·脊柱脊髓疾病·

显微改良瘘口封堵术治疗症状性骶管Tarlov囊肿疗效分析

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【摘要】 研究背景 相较其他手术策略，显微外科手术治疗症状性Tarlov囊肿的长期预后更佳，但仍存在较高的囊肿复发率和脑脊液漏发生率，阻碍这一技术的临床推广。假设囊肿与蛛网膜下腔之间的瘘口未完全闭合是手术失败的原因，并基于此提出一种囊肿分离和瘘口封堵的新方法，旨在更牢固地封堵瘘口。**方法** 纳入2016年1月至2021年3月在南方医科大学南方医院行显微改良瘘口封堵术的35例症状性骶管Tarlov囊肿患者，记录手术时间、术中出血量、术后住院时间、随访时间，以及囊肿内神经根穿行和术后囊肿转归。分别于术前、出院时和末次随访时采用视觉模拟评分（VAS）以及术前和末次随访时采用脊髓功能临床评价评分系统（SCPS）、Oswestry功能障碍指数（ODI）、日本骨科协会下腰痛评分（JOA29）和腰椎功能MacNab评定标准评估神经功能，记录术后并发症（切口感染、神经损伤、脑脊液漏、术后粘连等）发生率，并随访复查MRI有无囊肿复发。**结果** 共35例患者计74个囊肿，其中大囊肿（直径＞1.50 cm）49个（66.22%），囊肿主要压迫S_1神经根（22个，29.73%）和S_2神经根（36个，48.65%），均有瘘口及穿行其中的神经根。平均随访（37.78±17.19）个月，至末次随访时，症状改善率最显著的是神经根性疼痛（94.29%，33/35），其次依次为会阴部疼痛（13/14）、腰骶部疼痛（85.19%，23/27）、直立性头痛（2/3）、神经源性跛行（5/8）、下肢麻木（12/20）、会阴部麻木（7/14）、性功能障碍（4/9）、大便障碍（8/19）、小便障碍（6/17）。末次随访时神经根性疼痛评分（$P=0.000$，0.000）、腰骶部疼痛评分（$P=0.000$，0.001）和会阴部疼痛评分（$P=0.001$，0.009）低于术前和出院时，出院时亦低于术前（$P=0.000$，0.000，0.001）；末次随访时SCPS总评分（$P=0.000$）及疼痛和感觉障碍（$P=0.000$）、肌力（$P=0.000$）、步态（$P=0.000$）和小便功能（$P=0.019$）分评分高于术前；ODI指数（$P=0.000$）及疼痛程度（$P=0.000$）、提/携物（$P=0.000$）、行走（$P=0.000$）、坐（$P=0.000$）、站立（$P=0.000$）、睡眠（$P=0.000$）、个人护理（$P=0.000$）、社会活动（$P=0.000$）和旅行（$P=0.000$）分评分低于术前；JOA29量表和MacNab评定标准的总体改善率均为94.29%（33/35）。术后有2例新发下肢麻木，无一例出现囊肿复发或脑脊液漏。**结论** 显微改良瘘口封堵术是治疗症状性骶管Tarlov囊肿安全、有效的手术策略，可以完全封堵瘘口，降低术后囊肿复发和脑脊液漏风险。

【关键词】 Tarlov囊肿； 疼痛； 显微外科手术； 神经外科手术

Clinical analysis of microscopic modified ostium obstruction surgery for symptomatic sacral Tarlov cysts

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黄钦国与吴炎宇对本文有同等贡献

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【Abstract】 Background Microsurgical techniques are increasingly being recommended for the treatment of symptomatic Tarlov cysts (TCs) due to improved long-term outcomes compared to those of other strategies. However, these techniques are associated with a high risk of cysts recurrence and cerebrospinal fluid (CSF) leakage, resulting in the surgical strategy of TCs remains controversial. We hypothesize that incomplete closure of the ostium between the cysts and the subarachnoid space is the probable cause of surgical failure. Accordingly, we present a novel method of cysts separation and ostium closure that aims to block the ostium more firmly and reliably. **Methods** Thirty-five consecutive patients underwent the microscopic modified ostium obstruction surgery in Nanfang Hospital, Southern Medical University due to symptomatic sacral TCs from January 2016 to March 2021. The operation time, intraoperative blood loss, postoperative hospitalization time, follow-up time, as well as the situation of nerve roots passing through the cysts and the postoperative outcome of the cysts were recorded. Visual Analogue Scale (VAS) was used before surgery, at discharge and at the last follow-up, and Scoring System for the Clinical Evaluation of Patients with Spinal Processes (SCPS), Oswestry Disability Index (ODI), Japanese Orthopedic Association Scores (JOA29) and MacNab criteria were used before surgery and at the last follow-up to evaluate neurological function. Postoperative complications (infection, nerve injury, CSF leakage, postoperative adhesion, etc.) were recorded, and the cysts recurrence was observed by follow-up MRI. **Results** A total of 74 cysts were detected in 35 patients, among which 49 (66.26%) were large cysts (diameter > 1.50 cm), and cysts mainly compressed S_1 nerve roots (22 cysts, 29.73%) and S_2 nerve roots (36 cysts, 48.65%), all of which had fistulas and nerve roots passing through them. Average follow-up was (37.78 ± 17.19) months. To the last follow-up, the most significant symptom improvement rate was nerve root pain (94.29%, 33/35), followed by perineal pain (13/14), lumbosacral pain (85.19%, 23/27), orthostatic headache (2/3), neurogenic claudication (5/8), lower limb numbness (12/20), perineal numbness (7/14), sexual dysfunction (4/9), bowel dysfunction (8/19) and bladder dysfunction (6/17). The nerve root pain score (P = 0.000, 0.000), lumbosacral pain score (P = 0.000, 0.001) and perineal pain score (P = 0.001, 0.009) at the last follow-up were lower than those before surgery and at discharge, while those at discharge were lower than those before surgery (P = 0.000, 0.000, 0.001). The total score of SCPS (P = 0.000), pain and sensory disturbance (P = 0.000), muscle strength (P = 0.000), gait (P = 0.000) and urinal function (P = 0.019) at the last follow-up were higher than those before surgery. ODI index (P = 0.000) and pain level (P = 0.000), lifting/carrying (P = 0.000), walking (P = 0.000), sitting (P = 0.000), standing (P = 0.000), sleeping (P = 0.000), personal care (P = 0.000), social activities (P = 0.000) and travel (P = 0.000) at the last follow-up were lower than those before surgery. The overall improvement rate of both JOA29 and MacNab criteria was 94.29% (33/35). After surgery, 2 patients had new symptoms of lower limb numbness, and none had recurrence of cysts or CSF leakage. **Conclusions** The microscopic modified ostium obstruction surgery is a safe and effective strategy for management of patients with symptomatic sacral TCs, and is associated with a low incidence of cysts recurrence and CSF leakage since it achieves complete closure of cysts ostium.

