

Knosp 分级和海绵窦分区在侵袭性垂体瘤经鼻内镜手术中的临床意义

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【摘要】目的 探讨 Knosp 分级和海绵窦分区对评价垂体瘤侵袭性和指导经鼻内镜手术的临床意义。**方法** 75 例患者 (Knosp 分级 3 级 44 例、4 级 31 例) 均源自 2015 年 7 月至 2017 年 6 月住院行经鼻内镜手术的垂体瘤病例。术前通过鞍区冠状位 MRI 计算颈内动脉海绵窦段至前床突上段血管中点连线距离与肿瘤向鞍旁侵袭最远点至该连线垂直距离的比值 (比值 R) 以判断 Knosp 分级 3 级垂体瘤的侵袭程度, 然后根据内镜下海绵窦分区和海绵窦内侧壁是否受累将侵入不同海绵窦间隙的 Knosp 分级 3 级垂体瘤进一步分为 3A 级 (侵袭性和非侵袭性) 和 3B 级, 从而制定手术方案。**结果** Knosp 分级 3A 级垂体瘤患者共 36 例, 肿瘤呈侵袭性生长 12 例 (主要侵入海绵窦后上间隙, 影响动眼神经)、非侵袭性生长 24 例 (肿瘤推挤海绵窦内侧壁但未侵入, 呈假侵袭), 侵袭组比值 R 小于非侵袭组 (1.28 ± 0.18 对 1.74 ± 0.27 ; $t = 5.275$, $P = 0.000$)。Knosp 分级 3A 级患者中比值 R ≤ 1.59 (中位值) 者 17 例、 > 1.59 者 19 例, 前者肿瘤侵袭性高于后者 (12/17 对 0/19; Fisher 确切概率法: $P = 0.000$)。75 例患者肿瘤全切除率 72% (54/75), Knosp 分级 3 级达 84.09% (37/44)、4 级为 54.84% (17/31)。术后平均随访 (14.84 ± 5.66) 个月, 无一例复发。**结论** 术前通过鞍区冠状位 MRI 计算比值 R, 有助于评价 Knosp 分级 3A 级垂体瘤侵袭程度, 结合术中内镜下海绵窦分区, 对经鼻内镜垂体瘤切除术具有重要指导意义。

【关键词】 垂体肿瘤; 肿瘤浸润; 海绵窦; 内窥镜; 神经外科手术

The significance of Knosp classification and cavernous sinus division in endoscopic transnasal surgery for invasive pituitary adenomas

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【Abstract】Objective To evaluate the value of Knosp classification and cavernous sinus zoning in the diagnosis of pituitary adenoma invasiveness and the significance of endoscopic transnasal surgery for pituitary adenomas. **Methods** There were 75 cases with pituitary adenomas of Knosp grade 3-4 (44 cases of Knosp grade 3 and 31 cases of Knosp grade 4) who were performed endoscopic transnasal surgery from July 2015 to June 2017 in our hospital. Based on coronal MRI of sellar region in patients with Knosp 3 pituitary adenomas, the ratio R of distance from the middle point of internal carotid artery (ICA) cavernous sinus segment to the upper part of anterior clinoid process segment and vertical distance from the furthest point of tumor invasion to the line was calculated and analyzed statistically. According to cavernous sinus zoning under endoscope and involvement of medial wall of cavernous sinus, patients with Knosp grade 3 pituitary adenomas were further divided into Knosp grade 3A (invasive and non-invasive) and 3B by invading different cavernous spaces. The total removal rate of tumor was reviewed by MRI in sellar region after operation. **Results** Among 75 cases, 36 were classified as Knosp grade 3A in 44 cases of Knosp grade 3 pituitary adenomas, including 12 cases of invasive pituitary adenomas (mainly involving posterior superior space of cavernous sinus and affecting oculomotor nerve) and 24 cases of non-invasive pituitary adenomas (the tumor pushed against the medial wall of cavernous sinus, presenting "pseudoinvasion"). The ratio R of invasive pituitary adenomas was significantly smaller than non-invasive pituitary adenomas ($1.28 \pm$

0.18 vs. 1.74 ± 0.27 ; $t = 5.275$, $P = 0.000$). The Knosp grade 3A was divided into 2 groups according to the median value of ratio R: ≤ 1.59 group (17 cases) and > 1.59 group (19 cases). The invasion rate of ratio R ≤ 1.59 group was higher than that of > 1.59 group (12/17 vs. 0/19; Fisher's exact probability, $P = 0.000$). The total resection rate of 75 cases was 72% (54/75), among which the total resection rate of Knosp grade 3 was 84.09% (37/44), and rate of Knosp grade 4 was 54.84% (17/31). The average follow-up period was (14.84 ± 5.66) months, and no one case relapsed. **Conclusions** The calculation of ratio R in preoperative coronal MRI helps to evaluate the invasion degree of Knosp grade 3A pituitary adenomas. Combined with artificial division of cavernous sinus, it has guiding significance in endoscopic transnasal surgery for pituitary adenoma removal.

