, and outcomes

Parameter	Prabhu et al., 2009	Segal et al., 2013	Benadjaoud et al., 2017	Alalade et al., 2018
Case No.	1	2	3	Present case
Age in yrs	5	12	7	9
Sex	F	F	M	M
Clinical presentation	Fever, reduced oral intake, neck stiffness, bilat cervical lymphadenopathy	Fever, HA, neck stiffness, Kernig's & Brudzinski's signs, R strabismus, altered consciousness, opisthotonus	HAs, fever, torticollis	HAs, fever, photosensitivity, neck stiffness, cranial nerve palsies
Radiographic findings	XR: thickening of prevertebral soft tissues; CT: large retropharyngeal abscess w/ notch-like clival defect w/ associated osteolysis & cortical destruction; MRI: abnormal clival enhancement w/ collections w/ in longus colli bilaterally	CT: small fluid collection in nasopharynx just in front of clivus & a bony notch-like round defect; MRI: soft tissue swelling in nasopharyngeal & suboccipital areas, R internal jugular vein thrombus; connection btwn nasopharynx & skull base	CT: fossa navicularis magna in basiocciput; MRI: clival osteomyelitis w/ associated retropharyngeal abscess & C1–2 epidural enhancement	CT: fossa navicularis magna through clivus; MRI: fossa navicularis w/in clivus; rim-enhancing collection w/in canal; associated clival osteomyelitis
Implicated organisms	Group A *Streptococcus*	NA	*Streptococcus intermedius*, *Fusobacterium* spp.	NA
Treatment	Medical: initially IV ceftriaxone for 4 wks, followed by 4 wks oral amoxicillin; surgical: transoral incision & drainage of retropharyngeal abscess	Medical: antibiotics* & anticoagulants*	Medical: initially IV cefotaxime, metronidazole, gentamicin for 1st 7 days, IV co-amoxiclav after definitive culture results, followed by 3 mos oral prednamycin; surgical: transnasal aspiration of retropharyngeal abscess	Medical: initially IV ceftriaxone for 6 wks (additional IV metronidazole for 1st wk), followed by 6 wks oral amoxicillin; surgical: endonasal endoscopic repair of defect
Outcome	Good, no sequelae	Resolution of strabismus & partial resolution of venous sinus thrombosis	Good, no sequelae	Good, no sequelae

HA = headache; IV = intravenous; NA = not applicable; XR = radiography.
* Name not provided.

Discussion, continued

The variant was noted in 5.3% of the dry skulls examined (2.4% were less than 2 mm deep, and 2.9% were deeper than 2 mm). From the CT evaluation, they found that 3.0% of the patients had a fossa navicularis. As the CT sections were 2 mm (and would not highlight defects smaller than that), the authors suggested that the incidence of fossa navicularis was similar in their population and more frequent than previous studies had suggested. Beltramello et al reported that the fossa navicularis was filled by lymphoid tissue of the pharyngeal tonsil. Their patient was diagnosed with a prominent fossa navicularis following evaluation for sinusitis. This finding was supported by Prabhu et al who identified lymphoid tissue from the pharyngeal tonsil around the fossa navicularis. However, Sheikh et al found the overlying tissue to be composed of loose connective tissue with a mixture of collagen, elastic fibres, and vascular matrix. They reported no glandular, lymphoid, or notochordal tissue in the histologically analysed tissues. Our histopathological assessment revealed gliotic tissue within the visible tract, which represents a new finding.

The MRI features of bone marrow in the clivus have been seen to vary with age. In childhood, the bone marrow is rich in hematopoietic tissue and the clivus is homogeneously hypointense. This is referred to as "stage I" clivus bone marrow as opposed to stage II (intermediate stage with fatty infiltration of the marrow and the clivus has a heterogeneous appearance) or stage III (hypoactive marrow with a homogeneous hypoactive clivus).

Discussion, continued

Olcu et al found in their study that the stage III features were not noted in the age group of 0–9 years. In cases in which unexpected MRI clival changes are noted, as was the case with our patient, there is most likely an underlying pathology. The synchondroses at the skull base are important for craniofacial development, and the spheno-occipital synchondrosis usually completely fuses at 18 years. However, this joint is different from the fossa navicularis as the fusion begins superiorly and progresses inferiorly, through the five stages described by Bassed et al. In stages II and III, when partially fused, it is typically visible as a linear partition between the sphenoid and occiput rather than the notch-like defect appearance of the fossa navicularis.

Conclusions

Fossa navicularis is a notch-like defect seen in the clivus. It is an anatomic skull base variant previously described in the literature as very rare. The cases reported were all associated with intracranial infection. This skull base morphological anomaly should be considered in the differential diagnoses for unexplained skull base infective pathology.

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