【Key words】 Tarlov cysts; Pain; Microsurgery; Neurosurgical procedures

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骶神经束膜囊肿由Tarlov[1]于1938年首次报道，又称骶管Tarlov囊肿，是骶背根神经节邻近神经根鞘的神经内膜与神经束膜之间的脑脊液积聚[2]。因体积较小、发病率较低且通常无症状，易误诊或漏诊[3-5]，而体积逐渐增大的囊肿所产生的流体静水压或搏动可刺激邻近神经根，导致神经根性疼痛等非特异性症状[6-7]。MRI是首选诊断方法，可准确评估神经根与囊肿之间的空间关系[6,8-9]。尽管临床有多种治疗方法，但仍缺乏公认的最佳治疗策略，显微外科手术因更佳的长期疗效越来越多地应用于症状性骶管Tarlov囊肿的治疗[7,10-12]，仍有较高的复发率和脑脊液漏风险[2,6-7,12-15]，推测可能是由于囊肿与蛛网膜下腔之间瘘口未完全闭合[16]。基于此，南方医科大学南方医院陆云涛教授团队提出一种囊肿分离和瘘口闭合的新技术，评估其治疗症状性骶管Tarlov囊肿的疗效。

对象与方法

一、研究对象

1. 手术指征 (1)臀部至单侧下肢后侧或内侧

出现的中至重度神经根性疼痛，且疼痛逐渐加重，常伴随腰骶部和会阴部疼痛、下肢麻木、神经源性跛行、大小便和性功能障碍。(2)腰骶椎MRI显示至少存在1个大的(直径>1.50 cm)Tarlov囊肿且压迫同侧邻近神经根。(3)非手术治疗>6个月无效，包括镇痛药、非甾体抗炎药、激素等药物治疗和物理治疗等。(4)端坐、站立或行Valsalva动作时症状明显加重，平卧位时症状减轻。(5)持续性症状具有解剖-临床相关性(如症状发生于囊肿同侧肢体，症状与囊肿压迫神经根相关)，且严重影响患者生活质量。(6)无明确手术禁忌证。(7)排除疑似导致相似症状的其他病变(如腰椎间盘突出症或腰椎管狭窄症)及精神疾病；若存在肠道功能障碍、膀胱功能障碍或性功能障碍等症状，则由相关专家进行会诊以排除其他病因。

2.纳入与排除标准 (1)符合上述手术指征，并行显微改良瘘口封堵术。(2)所有手术均由同一位神经外科医师主刀完成。(3)定期复查并评估长期(术后1年以上)临床疗效。(4)排除瘘口无法识别的囊肿、临床资料不完整或失访患者。(5)所有患者或其家属均自愿参加本研究，对手术方案和手术风险知情并签署知情同意书。

3.一般资料 选择2016年1月至2021年3月在南方医科大学南方医院神经外科行显微改良瘘口封堵术的症状性骶管Tarlov囊肿患者共35例，男性14例，女性21例；年龄11～69岁，平均(35.00±13.69)岁；体重指数(BMI)11.96～29.76 kg/m^2，平均(20.96±3.85) kg/m^2；临床症状为神经根性疼痛占100%(35/35)，腰骶部疼痛占77.14%(27/35)，会阴部疼痛占40%(14/35)，下肢麻木占57.14%(20/35)，会阴部麻木占40%(14/35)，神经源性跛行占22.86%(8/35)，小便障碍占48.57%(17/35)，大便障碍占54.29%(19/35)，性功能障碍占25.71%(9/35)，直立性头痛占8.57%(3/35)，所有患者均于平躺后症状减轻；症状持续时间6～120个月，中位时间22(9，24)个月；其中7例(20%)为外院首次手术后症状未缓解或复发而行二次手术。共有囊肿74个(22例为多发囊肿)，最大径0.70～5.50 cm，平均(1.90±1.00) cm，其中大囊肿(直径>1.50 cm)49个(66.22%)，每例患者至少存在1个大囊肿；呈串珠状34个(45.95%)，卵圆形或圆形40个(54.05%)；压迫神经根部位分别为左侧L_5神经根(2个，2.70%)，右侧L_5神经根(1个，1.35%)，左侧S_1神经根(12个，16.22%)，右侧S_1神经根(10个，13.51%)，左侧S_2神经根(16个，21.62%)，右侧S_2神经根(20个，27.03%)，左侧S_3神经根(6个，8.11%)，右侧S_3神经根(4个，5.41%)，左侧和右侧S_4神经根(各1个，1.35%)，左侧S_5神经根(1个，1.35%)。