【Key words】 Pituitary neoplasms; Neoplasm invasiveness; Cavernous sinus; Endoscopes; Neurosurgical procedures

Conflicts of interest: none declared

侵袭性垂体瘤占全部垂体瘤的10%~20%^[1],呈侵袭性生长^[2],向上可突破鞍膈侵入前颅底或使第三脑室受累;向下累及鞍底骨质和硬脑膜,甚至充满蝶窦,易误诊为脊索瘤;若向鞍旁侵入海绵窦则包绕颈内动脉^[3],此类垂体瘤一般难以手术全切除^[4-5]。鞍区MRI增强扫描和经鼻内镜手术是诊断与治疗侵袭性垂体瘤的主要方法^[6-7],且经鼻内镜肿瘤全切除率明显高于其他入路^[8-9]。然而,经鼻内镜手术最严重的并发症,即术中静脉丛或颈内动脉损伤引起的难以控制的大出血,至今仍是该入路手术高病死率的主要原因。因此,术中准确判断垂体瘤是否具有侵袭性对获得手术成功至关重要。Knosp等^[10]根据MRI所示垂体瘤侧部相对于颈内动脉的位置,以蝶鞍中段平面作为参考,并以颈内动脉海绵窦段内流空影之间内、中、外切线作为标记,将其分为4级,其中Knosp分级3级的垂体瘤边界超过颈内动脉外切线、4级包绕颈内动脉,故被共同定义为侵袭性垂体瘤。然而,我们在临床实践中发现,Knosp分级为3级的垂体瘤其侵袭程度远低于既往文献报道^[10],但亦有部分肿瘤侵入海绵窦上部或下部,因此有必要对Knosp分级为3级的垂体瘤进一步分级,即根据其侵袭程度分为3A级和3B级。经临床观察仅少数Knosp分级3A级垂体瘤呈侵袭性生长,主要累及海绵窦后上间隙,大多数3A级垂体瘤呈非侵袭性生长,虽然其在生长过程中可能会推挤海绵窦内侧壁但并未侵入其内,故为假侵袭;而Knosp分级3B级者则均呈侵袭性生长,主要侵入海绵窦前下间隙,亦可使海绵窦前下间隙和后下间隙同时受累。在本研究中,我们在术前通过鞍区冠状位MRI增强扫描所见,计算颈内动脉海绵窦段至前床突上段血管中点连线距离与肿瘤向鞍旁侵袭最

远点至该连线垂直距离的比值(比值R),以判断Knosp分级3级垂体瘤的侵袭性,并在术中通过内镜下海绵窦分区加以验证,初步探讨Knosp分级和海绵窦分区在侵袭性垂体瘤经鼻内镜手术中的作用。

资料与方法

一、一般资料

选择2015年7月至2017年6月经中国医科大学附属第一医院神经外科明确诊断并住院治疗的侵袭性垂体瘤患者共75例,所有患者术前均经鞍区MRI(主要是冠状位增强T₁WI)证实至少一侧海绵窦受累,行内镜下经鼻入路肿瘤切除术,术后病理证实均为垂体腺瘤。男性32例,女性43例;年龄17~70岁,平均(49.60 ± 11.35)岁。术前内分泌功能检测显示,无功能性垂体腺瘤47例(62.67%)、生长激素腺瘤14例(18.67%)、催乳素腺瘤12例(16%)、促肾上腺皮质激素腺瘤2例(2.67%);Knosp分级3级者44例(58.67%)、Knosp分级4级者31例(41.33%)。

二、手术方法

1. 比值R的计算 Knosp分级为3级的垂体瘤患者根据鞍区冠状位MRI增强扫描所见,计算颈内动脉海绵窦段至前床突上段血管中点连线距离与肿瘤向鞍旁侵袭最远点至该连线垂直距离的比值,即比值R(图1)。

2. 术中海绵窦分区 术中肿瘤切除顺序分别为鞍内、鞍旁肿瘤囊外部分,为了避免鞍膈塌陷影响视野最后切除鞍上肿瘤。在切除鞍旁肿瘤之前,先于内镜下进行海绵窦分区,以颈内动脉垂直段为界线分为海绵窦前后间隙,以水平段与垂体下动脉连为界线分为海绵窦上下间隙,共4个间隙,即前上

间隙、后上间隙、前下间隙、后下间隙,其中海绵窦前上间隙和后上间隙有动眼神经走行、海绵窦前下间隙和后下间隙有外展神经走行(图2)。根据肿瘤侵入海绵窦间隙程度的不同,将 Knosp 分级为 3 级者进一步分为 3A 级和 3B 级,以内镜下海绵窦内侧壁完整与否,再将 Knosp 分级 3A 级垂体瘤分为侵袭性和非侵袭性两类。由于内镜直视下海绵窦内侧壁的完整性是判断垂体瘤是否呈侵袭性生长的“金标准”^[11],故内镜下可见下列情况之一者即诊断为侵袭性垂体瘤:海绵窦内侧壁不完整或明显粗糙;肿瘤明显包绕颈内动脉;肿瘤侵袭致术中海绵窦破坏、出血。

