REVIEW

The Diaphragma Sellae: A Concise Review

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ABSTRACT

The diaphragma sellae may be involved in pathology at the skull base. Therefore, a clear understanding of its anatomy and variations is important for surgeons who operate the skull base and radiologists who interpret imaging of the sellar region. The present paper reviews the anatomy and relation to disease of the diaphragma sellae. Biomed. Int. 2013; 4: 40-44. ©2013 Biomedicine International, Inc.

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INTRODUCTION

The diaphragma sellae (DS) is a small horizontal duplicated dural fold that makes the roof of the sellae turcica and is formed by the anterior extension of the tentorium cerebelli and regional parasellar dura.¹,² Some have referred to it as the so-called tentorium or operculum of the hypophysis.³ The DS is attached anteriorly to the tuberculum sellae and posteriorly to the dorsum sellae (Figure 1). Laterally, it tends to be thicker and wider, and connects to the anterior and posterior clinoid processes.⁴ Centrally, the DS has a central opening (diaphragmatic foramen) for the pituitary stalk.⁴ Along its anterior and posterior margins runs the anterior and posterior intercavernous sinus, respectively, that may become confluent resulting in the formation of the so-called circular sinus. An infradiaphragmatic cistern is sometimes present.⁵

The DS is usually concave upward or flat⁶ and slopes downward toward the sellae.² The widths of the dural portion of the DS are approximately 4.5 mm laterally and 1.5 anteriorly or posteriorly.⁷ The opening of DS is round in 54% of specimens and is in the form of a transverse oval in 46% of individuals.⁶ The defect in the DS for the pituitary stalk may enlarge with age.⁷ Bergland et al.⁸ observed that the defect for the stalk is often less than 5 mm in diameter, with only 39% of the specimens measuring greater than 5 mm. Won et al.⁹ found that the average horizontal and vertical diameters of the DS opening to be 7.9 and 7.6 mm, respectively. The diaphragmatic opening can be large (Figure 1) especially in women who have had several children as the result of intermittent swelling of the pituitary gland.¹⁰ Campero et al.⁷ classified DS based on its opening as Group A with an opening diameter of less than 4 mm (20% of specimens), Group B with an opening diameter of 4 to
8 mm (40% of specimens), and Group C with an opening greater than 8 mm (40% of specimens). Busch\textsuperscript{11} has yet presented another classification for the DS composed of three types; a type in which DS has a small opening for the pituitary stalk (41.9%) (Figure 2), an incomplete DS with an opening for the stalk of less than 3 mm (37.6%) and a DS represented by a very thin rim of tissue of less than 2 mm (20.5%). These data imply that the DS has a considerable variation among individuals. The DS may be visible as an elongated line on lateral radiographs of the head.\textsuperscript{12}

The superior hypophyseal arteries pass through the DSD.\textsuperscript{12} Lee et al.\textsuperscript{13} found that the blood supply to the DS may also arise from the inferior hypophyseal artery, a branch of the meningohypophyseal trunk, and/or directly from the cavernous portion of the internal
carotid artery through the inferior and anterior capsular arteries. Lang found that the superior hypophyseal arteries often pass through the DS in route to the anterior lobe of the pituitary gland and sometimes penetrate it. The sensory innervation to the DS is provided by the meningeal branches of the trigeminal nerve.

**CLINICAL ASPECTS**

The term empty sellae was coined by Busch in 1951 to describe a deficient DS, a slightly enlarged sellae and no visible pituitary gland. An elegant review on the empty sellae syndrome has been given by Lenz and Root. The incidence of this syndrome in the pediatric population ranges from 1.2% in individuals with endocrinopathy to 68% in those without endocrinopathy. The primary empty sellae syndrome occurs when a defect in the DS allows cerebrospinal fluid to enter the sellae turcica and compress the pituitary gland against the bony boundary of the sellae. The secondary forms of empty sellae can be the consequence of regional surgeries or pituitary apoplexy among other etiologies.

Sunderland found that the DS was tightly applied to the pituitary stalk in 20% of his specimens (Figure 2). Moreover, this author found that in childhood, there is normally no arachnoid below the level of the diaphragma foramen, thus no extension of the subarachnoid space into the pituitary fossa (Figure 3). In adults, he found atrophy of the gland with advancing age with descent of the arachnoid and subarachnoid space through many foramina. Roussy and Mosing found that the pia in this region divides with an anterior position fusing to the DS and a posterior layer descending between the pituitary stalk and pars tuberalis. Wislocki, in fetal specimens, concluded that “the dura developing around the body of the hypophysis and forming the sellar diaphragm fuses with the surface of the anterior and neural lobes and hence prevents permanently the development of pia arachnoid or of a subdural space around the body of the pituitary.” Hollinshead stated that the subarachnoid space extends through the DS over the upper surface of the pituitary gland and “except on it upper surface, however, the outer portion
of the gland is fused to the dura, so that the gland is held in place both by the diaphragm and its dural attachments.”

Some have opined that the DS, when fully formed, acts as a protective barrier against the pulsating action of CSF on the pituitary gland. Ferreri et al.\(^\text{18}\) have found that the DS is a factor in determining the morphology of the sellae turcica and its contents. For example, absence of or a small DS may be associated with a smaller pituitary gland. Sage et al.\(^\text{19}\) found that even with a normal pituitary gland, a defect in the DS may lead to expansion of the bony contour of the sellae turcica with greater downward bowing of the floor. These authors also found a correlation between the size of the defect and the depth of the intrasellar cistern that resulted from the downward extension of the suprasellar cistern. The DS can be expanded without rupture with growth of pituitary tumors. Cushing\(^\text{20}\) believed that a “defective” DS allowed for escape for some pituitary tumors. More recently, Hekimsoy et al.\(^\text{21}\) opined that normal functions of the pituitary gland may be impaired when the gland is compressed onto the floor of the sellar by arachnoid tissue extending through an “impaired” DS.

**SURGICAL ASPECTS**

Surgically, the DS is commonly assumed to provide a physical barrier between the sellae turcica and intracranial space during trans-sphenoidal procedures. However, Bergland et al.\(^\text{8}\) found that 10% of DS are too thin to serve as a reliable barrier against penetration with such procedures. The DS may be adherent to the pituitary stalk and thus necessitate dissection from the stalk during surgery in this area. Additionally, upward displacement of the DS may provide early evidence of an expanding pituitary lesion. Tumors of the peri-chiasmatic region have variable extension into the sellar cavity. Wang et al.\(^\text{3}\) found that craniopharyngiomas with prechiasmatic growth had subdiaphragmatic portions while only 3 (27%) of tumors with retrochiasmatic extension had subdiaphragmatic parts. These authors noted that tumors were less adherent to the optic nerves when covered by the DS.

**CONCLUSION**

The relevance of the DS in intracranial pathologies like empty sellae syndrome and peri-chiasmatic tumors is evident from the literature. A clear understanding of the anatomy of DS and its variability is important for surgeons who operate the skull base and radiologists who interpret imaging of the sellar region.

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**REFERENCES**