二、研究方法

1.显微改良瘘口封堵术 患者俯卧位，气管插管全身麻醉，术前C型臂X线扫描仪定位囊肿所在椎管层面，仅显露囊肿上部椎体的正常硬脊膜囊，咬骨钳咬除棘突和椎板，分离囊壁与硬脊膜囊的粘连，寻找并分离囊肿颈部，显露责任神经根袖套，顺囊肿最大径于背侧中部切开囊壁，游离并保护囊肿内神经根，寻找位于神经根入硬脊膜囊末端的囊肿瘘口，顺神经根走行向近端进一步剖开袖套和硬脊膜囊囊壁，打开蛛网膜，进入蛛网膜下腔；于切口皮下或臀上部(皮下脂肪少的患者取髂后上棘部位脂肪)，切取适量自体柔软脂肪组织并修剪成类似“葫芦”状或“哑铃”状(中间部分相对细小、两端部分相对膨大)，填塞入囊肿颈部与其上方硬脊膜囊下的蛛网膜下腔，并经裂隙颈部填充瘘口内外，使自体脂肪组织中间细小部分恰好卡压瘘口和神经根鞘处，上端膨大部分位于瘘口内侧的蛛网膜下腔、下端膨大部分填塞瘘口外侧的囊腔；6-0 Prolene线(美国Johnson & Johnson公司)自神经根鞘和瘘口下方开始连续缝合闭合瘘口和硬脊膜囊，神经根鞘处无需紧密缝合，仅固定脂肪组织，硬脊膜囊需水密缝合(图1，http://www.cjcnn.org/video/2024.12.006shoushushipin.mp4)。缝合后施加类似Valsalva动作即按压患者腹部或摇高床头使头高脚低位，观察5 min，若无脑脊液或生理盐水经原瘘口流入囊腔，证明瘘口完全闭合。值得注意的是，由于残留囊壁无分泌功能，故无需完全切除，残留囊腔可以自体脂肪和明胶海绵填充。

2.疗效评价 (1)记录手术时间、术中出血量、术后住院时间、随访时间，以及囊肿内神经根穿行和术后囊肿转归。(2)神经功能：分别于术前、出院时和末次随访时采用视觉模拟评分(VAS)以及于术前和末次随访时采用脊髓功能临床评价评分系统(SCPS)[16-17]、Oswestry功能障碍指数(ODI)、日本骨科协会下腰痛评分(JOA29)[18-19]和腰椎功能MacNab评定标准[20]评估神经功能。①VAS量表，嘱患者根据自身感受在1条10等分线段的相应位置做标记，线段最左端为“无痛”字样(数字0)、最右

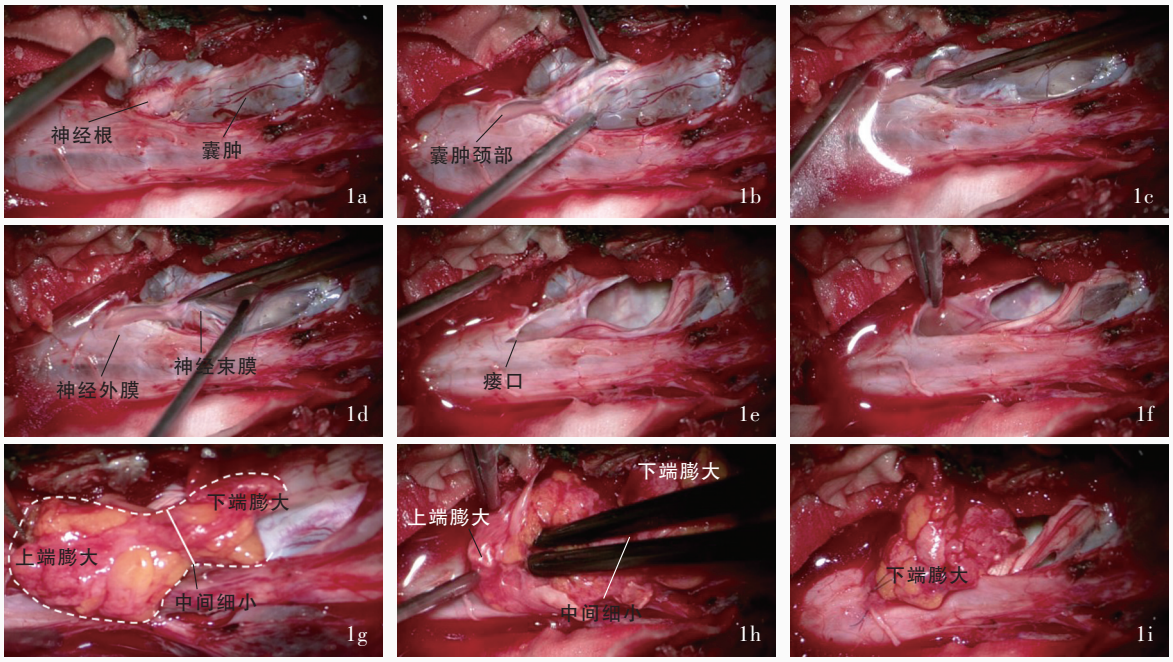

图1 术中所见 1a 显露囊肿上部骶椎的正常硬脊膜囊，可见囊肿呈半透明，表面囊壁相对紧张 1b 分离囊壁与硬脊膜囊之间的粘连，沿神经根纵向切开囊肿、囊颈和硬脊膜囊，显露蛛网膜，可见蛛网膜自硬脊膜囊内延伸至囊肿 1c，1d 切开蛛网膜，分离袖套口的蛛网膜，完全打开硬脊膜囊下的蛛网膜下腔 1e，1f 寻找到位于神经根进入硬脊膜囊末端的囊肿瘘口，可见脑脊液流出 1g，1h 于切口皮下或臀上部（髂后上棘切口适用于皮下脂肪较少患者）切取适量自体柔软脂肪组织，修剪成类似“葫芦”状或“哑铃”状，并填塞入囊颈和上方硬脊膜囊下的蛛网膜下腔，再经裂隙颈部填充瘘口内外 1i 填充脂肪块后，以6-0 Prolene线自神经根鞘和瘘口下方开始连续缝合瘘口和硬脊膜囊