3. 经鼻内镜垂体瘤切除术 患者气管插管全身麻醉,平卧位,头向后仰 $5^{\circ}\sim 10^{\circ}$ 、向右偏向术者 15° ,采用双人三手操作,常规选择右侧鼻腔作为手术通道。剥离子推开下鼻甲,中鼻甲剪刀剪下中鼻甲并制备游离中鼻甲黏膜瓣,长电刀头烧灼鼻中隔黏膜并制备带蒂鼻中隔黏膜瓣,沿后鼻道向上显露蝶窦开口^[12];咬切钳咬开蝶窦前壁、磨钻磨除蝶窦分隔,确认鞍底骨性标记(视神经隆起、颈内动脉隆起、视神经-颈内动脉隐窝、斜坡隐窝等);磨开鞍底、显微剪刀放射状剪开硬脑膜,显露肿瘤;常规 0° 内镜(德国 Karl Storz 公司)依次切除鞍内肿瘤、进行海绵窦分区、切除鞍旁肿瘤,最后切除鞍上肿瘤。根据术前 MRI 增强扫描所示鞍区薄层弧形强化影像辨认正常垂体并保护,防止术后发生严重的垂体功能减退症和尿崩症。对于鞍旁海绵窦内侧或包绕颈内动脉的肿瘤,术中需多普勒超声探明血管走行及肿瘤至血管的距离后再采用有一定弯曲角度的手术器械予以切除;而多种侵袭方式并存的侵袭性垂体瘤,如向上突破鞍膈侵袭前颅底或侵入第三脑室、向下累及斜坡、向鞍旁侵入海绵窦并包绕颈内动脉,均需结合术中导航予以切除。术中出血为该入路内镜手术的主要并发症之一,可通过抬高患者头部^[13]、填塞纤维压迫出血点、注入流体明胶剂或生物蛋白胶等方法进行止血,然后再以 30° 或 45° 内镜切除肿瘤;对于术中发生严重脑脊液漏的患者可切取大腿外侧脂肪组织和阔筋膜修补鞍底进行颅底重建。

4. 肿瘤全切除率与复发率的计算 根据内镜下直视所见以及术后 7 d 内复查鞍区 MRI 增强扫描显示无肿瘤残留为肿瘤全切除,并以此计算肿瘤全切除率。术后通过 MRI 分别随访 3、6、12 和 24 个月,

以鞍区 MRI 增强扫描未见占位性影像为肿瘤无复发,并以此计算肿瘤复发率。

三、统计分析方法

采用 SPSS 20.0 统计软件进行数据处理与分析。计数资料以相对数构成比(%)或率(%)表示,采用 Fisher 确切概率法;呈正态分布的计量资料以均数 \pm 标准差($\bar{x}\pm s$)表示,行两独立样本的 t 检验。以 $P\leq 0.05$ 为差异具有统计学意义。

结 果

本组 Knosp 分级为 3 级的 44 例垂体瘤患者中 3A 级 36 例,侵袭性 12 例、非侵袭性 24 例,侵袭组与非侵袭组患者比值 R 比较差异有统计学意义($t=5.275, P=0.000$;表 1)。根据比值 R 中位值(1.59),将 Knosp 分级为 3A 级的患者分为比值 $R\leq 1.59$ 组(17 例)和比值 $R> 1.59$ 组(19 例),前者侵袭性高于后者(Fisher 确切概率法: $P=0.000$;表 2),提示比值 $R\leq 1.59$ 的 Knosp 分级 3A 级垂体瘤更具侵袭性。

术中内镜下可见,侵袭性 Knosp 分级为 3A 级的垂体瘤主要累及海绵窦后上间隙,影响动眼神经;而非侵袭性 3A 级垂体瘤虽推挤海绵窦内侧壁但侧壁并未受累,呈假侵袭性生长。本组 Knosp 分级为 3B 级的患者共 8 例,垂体瘤均呈侵袭性生长,6 例侵入海绵窦前下间隙、2 例侵入海绵窦前下和后下间隙并累及外展神经;Knosp 分级为 4 级的 31 例患者肿瘤均呈侵袭性生长,主要侵入海绵窦前下、后下和后上间隙,有 6 例累及外展神经、6 例累及动眼神经、4 例外展神经与动眼神经同时受累(图 3~5)。

根据术中内镜下直视所见以及术后 7 d 内鞍区 MRI 增强扫描所示,本组 75 例患者中 54 例(72%)肿瘤达全切除,44 例 Knosp 分级为 3 级的患者中 37 例(84.09%)肿瘤全切除(图 4),31 例 Knosp 分级为 4 级的患者中 17 例(54.84%)肿瘤全切除(图 5)。术后随访 3~24 个月、平均(14.84 ± 5.66)个月,无一例肿瘤复发。

讨 论

侵袭性垂体瘤的体积较大,且质地较硬、生长速度较快,表现为不同的侵袭方式,多具有内分泌功能^[14-15],沿海绵窦外侧壁走行的脑神经^[16-17]如动眼神经、滑车神经和三叉神经^[7]均可受到肿瘤的压迫或手术损伤。目前,鞍区薄层 MRI 增强扫描是诊断侵袭性垂体瘤最有价值的方法,增强 T₁WI 显示海

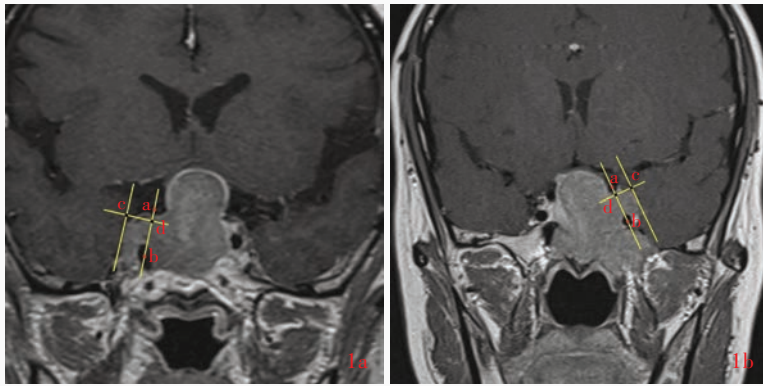


图1 鞍区冠状位增强T₁WI,ab为颈内动脉海绵窦段至床突上段血管中点连线距离,cd为肿瘤向鞍旁侵袭最远点至ab的垂直距离,ab/cd即为比值R
1a 肿瘤侵入右侧海绵窦 1b 肿瘤推挤左侧海绵窦内侧壁但未侵入,呈假侵袭

Figure 1 Coronal enhanced T₁WI in sellar region, ab was the distance between the midpoints of cavernous sinus segment and the superior clinoid process segment of ICA, and cd was the vertical distance from the furthest point of parasellar invasion to the ab. The ab/cd was ratio R. The tumor on the left intruded into the right cavernous sinus (Panel 1a). The tumor on the right pushed against the medial wall of the left cavernous sinus, presenting "pseudoinvasion" (Panel 1b).