Figure 1 Schematic illustration of the surgical procedure Exposed area of the upper part of the cysts and normal dural sac of the sacral vertebrae, translucent and relatively tense cysts were observed (Panel 1a). The adhesions between the cyst wall and dural sac were separated. The cyst, cystic neck, and dural sac were dissected longitudinally along the nerve root, exposing the arachnoid membrane, which extends from the dural sac into the cystic cavity (Panel 1b). The incised arachnoid, which separates at the dural sleeve, exposing the dural sac and subarachnoid space thoroughly (Panel 1c, 1d). An ostium at the end of the site where the nerve root entered the dural sac, from which cerebrospinal fluid could flow continuously along the subarachnoid space, was identified (Panel 1e, 1f). An appropriate amount of autologous soft adipose tissue was removed under the skin of the incision or deep in the upper part of the buttock (iliac spine incision, for less subcutaneous fat patients). It was then trimmed to resemble a gourd or dumbbell, with a relatively small middle section and two relatively large end sections. Trimmed graft was inserted into the neck of the sac and subarachnoid space below the dural sac so that it plugged the ostium inside and outside (Panel 1g, 1h). After filling the graft, Prolene 6-0 was used to continuously suture and close the ostium and dural sac starting from the lower part of the nerve root sheath and the ostium (Panel 1i).

端为“剧痛”字样（数字10），标记点至数字0之间距离即为疼痛评分，评分越高、疼痛越剧烈。②SCPS量表，包括疼痛和感觉障碍、肌力、步态、小便功能、大便功能共5项内容，每项评分0～5分（0分为功能障碍最严重，5分为无功能障碍），总评分25分，评分越高、脊髓功能越佳。③ODI量表，包括疼痛程度、提/携物、行走、坐、站立、睡眠、个人护理、社会活动和旅行共9项内容，每项评分0～5分（0分为无功能障碍，5分为功能障碍最严重），总评分45分，计算各项评分之和占总评分的百分比即ODI指数，指数越高、功能障碍越严重。④JOA29量表，包括主观症状（0～9分）、临床体征（0～6分）、日常活动受限程度（0～14分）和膀胱功能（-6～0分）共4项内容，总评分范围为-6～29分，评分越低、功能障碍越严重；并计算治疗改善率[改善率（%）=（末次随访时JOA29评分－术前JOA29评分）/（最高分－术前JOA29评分）×100%]，改善率达到100%为治愈、>60%～99%为显效、25%～60%为有效、<25%为无效。治愈、显效和有效为总体改善，并计算总体改善率。⑤MacNab评定标准，分为4种情况，优，无痛，活动不受限，恢复正常工作和生活；良，偶尔出现腰痛或腿痛，症状缓解，需改变工作方式；可，功能部分改善，仍有残疾，无法工作；差，症状无改善，需进一步手术治疗。优、良、可为总体改善，并计算总体改善率。（3）安全性：记录术后并发症，包括切口感染、脑脊液漏、术后粘连等。（4）随访：术后6个月和1年门诊随访，复查腰骶椎MRI观察有无囊肿复发，并评估神经功能，此后每年复查1次。为避免观察偏差，

表1 症状性骶管Tarlov囊肿患者手术前后VAS评分[$M(P_{25},P_{75})$,评分]

Table 1. VAS score in patients with symptomatic sacral Tarlov cysts before and after surgery [$M\ (P_{25},\ P_{75})$, score]

检测时间	神经根性疼痛（n=35）	腰骶部疼痛（n=27）	会阴部疼痛（n=14）
术前(1)	5.00（5.00,6.00）	6.00（5.00,7.00）	5.00（3.00,6.00）
出院时(2)	2.00（1.00,3.00）	3.00（2.00,3.00）	2.00（1.00,3.00）
末次随访时(3)	0.00（0.00,1.00）	1.00（0.00,3.00）	0.50（0.00,1.00）

表2 症状性骶管Tarlov囊肿患者手术前后不同时间点VAS评分的比较

Table 2. Comparison of VAS score at different time points in patients with symptomatic sacral Tarlov cysts

两两比较	神经根性疼痛		腰骶部疼痛		会阴部疼痛	
	Z值	P值	Z值	P值	Z值	P值
(1)∶(2)	-5.058	0.000	-4.226	0.000	-3.334	0.001
(1)∶(3)	-5.039	0.000	-4.208	0.000	-3.190	0.001
(2)∶(3)	-3.868	0.000	-3.206	0.001	-2.615	0.009

实施显微改良瘘口封堵术的医师未参与临床数据采集和神经功能评估。

3.统计分析方法 采用SPSS 23.0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。正态性检验采用Shapiro-Wilk检验,呈正态分布的计量资料以均数±标准差($\bar{x}\pm s$)表示,采用配对t检验;呈非正态分布的计量资料以中位数和四分位数间距[$M(P_{25},P_{75})$]表示,采用Wilcoxon符号秩和检验。以$P\leqslant0.05$为差异具有统计学意义。

结 果

本组患者手术时间1.00~4.50 h,平均(2.61±0.97) h;术中出血量10~210 ml,中位值为30(25,60) ml;术后住院时间2~15 d,平均(8.54±3.36) d;74个囊肿均有瘘口及穿行其中的神经根,囊壁由神经外膜和神经束膜组成,分别与硬脊膜和蛛网膜相连。随访时间13.51~76.77个月,平均(37.78±17.19)个月;至末次随访时,33例(94.29%)症状完全缓解或基本消失;症状改善率最显著的是神经根性疼痛(94.29%,33/35),其次依次为会阴部疼痛(13/14)、腰骶部疼痛(85.19%,23/27)、直立性头痛(2/3)、神经源性跛行(5/8)、下肢麻木(12/20)、会阴部麻木(7/14)、性功能障碍(4/9)、大便障碍(8/19)、小便障碍(6/17)。