图2 内镜下显示的海绵窦4个间隙(橘色圆圈为前下间隙,黄色圆圈为后下间隙,绿色圆圈为后上间隙,红色圆圈为前上间隙;内镜下所见橘线、黄线和绿线分别为与MRI相对应的海绵窦前下间隙、后下间隙和后上间隙,蓝线为颈内动脉水平段,毗邻垂体下动脉)

Figure 2 The whole cavernous sinus is divided into four intervals (orange circle indicated anterior inferior, yellow circle indicated posterior inferior, green circle indicated posterior superior, red circle indicated anterior superior spaces. The orange, yellow and green lines indicated anterior inferior, posterior inferior, posterior superior spaces in MRI. Blue line indicated horizontal segment of ICA, which was adjacent to inferior hypophysial artery).

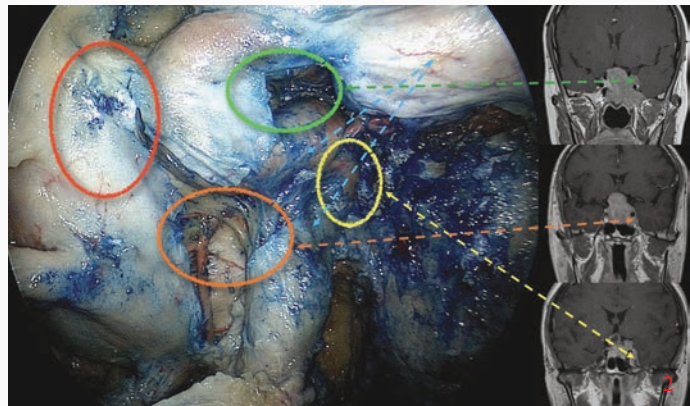


表1 Knosp分级为3A级的侵袭性与非侵袭性垂体瘤患者比值R的比较($\bar{x} \pm s$)

Table 1. Comparison of ratio R between the invasive group and non-invasive group of Knosp grade 3A ($\bar{x} \pm s$)

组别	例数	比值R	t value	P value
非侵袭组	24	1.74 ± 0.27	5.275	0.000
侵袭组	12	1.28 ± 0.18		

表2 比值R ≤ 1.59组与比值R > 1.59组患者垂体瘤侵袭程度的比较[例(%)]

Table 2. Comparison of the invasion rate between ratio R ≤ 1.59 group and > 1.59 group [case (%)]

组别	例数	侵袭性	非侵袭性	P value*
比值R ≤ 1.59	17	12(12/17)	5(5/17)	0.000
比值R > 1.59	19	0(0/19)	19(19/19)	

*Fisher's exact probability, Fisher确切概率法

海绵窦内侧硬脑膜边缘呈低信号的线性结构,由于术前无法准确识别海绵窦内侧硬脑膜壁,因此MRI影像所显示的与垂体瘤相邻的海绵窦内的单侧颈内动脉包膜则成为预测垂体瘤侵入海绵窦的特异性征象^[18]。有研究显示,侵袭性垂体瘤手术切除程度与海绵窦侵袭程度呈负相关($P=0.04$),侵袭程度越高、全切除率越低^[13]。在本研究中,我们采用Knosp分级对垂体瘤进行分级,而未将向上侵入第三脑室、向下累及鞍底的分级方法作为分级标准,即未考虑Hardy分级^[19]。我们在临床实践中发现,Knosp分级为3级的垂体瘤所侵入的海绵窦间隙部位并不相同,既可侵入海绵窦上部亦可侵入其下部,且侵袭程度低于Knosp等^[10]的报告,仅是推挤海绵窦内侧壁而非侵入其内,呈假侵袭性生长^[20-21]。因此我

们认为,有必要将Knosp分级为3级的垂体瘤进一步分为3A级和3B级两类。

随着神经内镜技术在临床的应用与普及,目前经鼻内镜颅底手术主要采用双人三手或四手操作,具有视野显露清晰、盲区少、创伤小、观察角度灵活、肿瘤全切除率高、患者术后恢复迅速等优点^[22],业已成为侵袭性垂体瘤的主要外科手术方法^[23]。与传统的显微外科手术相比,经鼻内镜颅底手术不仅可在直视下观察海绵窦内侧壁的完整程度,而且可以更广泛地切除肿瘤,在侵袭性垂体瘤的外科手术中具有较大优势^[24]。由于缺乏明确的影像学诊断标准,且术中无法从海绵窦内侧壁切取病变组织进行组织病理学检查,因此目前仍以内镜直视下观察海绵窦内侧壁是否完整和颈内动脉包绕程度等

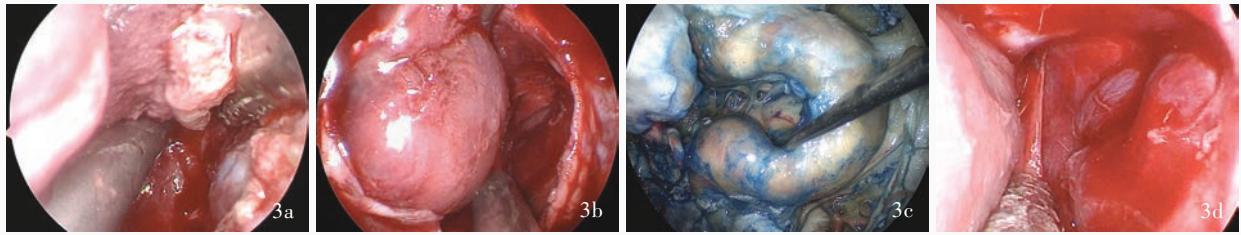


图 3 男性患者, 51 岁, 临床诊断为无功能性垂体腺瘤 (Knosp 分级 3A 级)。经鼻内镜手术中所见 3a 肿瘤推挤海绵窦内侧壁 3b 切除肿瘤后可见塌陷的鞍膈和完整的海绵窦内侧壁 3c 30° 内镜视角下海绵窦后上间隙解剖图 3d 术中 30° 内镜视角下海绵窦后上间隙

Figure 3 A 51-year-old male patient with clinically diagnosed as nonfunctional pituitary adenoma (Knosp grade 3A) underwent transnasal endoscopic pituitary adenoma resection. Tumor pushed against the medial wall of cavernous sinus (Panel 3a). Collapsed sellar diaphragm and intact medial wall of cavernous sinus could be seen after removal of tumor (Panel 3b). Anatomical images of the posterior superior space of cavernous sinus from a 30° endoscopic perspective (Panel 3c). Surgical images of the posterior superior space of cavernous sinus from a 30° endoscopic perspective (Panel 3d).

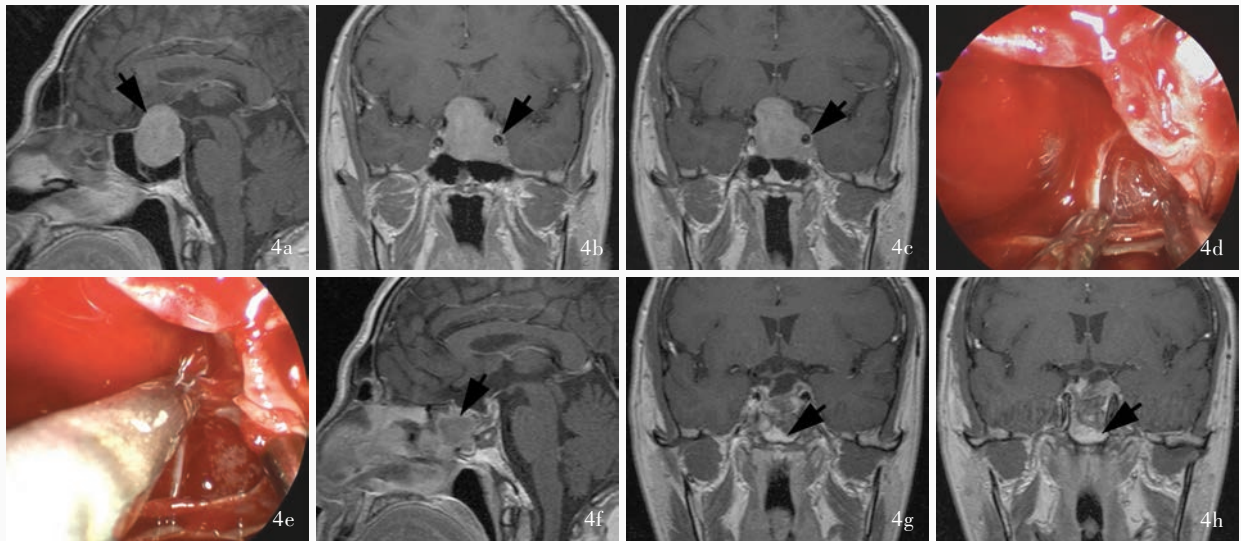


图 4 女性患者, 62 岁, 临床诊断为无功能性垂体腺瘤 (Knosp 分级 3B 级)。手术前后鞍区 MRI 和术中内镜所见 4a 术前矢状位增强 T₁WI 显示肿瘤呈类圆形不均匀强化 (箭头所示), 视交叉上抬, 垂体窝扩大 4b, 4c 术前冠状位增强 T₁WI 显示, 肿瘤呈不均匀强化, 侵袭性生长, 左侧颈内动脉壁受累 (箭头所示) 4d 术中内镜下可见肿瘤呈侵袭性生长, 一侧海绵窦前下间隙受累, 肿瘤突破海绵窦内侧壁, 侵入海绵窦 4e 术中内镜下可见海绵窦侧壁裂口, 切除肿瘤后显示海绵窦内分隔组织结构 4f 术后矢状位增强 T₁WI 显示肿瘤基本全切除, 代替为填充物, 最外侧黏膜瓣呈均匀强化征象 (箭头所示) 4g, 4h 术后冠状位增强 T₁WI 显示肿瘤基本全切除, 代替为填充物, 最外侧黏膜瓣呈均匀强化征象 (箭头所示)