VAS评分比较,出院时神经根性疼痛评分($P=0.000$)、腰骶部疼痛评分($P=0.000$)和会阴部疼痛评分($P=0.001$)低于术前,至末次随访时神经根性疼痛评分($P=0.000,0.000$)、腰骶部疼痛评分($P=0.000,0.001$)和会阴部疼痛评分($P=0.001,0.009$)低于术前和出院时(表1,2)。SCPS评分比较,末次随访时SCPS总评分($P=0.000$)及疼痛和感觉障碍($P=0.000$)、肌力($P=0.000$)、步态($P=0.000$)和小便功能($P=0.019$)分评分均高于术前(表3)。ODI指数比较,末次随访时ODI指数($P=0.000$)及疼痛程度($P=0.000$)、提/携物($P=0.000$)、行走($P=0.000$)、坐($P=0.000$)、站立($P=0.000$)、睡眠($P=0.000$)、个人护理($P=0.000$)、社会活动($P=0.000$)和旅行($P=0.000$)评分均低于术前(表4)。JOA29评分达治愈3例(8.57%)、显效23例(65.71%)、有效7例(20%),总体改善率94.29%(33/35)。MacNab评定标准为优6例(17.14%)、良22例(62.86%)、可5例(14.29%),总体改善率亦为94.29%(33/35)。

术后随访期间发现2例患者新发下肢麻木,均为手术相关神经功能障碍。其中1例再次手术,术中证实无囊肿复发,但神经根周围脂肪垫薄弱,自臀上部切取深层脂肪块重新填充后症状略改善;另1例拒绝再次手术。所有患者均未出现囊肿复发,以及切口感染、术后粘连、脑脊液漏或假性脊膜膨出等并发症。手术至末次MRI复查时间为12.10~71.50个月,平均(34.19±16.12)个月,均显示囊肿消失或明显缩小,且无复发征象(图2)。

讨 论

Tarlov囊肿可发生于脑和脊椎任意节段,最常发生于骶椎[6,21],尤其是S_2和S_1椎体水平[22],好发于女性[22-24]。其形成机制尚不清楚,可能与先天性发育异常和获得性创伤性炎症有关[5,12-13,25-26],球阀机制是目前普遍认可的假说。如图3所示,我们既往研究发现骶神经根的正常解剖结构,即无论骶神经根如何离开硬脊膜,在神经节前均有硬脊膜和蛛网膜袖套[27],本研究术中所见亦证实该发现(图1d)。研究显示,囊肿腔内存在1条通畅的类似阀门的微通道[2,8,28],系硬脊膜先天性缺陷或薄弱所致[16],可

表3 症状性骶管Tarlov囊肿患者手术前后SCPS评分的比较(n=35,$\bar{x}\pm s$,评分)

Table 3. Comparison of SCPS scores in patients with symptomatic sacral Tarlov cysts before and after surgery (n=35, $\bar{x}\pm s$, score)

检测项目	术前	末次随访时	*t*值	*P*值	检测项目	术前	末次随访时	*t*值	*P*值
总评分	19.14±2.25	22.49±2.24	-6.704	0.000	步态	4.23±0.55	4.83±0.38	-5.454	0.000
疼痛和感觉障碍	2.34±0.64	4.00±0.64	-9.820	0.000	小便功能	4.49±0.70	4.80±0.47	-2.452	0.019
肌力	3.94±1.11	4.60±0.69	-4.015	0.000	大便功能	4.14±0.88	4.26±0.92	-1.160	0.254

表4 症状性骶管Tarlov囊肿患者手术前后ODI指数的比较(n=35,$\bar{x}\pm s$)

Table 4. Comparison of ODI index in patients with symptomatic sacral Tarlov cysts before and after surgery (n=35, $\bar{x}\pm s$)

检测项目	术前	末次随访时	*t*值	*P*值	检测项目	术前	末次随访时	*t*值	*P*值
ODI指数(%)	41.21±13.54	12.89±11.99	8.953	0.000	站立(评分)	36.57±15.71	11.43±13.10	7.160	0.000
疼痛程度(评分)	58.56±16.05	20.57±17.14	8.925	0.000	睡眠(评分)	34.86±19.61	5.14±13.14	8.695	0.000
提/携物(评分)	43.43±14.94	15.43±14.62	8.005	0.000	个人护理(评分)	42.49±12.62	17.14±15.45	7.363	0.000
行走(评分)	36.57±19.09	10.29±13.17	7.399	0.000	社会活动(评分)	41.14±16.76	13.14±11.83	8.234	0.000
坐(评分)	40.57±14.13	12.00±13.89	7.935	0.000	旅行(评分)	36.57±16.44	10.86±14.01	-4.441	0.000

ODI, Oswestry Disability Index, Oswestry功能障碍指数

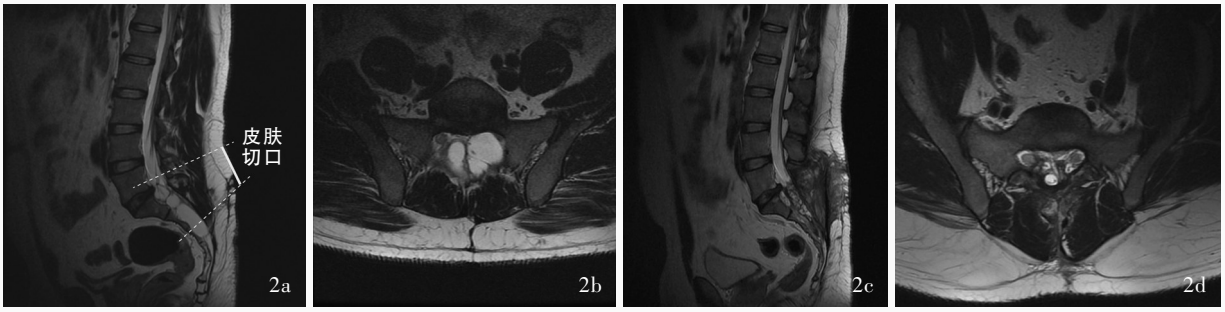

图2 女性患者,51岁,临床诊断为症状性骶管Tarlov囊肿,行显微改良瘘口封堵术。手术前后腰骶椎MRI检查所见 2a,2b 术前矢状位和横断面T_2WI显示,$S_{1\sim3}$多发椎管内Tarlov囊肿 2c,2d 术后近4年矢状位和横断面T_2WI显示Tarlov囊肿完全消失

Figure 2 A 51-year-old female patient was diagnosed with symptomatic sacral Tarlov cysts and underwent the microscopic modified ostium obstruction surgery. MRI findings before and after surgery Preoperative sagittal (Panel 2a) and axial (Panel 2b) T_2WI showed multiple Tarlov cysts situated S_{1-3}. Nearly 4 years after surgery, sagittal (Panel 2c) and axial (Panel 2d) T_2WI showed complete resolution of the Tarlov cysts.

能具有瓣膜作用,脑脊液经该微通道流入囊腔,却无法再流回硬脊膜囊,导致囊肿形成并逐渐充盈扩大[4,6,21,26,29]。球阀机制也已得到验证[16,24],本研究术中所见亦证实这一机制(图1),囊肿具有不可压缩性,囊肿延伸至受累神经根袖套前切开硬脊膜释放脑脊液后仍可见囊肿保持充盈,随后囊腔也不会快速再灌注。

症状性Tarlov囊肿的治疗方法迄今尚未达成共识,药物治疗或物理治疗效果欠佳[13,30];脑脊液引流术、CT引导下经皮穿刺抽吸引流术或联合纤维蛋白胶注射等因无法满意改善症状且术后易复发而未在临床推广[8,21,31-32];显微外科手术是目前治疗症状性Tarlov囊肿的首选方法。2019年的一项Meta分析对比显微外科手术与经皮穿刺抽吸引流术的疗效,发现显微外科手术可获得更好的长期疗效[7]。症状性Tarlov囊肿的手术指征为,出现神经根性疼痛且为大囊肿(直径>1.50 cm)[12,28,33];此外,改变体位或进行Valsalva动作使神经根性疼痛加重的患者最可能从显微外科手术中获益[2,6],且疼痛尤其是神经根性疼痛的改善率显著高于其他症状[14,16,34]。脊髓造影易造成放射损伤,既往研究显示,MRI足以明确诊断Tarlov大囊肿[24]。因此,本研究采纳上述手术指征,且未行侵入性脊髓造影。如表5所示,我们总结近10年关于症状性骶管Tarlov囊肿治疗方法的国内外临床研究[11,13,15-16,24,34-48],显微外科术式包括囊肿切除、切开、叠瓦或夹闭,但均存在囊肿复发或脑脊液漏风险。手术以缓解症状以及防止囊肿复发和脑脊液漏为目的,前者通过囊肿和神经根减

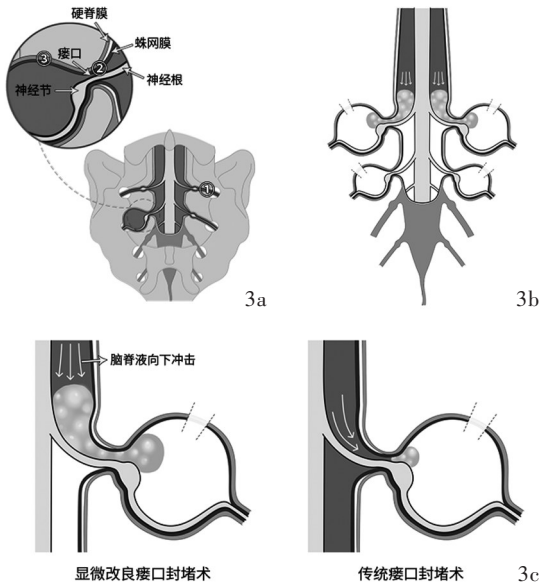

图3 骶管Tarlov囊肿示意图 3a 骶神经根的正常解剖结构为，神经节前均有硬脊膜和蛛网膜袖套，其中，硬脊膜、蛛网膜和软脊膜分别向外延伸为神经根的神经外膜、神经束膜和神经内膜，神经束膜与神经内膜之间存在潜在的神经束膜下腔。神经节近端，硬脊膜、蛛网膜与神经根之间的间隙逐渐缩小至完全消失，三者最终完全贴合，形成锥状结构，故神经束膜下腔通常是封闭的，与蛛网膜下腔不相通（①所示）。囊肿腔均存在与蛛网膜下腔相通的瘘口（②所示），囊壁由神经外膜和神经束膜组成，分别与硬脊膜囊的硬脊膜和蛛网膜相延续（③所示） 3b 存在多发囊肿时，不一定全部处理，针对上方2～3个囊肿处理后，完全填塞蛛网膜下腔，无脑脊液向下冲击力，下方囊肿自然闭合 3c 显微改良瘘口封堵术需彻底显露硬脊膜囊和蛛网膜下腔，常需封堵瘘口后水密缝合硬脊膜囊，较传统瘘口封堵术更有效封堵瘘口

Figure 3 Schematic diagram of sacral Tarlov cysts There were dural and arachnoid sleeves before the ganglion. Among them, the spinal dura mater, arachnoid, and pia mater extended outwards into the epineurium, perineurium and endoneurium of the nerve roots, respectively. The potential space between the perineurium and endoneurium was normally closed because the space between the dura and arachnoid and the nerve roots were gradually narrowed and eventually could not be distinguished at the proximal pole of the nerve root ganglion. All the Tarlov cysts had an ostium, which communicated with the subarachnoid space. The cyst wall was composed of the epineurium and perineurium, which are continuous with the dura and arachnoid of the dural sac, respectively (Panel 3a). It is unnecessary to treat all cysts in patients with multiple Tarlov cysts. The subarachnoid space was completely filled with fat grafts after blocking 2-3 superiorly located cysts. Subsequently, the downward cerebrospinal fluid pressure disappeared, and the ostia of the lower cysts closed spontaneously (Panel 3b). In contrast to the traditional ostium obstruction surgery, the microscopic modified ostium obstruction surgery effectively occluded the communication. In addition, the modified operation needed to expose the dural sac and subarachnoid space thoroughly, and the dural sac needed to be watertight sutured after the ostium was filled (Panel 3c).