Figure 4 A 62-year-old female patient was clinically diagnosed as nonfunctional pituitary adenoma (Knosp grade 3B). MRI of sellar region before and after operation and endoscopic findings during operation Preoperative sagittal contrast-enhanced T₁WI showed round-like tumor with uneven enhancement (arrow indicates), optic chiasma elevation, and enlargement of pituitary fossa (Panel 4a). Preoperative coronal contrast-enhanced T₁WI showed that the tumor invaded the wall of left ICA with uneven enhancement (arrows indicate; Panel 4b, 4c). Under the endoscope, the tumor invaded the anterior inferior space of cavernous sinus, broke through the medial wall of cavernous sinus, and entered the cavernous sinus (Panel 4d). Under endoscope, cavernous sinus lateral wall fissure and the structure of cavernous sinus septum could be seen after removal of tumor (Panel 4e). Postoperative sagittal contrast-enhanced T₁WI showed that the tumor was basically completely resected and replaced with tamponade. External mucosal flap was shown as even enhancement (arrow indicates, Panel 4f). Postoperative coronal contrast-enhanced T₁WI showed that the tumor was basically completely resected and replaced with tamponade. External mucosal flap was shown as even enhancement (arrows indicate; Panel 4g, 4h).

作为判断垂体瘤侵袭性的“金标准”。

在本研究中, 我们根据术中内镜下所见, 以颈内动脉垂直段为界线分为海绵窦前后间隙, 以水平段与垂体下动脉连线为界线分为海绵窦上下间隙, 将海绵窦共分为 4 个间隙, 即海绵窦前上间隙、后上间隙、前下间隙和后下间隙, 以指导术中切除程度,

重点关注侵入该部位肿瘤是否存在残留, 尽可能全切除, 并预测患者预后。结果显示, 12/36 例 Knosp 分级为 3A 级垂体瘤患者肿瘤灶均侵入海绵窦后上间隙, 且动眼神经受累; 6/8 例 Knosp 分级为 3B 级垂体瘤患者肿瘤灶侵入海绵窦前下间隙, 2/8 例海绵窦前下间隙和后下间隙同时受累, 并累及外展神经;

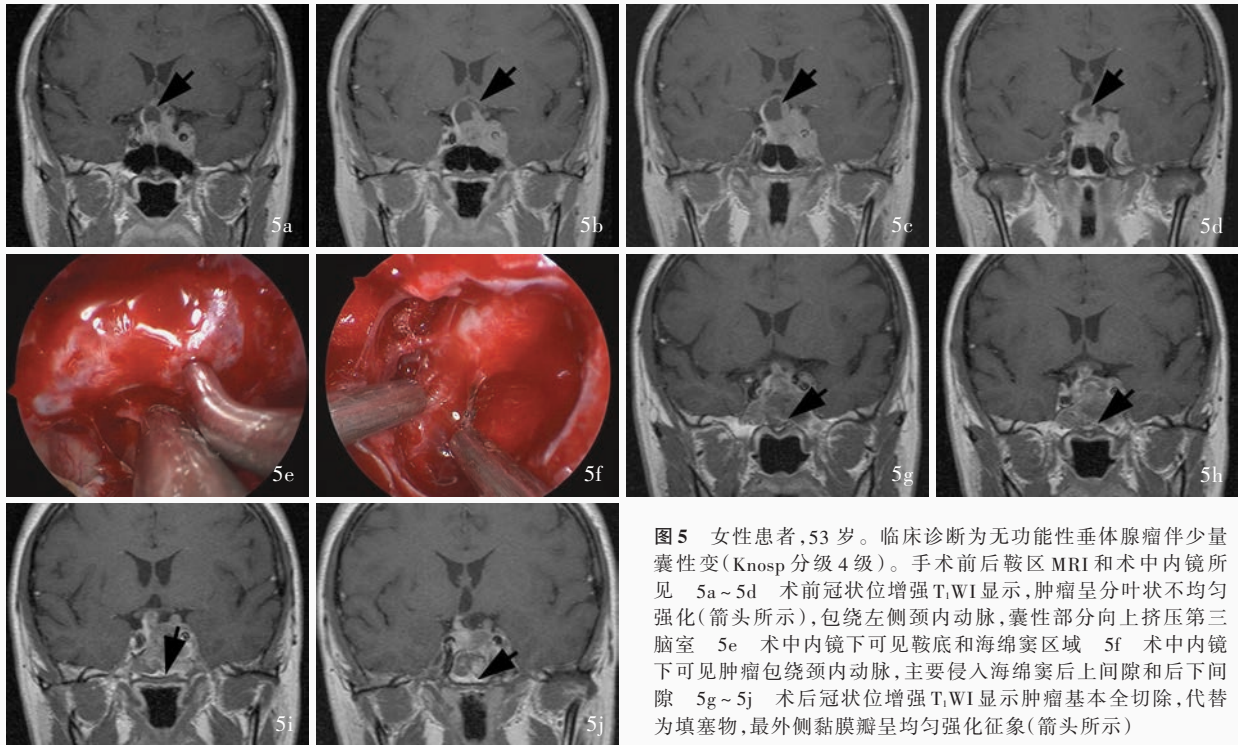


图 5 女性患者, 53 岁。临床诊断为无功能性垂体腺瘤伴少量囊性变(Knosp 分级 4 级)。手术前后鞍区 MRI 和术中内镜所见 5a~5d 术前冠状位增强 T₁WI 显示, 肿瘤呈分叶状不均匀强化(箭头所示), 包绕左侧颈内动脉, 囊性部分向上挤压第三脑室 5e 术中内镜下可见鞍底和海绵窦区域 5f 术中内镜下可见肿瘤包绕颈内动脉, 主要侵入海绵窦后上间隙和后下间隙 5g~5j 术后冠状位增强 T₁WI 显示肿瘤基本全切除, 代替为填充物, 最外侧黏膜瓣呈均匀强化征象(箭头所示)