压实现，后者通过有效封堵瘘口实现[16]。已报道的显微外科手术主要解决囊肿的占位效应，并未对瘘口进行有效封堵。囊肿颈部结扎术虽可有效封堵瘘口，但极易造成神经根卡压，被逐渐摒弃；而应用高值材料封堵瘘口，不仅增加医疗费用，也带来排斥反应、感染等风险。相比之下，自体脂肪块或肌肉块封堵瘘口可能更简单有效，但仅简单地将脂肪块或肌肉块填塞在瘘口外侧，在蛛网膜下腔脑脊液的冲击下，极易脱落，再次出现瘘口，导致脑脊液漏或囊肿复发（图3）。基于此，我们提出一种囊肿分离和瘘口封堵的新方法，对自体脂肪块封堵瘘口的传统术式进行改良。由于神经根经狭小的瘘口穿入囊肿腔内，因此将自体脂肪块修剪成“葫芦”状或“哑铃”状，旨在更加贴合瘘口形状，减少对神经根的压迫；填塞后脂肪块膨大的上端位于瘘口内侧蛛网膜下腔，此时，脂肪块对瘘口的封堵如同瓶盖盖住瓶口一样，且在蛛网膜下腔脑脊液的向下冲击力作用下，封堵愈加严实（图3c），术后无需留置腰椎外引流管，还可鼓励患者早期离床活动。值得注意的是，手术成功的关键在于自体脂肪块的选取和瘘口的缝合，脂肪块的柔软性决定术后是否出现神经根卡压、体积决定术后是否复发，如果遗留较大空腔，填塞自体脂肪块，此时填塞的脂肪块可提供一定支撑力以平衡空腔与硬脊膜囊之间的压力，防止瘘口填塞物撕裂或移位。不推荐纤维蛋白胶填充空腔，这是由于组织间被胶水间隔，直接破坏组织重塑。既往认为深部脂肪组织是首选的瘘口填塞物，柔软、相对疏松，具有更好的可塑性，且表面光滑，对周围组织尤其是神经根的刺激较小，不易形成瘢痕粘连；相反，肌肉组织和浅部脂肪组织偏坚韧，可塑性较差，表面粗糙，易压迫和刺激神经根，也易形成瘢痕粘连，导致粘连性神经根损伤[37,49]。尽管有文献报道因自体脂肪块降解而致瘘口封堵失败[35]，但本研究长期影像学随访并未发现此类现象，推测是由于手术切取的自体脂肪块足够大，可长期存活并重建血运[49]，这一推测尚有待进一步证实。此外，应在神经根袖套顶部缝合瘘口，而非缝合整条袖套，缝线应适当收紧。我们建议，缝合时不宜过紧，以免压迫神经。手术可在显微镜下直视骶神经，保持神经完整性和连续性并非难事，故术中不一定需要神经电生理监测。应强调术前充分评估，包括CT排除隐性脊柱裂、MRI判断圆锥和马尾位置，一旦合并脊髓拴系或隐性脊柱裂，有可能是终丝囊肿，术中需离断终丝，此时神经电生理监

表5 近10年症状性骶管Tarlov囊肿治疗方法的文献总结

Table 5. Literature review of surgical treatment of symptomatic sacral Tarlov cysts in recent 10 years

文献来源	手术方式	病例数	囊肿复发或脑脊液漏[例(%)]	其他并发症[例(%)]	总体并发症[例(%)]	长期总体改善[例(%)]
Mezzadri等[48](2014)	囊肿抽吸+脂肪或肌肉块填塞	6	1(1/ 6)	0(0/ 6)	1(1/ 6)	5(5/ 6)
Weigel等[35](2016)	囊肿切开+叠瓦缝合+脂肪块填塞	13	3(3/13)	0(0/13)	3(3/13)	9(9/13)
Potts等[36](2016)	囊肿切开+叠瓦缝合+带蒂肌瓣填塞	30	14(46.67)	10(33.33)	24(80.00)	14(46.67)
Elsawaf等[37](2016)	囊肿切除+脂肪块填塞	15	1(1/15)	2(2/15)	3(3/15)	15(15/15)
Zheng等[38](2016)	球囊辅助瘘管封堵+肌肉块封堵瘘口+叠瓦缝合	22	1(4.54)	6(27.27)	7(31.81)	19(86.36)
Burke等[39](2016)	囊肿切除+肌肉块填塞	23	4(17.39)	1(4.35)	5(21.74)	17(73.91)
Jiang等[13](2017)	囊肿切开+叠瓦缝合+脂肪或肌肉块填塞	14	6(6/14)	0(0/14)	6(6/14)	11(11/14)
Medani等[15](2019)	囊肿切开或叠瓦缝合	36	12(33.33)	3(8.33)	15(41.67)	29(80.56)
Fletcher-Sandersjöö等[11](2019)	囊肿切开+缺损修补	17	0(0/17)	0(0/17)	0(0/17)	16(16/17)
Yang等[16](2019)	囊肿切除+肌肉块填塞	18	3(3/18)	2(2/18)	5(5/18)	15(15/18)
Kikuchi等[24](2020)	囊肿切开+叠瓦缝合	9	2(2/ 9)	0(0/ 9)	2(2/ 9)	6(6/ 9)
Galarza等[40](2021)	囊肿切开+叠瓦缝合	44	1(2.27)	3(6.82)	4(9.09)	43(97.73)
Sugawara等[34](2021)	膨胀的聚四氟乙烯膜包裹	7	0(0/ 7)	0(0/ 7)	0(0/ 7)	7(7/ 7)
Chu等[41](2022)	纤维蛋白胶封闭+脂肪块填塞	265	15(5.66)	4(1.51)	19(7.17)	155(58.49)
Wang等[42](2022)	内镜下切除+脂肪块填塞	15	0(0/15)	0(0/15)	0(0/15)	12(12/15)
吴超等[43](2023)	囊肿部分切除+瘘口缩窄+神经根袖套重建及人工硬脊膜加固	71	2(2.82)	7(9.86)	9(12.68)	67(94.37)
Yucesoy等[44](2023)	囊肿膜皱缩术	40	1(2.50)	7(17.50)	8(20.00)	35(87.50)
Li等[45](2024)	囊肿切除+神经根袖套重塑	42	1(2.38)	1(2.38)	2(4.76)	32(76.19)
Luchtmann等[46](2024)	囊肿切除+内镜下切开	48	5(10.42)	1(2.08)	6(12.50)	35(72.92)
Jiang等[47](2024)	内镜下脂肪块填塞+纤维蛋白胶固定	32	0(0.00)	0(0.00)	0(0.00)	27(84.38)
本研究	显微改良瘘口封堵术	35	0(0.00)	2(5.71)	2(5.71)	33(94.29)