Figure 5 A 53-year-old female patient was clinically diagnosed as nonfunctional pituitary adenoma with a small amount of cystic change (Knosp grade 4). MRI of sellar region before and after operation and endoscopic findings during operation Preoperative coronal contrast-enhanced T₁WI showed that the tumor components showed leaf-like uneven enhancement (arrows indicate), wrapped around the left ICA, and the cystic part squeezed the third ventricle (Panel 5a-5d). Sellar floor and cavernous sinus were exposed under the endoscope during operation (Panel 5e). Intraoperative endoscope showed the tumor wrapped around the left ICA, and mainly invaded the posterior superior and posterior inferior spaces of cavernous sinus (Panel 5f). Postoperative coronal contrast-enhanced T₁WI showed that the tumor was basically completely resected and replaced with tamponade. External mucosal flap was shown as even enhancement (arrows indicate; Panel 5g-5j).

16/31 例 Knosp 分级 4 级患者垂体瘤主要侵入海绵窦前下间隙、后下间隙和后上间隙, 同时引起外展神经和动眼神经麻痹。侵入海绵窦后上间隙的 Knosp 分级为 3A 级的垂体瘤, 我们在术中沿着鞍内肿瘤追踪到侵入海绵窦的突破处后, 遂扩大海绵窦突破处并切除侵入其内的肿瘤。对于侵入海绵窦后下间隙和前下间隔的 Knosp 分级为 3B 级和 4 级的垂体瘤, 术中应主动打开颈内动脉海绵窦段外侧硬脑膜, 以达到肿瘤近全切除。

对于 Knosp 分级为 4 级的垂体瘤, 术前影像学显示其明显包绕颈内动脉, 即可判断为侵袭性肿瘤; 而对于 Knosp 分级为 3 级的垂体瘤是否呈侵袭性生长则不易判断。我们于术前通过计算鞍区冠状位 MRI 所示颈内动脉海绵窦段至前床突上段血管中点连线距离与肿瘤向鞍旁侵袭最远点至该连线垂直距离的比值(比值 R), 发现比值 $R \leq 1.59$ 的 Knosp 分级为 3A 级的垂体瘤的侵袭性程度较高, 提示术中应重点关注海绵窦受累一侧, 仔细探查, 尽

可能全切除并尽量避免海绵窦大出血, 再结合术中海绵窦分区, 对侵入海绵窦间隙的肿瘤仔细切除, 避免遗漏和损伤神经。

综上所述, 术前根据鞍区冠状位 MRI 计算比值 R, 有助于手术医师判断 Knosp 分级为 3A 级的垂体瘤的侵袭程度, 再结合术中内镜下海绵窦分区, 对指导经鼻内镜垂体瘤切除术、预测患者预后具有重要临床意义。

利益冲突 无

参 考 文 献

- [1] Aflorei ED, Korbonits M. Epidemiology and etiopathogenesis of pituitary adenomas[J]. J Neurooncol. 2014, 117:379-394.
- [2] Micko AS, Wohrer A, Wolfsberger S, Knosp E. Invasion of the cavernous sinus space in pituitary adenomas: endoscopic verification and its correlation with an MRI-based classification [J]. J Neurosurg, 2015, 122:803-811.
- [3] Ceylan S, Koc K, Anik I. Endoscopic endonasal transsphenoidal approach for pituitary adenomas invading the cavernous sinus [J]. J Neurosurg, 2010, 112:99-107.
- [4] Ahmadi J, North CM, Segall HD, Zee CS, Weiss MH.