测是必要的。

本研究至末次随访时,疼痛症状改善最显著,分别为神经根性疼痛为94.29%(33/35)、会阴部疼痛为13/14、腰骶部疼痛为85.19%(23/27)、直立性头痛为2/3,而大小便障碍和性功能障碍不易缓解,与既往研究结果相似[14,24]。SCPS量表是针对脊柱脊髓疾病的脊髓神经学评分量表[17],本研究至末次随访时SCPS评分改善,尤以疼痛和感觉障碍、肌力、步态和小便功能改善更明显,优于既往文献报道[16];ODI指数自术前的41.21%降至末次随访时的12.89%,降幅达68.72%,显著高于最新发表的一项前瞻性队列研究的35.53%(自术前的45.6%降至术后1年的29.4%)[50];JOA29量表和MacNab评定标准的总体改善率均为94.29%(33/35),高于大多数文献报道(表5)。一项Meta分析纳入32项关于症状性骶管Tarlov囊肿显微外科手术治疗的临床研究计333例患者,总体改善率为83.48%(278/333)[7];亦有文献报道症状性骶管Tarlov囊肿显微外科手术治疗的总体改善率为80.92%(229/283)[14]。

本研究有2例患者术后出现手术相关神经功能障碍,1例$L_5\sim S_3$椎体水平有3个囊肿(最大者位于右侧S_1)、1例$S_{1\sim3}$椎体水平有3个囊肿(最大者位于右侧S_2),一次手术全部处理,偏多的神经干扰难以避免;加之这2例患者均体型瘦小,体重指数低(13.42和18.01 kg/m^2),术中切取的脂肪块有限且柔软性不足,使得神经根周围无充足的脂肪垫包绕,可能导致术后出现神经功能障碍;术后MRI均显示囊肿无复发,但神经根性疼痛并无改善,且新发下肢麻木;同时不可否认的是,这2例是我们开展显微改良瘘口封堵术的最早期病例,经验不足和手术技巧不熟练亦影响手术效果。相比近10年数据(表5),本研究术后并发症发生率较低(5.71%,2/35),且无脑脊液漏、假性脊膜膨出、囊肿复发等严重并发症,表明该术式可以实现瘘口的长期严密封堵,亦证实我们对传统手术失败原因的假设。为更好预防上述并发症,我们采取以下改进措施:(1)臀上部

(髂后上棘横行小切口更美观)的脂肪组织多且柔软,首选在此处切取足量脂肪块,再根据实际情况修剪,尤其是体型瘦小患者,术前应预留髂后上棘切口,切取此处的深部脂肪组织。(2)主张多发囊肿不一定一次手术全部处理,处理上方2~3个大囊肿后,完全填塞蛛网膜下腔,此时无脑脊液向下冲击力,下方囊肿可自然闭合(图3c)。(3)自神经根袖套上方开始缝合瘘口,缝合松紧度适中,若难以把握则倾向较松缝合,这是由于缝合过紧易造成神经根损伤(图1i)。经改进后未再出现类似并发症。

综上所述,显微改良瘘口封堵术是治疗症状性骶管Tarlov囊肿的安全、有效的手术策略,可以严密封堵瘘口,降低术后囊肿复发和脑脊液漏发生率。然而,本研究样本量较小、缺乏标准的囊肿评价指标、随访时间仍较短,且未对受累责任神经根行神经电生理监测。尽管存在上述局限性,且不足以解决目前关于症状性Tarlov囊肿治疗方式的争议,但本研究展示了一种可以彻底封堵瘘口的新型手术方法,为减少术后囊肿复发和脑脊液漏提供了新的见解。未来尚待扩大样本量、设计严谨的前瞻性随机对照试验,更好地验证显微改良瘘口封堵术的有效性和安全性。

利益冲突 无

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下期内容预告 本刊2025年第1期报道专题为神经调控，重点内容包括：神经调控技术临床应用进展及展望；基于反应性神经电刺激系统的癫痫治疗与研究进展；帕金森病脑深部电刺激术治疗；特发性震颤神经调控治疗；肌张力障碍神经调控治疗；罕见运动障碍疾病神经调控治疗；中枢性疼痛神经调控治疗；慢性意识障碍神经调控治疗；精神疾病神经调控治疗；脑卒中后神经调控结合康复训练促进功能恢复现状与展望；周围神经疾病脊髓电刺激术治疗；骶神经调控在盆底功能障碍疾病治疗中的应用与研究进展