- Cavernous sinus invasion by pituitary adenomas[J]. AJR Am J Roentgenol, 1986, 146:257-262.
- [5] Nishioka H, Fukuhara N, Horiguchi K, Yamada S. Aggressive transsphenoidal resection of tumors invading the cavernous sinus in patients with acromegaly: predictive factors, strategies, and outcomes[J]. J Neurosurg, 2014, 121:505-510.
- [6] Li J, Cong Z, Ji X, Hu Z, Jia Y, Wang H. Application of intraoperative magnetic resonance imaging in large invasive pituitary adenoma surgery[J]. Asian J Surg, 2015, 38:168-173.
- [7] Daniels DL, Pech P, Mark L, Pojunas K, Williams AL, Haughton VM. Magnetic resonance imaging of the cavernous sinus[J]. AJR Am J Roentgenol, 1985, 144:1009-1014.
- [8] Guo-Dong H, Tao J, Ji-Hu Y, Wen-Jian Z, Xie-Jun Z, Jian G, Zhen L, Tai-Peng J, Jian-Jun D, Yong-Zhong G, Wenlan L, Wei-Ping L. Endoscopic versus microscopic transsphenoidal surgery for pituitary tumors[J]. J Craniofac Surg, 2016, 27:E648-655.
- [9] Alahmadi H, Dehdashti AR, Gentili F. Endoscopic endonasal surgery in recurrent and residual pituitary adenomas after microscopic resection[J]. World Neurosurg, 2012, 77(3/4):540-547.
- [10] Knosp E, Steiner E, Kitz K, Matula C. Pituitary adenomas with invasion of the cavernous sinus space: a magnetic resonance imaging classification compared with surgical findings [J]. Neurosurgery, 1993, 33:610-618.
- [11] Newton DR, Dillon WP, Norman D, Newton TH, Wilson CB. Gd-DTPA-enhanced MR imaging of pituitary adenomas[J]. AJNR, 1989, 10:949-954.
- [12] Su WW, Chen PY, Hsiao CH, Chen HS. Primary phacoemulsification and intraocular lens implantation for acute primary angle-closure[J]. PLoS One, 2011, 6:E20056.
- [13] Kitano M, Taneda M, Shimono T, Nakao Y. Extended transsphenoidal approach for surgical management of pituitary adenomas invading the cavernous sinus[J]. J Neurosurg, 2008, 108:26-36.
- [14] Greenman Y, Stern N. Non-functioning pituitary adenomas[J]. Best Pract Res Clin Endocrinol Metab, 2009, 23:625-638.
- [15] Bakhtiar Y, Hanaya R, Tokimura H, Hirano H, Oyoshi T, Fujio S, Bohara M, Arita K. Geometric survey on magnetic resonance imaging of growth hormone producing pituitary adenoma [J]. Pituitary, 2014, 17:142-149.
- [16] Sun HL, Cui SL, Liu L, Jiang HQ, Zhang XJ, Wang JW. Clinical and imaging features and etiologic diagnosis value in patients with cavernous sinus lesion presenting with ophthalmoplegia[J]. Zhonghua Yi Xue Za Zhi, 2018, 98:202-207.[孙厚亮, 崔世磊, 刘磊, 江汉秋, 张晓君, 王佳伟. 表现为眼肌麻痹的海绵窦区病变临床影像特征及病因学诊断价值[J]. 中华医学杂志, 2018, 98:202-207.]
- [17] Berest IE, Mironets SN. Septic thrombus of the cavernous sinus [J]. Vestn Otorinolaringol, 2017, 82:72-76.
- [18] Scotti G, Yu CY, Dillon WP, Norman D, Colombo N, Newton TH, De Groot J, Wilson CB. MR imaging of cavernous sinus involvement by pituitary adenomas[J]. AJR Am J Roentgenol, 1988, 151:799-806.
- [19] Hardy J, Vezina JL. Transsphenoidal neurosurgery of intracranial neoplasm[J]. Adv Neurol, 1976, 15:261-273.
- [20] Harris FS, Rhoton AL. Anatomy of the cavernous sinus: a microsurgical study[J]. J Neurosurg, 1976, 45:169-180.
- [21] Fahlbusch R, Buchfelder M. Transsphenoidal surgery of parasellar pituitary adenomas[J]. Acta Neurochir (Wien), 1988, 92(1-4):93-99.
- [22] Cavallo LM, Solari D, Tasiou A, Esposito F, de Angelis M, D'Enza AI, Cappabianca P. Endoscopic endonasal transsphenoidal removal of recurrent and regrowing pituitary adenomas: experience on a 59 - patient series [J]. World Neurosurg, 2013, 80(3/4):342-350.
- [23] Catapano D, Sloffer CA, Frank G, Pasquini E, D'Angelo VA, Lanzino G. Comparison between the microscope and endoscope in the direct endonasal extended transsphenoidal approach: anatomical study[J]. J Neurosurg, 2006, 104:419-425.
- [24] Komotar RJ, Starke RM, Raper DM, Anand VK, Schwartz TH. Endoscopic endonasal compared with microscopic transsphenoidal and open transcranial resection of craniopharyngiomas[J]. World Neurosurg, 2012, 77:329-341.

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【点评】 侵袭性垂体瘤一直是临床诊断与治疗的重点,目前主要根据术前鞍区MRI(主要是冠状位增强T₁WI)和1993年的Knosp分级对侵入海绵窦的垂体瘤的侵袭程度进行评价。随着神经内镜技术的发展,2017年Fernandez-Miranda在Harris和Rhoton提出的海绵窦间隙四分法(内侧间隙、外侧间隙、上方间隙和下方间隙)基础上,结合2013年改良Knosp分级(Knosp分级3A级累及颈内动脉上方间隙、3B级累及颈内动脉下方间隙),提出了海绵窦间隙的新分法,即上方间隙、下方间隙、后方间隙和外侧间隙。进一步补充和丰富了临床医师对侵袭性垂体瘤的认识。该文作者具有丰富的经鼻内镜垂体瘤切除术经验,通过长期临床实践积累,提出以术前鞍区冠状位MRI颈内动脉海绵窦段至前床突上段血管中点连线距离与肿瘤向鞍旁侵袭最远点至该连线垂直距离的比值(比值R)可以作为量化评价Knosp分级3级垂体瘤侵袭程度的新指标,具有一定创新性;同时结合不同Knosp分级垂体瘤根据颈内动脉垂直段和水平段与垂体下动脉的连线进行海绵窦的重新分区,即前上间隙、后上间隙、前下间隙和后下间隙,对经鼻内镜垂体瘤切除术的术前评估和预后评价具有重要指导意义。

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下期内容预告 本刊2019年第4期报道专题为内镜颅底手术后并发症,重点内容包括:经鼻蝶入路垂体腺瘤切除术中应注意的问题;复发性鼻咽癌内镜手术治疗现状;我国内镜神经外科发展史;内镜颅底肿瘤切除术中高流量脑脊液漏修补失败原因及处理;经鼻内镜手术治疗脑脊液鼻漏;经鼻内镜手术治疗脑脊液鼻漏初步研究;经鼻内镜颅底手术后蝶窦炎的诊断与治疗;内镜颅底手术并发严重鼻出血诊断与治疗