

# 达芬奇机器人单吻合口十二指肠回肠旁路联合袖状胃切除术治疗肥胖患者的安全性及学习曲线

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**【摘要】目的** 探讨达芬奇机器人单吻合口十二指肠回肠旁路联合袖状胃切除术(SADI-S)治疗肥胖患者的安全性及其学习曲线。**方法** 采用描述性病例系列研究方法。回顾性分析2020年3月至2021年5月期间在吉林大学中日联谊医院接受达芬奇机器人SADI-S治疗的肥胖患者的临床资料。单纯肥胖者体质指数 $\geq 37.5 \text{ kg/m}^2$ 或 $28 \text{ kg/m}^2 < \text{体质指数} < 37.5 \text{ kg/m}^2$ 同时合并有2型糖尿病、或两项代谢综合征组分、或肥胖合并症接受SADI-S治疗、且通过达芬奇机器人手术系统完成者纳入研究;排除行SADI-S以外的其他减重术式或以达芬奇机器人SADI-S作为修正手术者。共77例患者纳入本次研究,其中男31例,女46例;中位年龄33(18~59)岁;术前体质量( $123.0 \pm 26.2$ ) kg,体质指数( $42.2 \pm 7.1$ )  $\text{kg/m}^2$ ,腰围( $127.6 \pm 16.3$ ) cm。按手术日期先后顺序将入组患者依次编为1~77号,采用教科书效果(TO)来分析每例患者的临床结局,采用Dindo-Clavien分级标准对手术并发症进行分类。TO标准:手术时间小于或等于患者手术时间的第75百分位数(210 min);术后住院时间小于或等于患者术后住院时间的第75百分位数(7 d);并发症分级小于Clavien grade II级;无再次入院;无中转开腹及死亡。当机器人SADI-S患者同时满足上述5个条件时,则该患者被认为达到了TO标准。采用累积和分析方法(CUSUM)计算患者的TO率,以手术例数为横坐标,TO率为纵坐标绘制散点图,以了解机器人SADI-S的学习曲线。**结果** 77例达芬奇机器人SADI-S患者的手术时间为( $182.9 \pm 37.5$ ) min,术后中位住院时间为6(4~55) d,无中转开腹及死亡病例。并发症发生率9.1%(7/77),其中4例(5.2%)为II级并发症,包括十二指肠回肠吻合口漏、腹腔出血、腹腔积液和胃肠功能恢复延迟各1例;2例(2.6%)为IIIb级并发症,均为胃漏;1例(1.3%)IV级并发症,为术后呼吸功能衰竭,均通过对症处理痊愈出院。有51例患者的临床结局达到了TO标准,TO率在第46例后为正值,且稳步上升。以本组第46例为界,将所有患者分为学习提高组(46例)和熟练掌握组(31例),两组患者在性别、年龄、体质量、体质指数、腰围、美国麻醉医师分级、肝体积及手术时间、术后并发症发生率等方面比较,差异均无统计学意义(均 $P > 0.05$ );学习提高组的腹腔引流管留置比为54.3%(25/46),高于熟练掌握组的16.1%(5/31),术后住院时间为6(4~22) d,长于熟练掌握组的6(5~55) d,差异均有统计学意义(均 $P < 0.05$ )。**结论** 达芬奇机器人SADI-S安全可行;其学习曲线为46例。

**【关键词】** 肥胖; 达芬奇机器人; 十二指肠回肠旁路联合袖状胃切除术,单吻合口; 并发症; 学习曲线; 安全性

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**Safety and learning curve of Da Vinci robotic single-anastomosis duodenal-ileal bypass with sleeve gastrectomy in the treatment of obesity patients**

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**【Abstract】 Objective** To investigate the safety and learning curve of Da Vinci robotic single-anastomosis duodenal-ileal bypass with sleeve gastrectomy (SADI-S) in the treatment of obesity patients. **Methods** A descriptive case series study was performed. Clinical data of obesity patients who were treated with Da Vinci robotic SADI-S in China-Japan Union Hospital of Jilin University from March 2020 to May 2021 were analyzed retrospectively. Case inclusion criteria: (1) uncomplicated obese patients with body mass index (BMI)  $\geq 37.5$  kg/m<sup>2</sup>; (2) patients with BMI of 28 to  $< 37.5$  kg/m<sup>2</sup> complicated with type 2 diabetes or two metabolic syndrome components, or obesity comorbidities; (3) patients undergoing SADI-S by Da Vinci robotic surgery system. Those who received other bariatric procedures other than SADI-S or underwent Da Vinci robotic SADI-S as revisional operation were excluded. A total of 77 patients were enrolled in the study, including 31 males and 46 females, with median age of 33 (18-59) years, preoperative body weight of (123.0 $\pm$ 26.2) kg, BMI of (42.2 $\pm$ 7.1) kg/m<sup>2</sup> and waistline of (127.6 $\pm$ 16.3) cm. According to the order of operation date, the patients were numbered as 1-77. The textbook outcome (TO) and Clavien-Dindo grading standard were used to analyze the clinical outcome of each patient and to classify surgical complications, respectively. The standard of textbook outcome was as follows: the operative time less than or equal to the 75th percentile of the patient's operation time (210 min); the postoperative hospital stay less than or equal to the 75th percentile of the patient's postoperative hospital stay (7 d); complication grade lower than Clavien grade II; no readmission; no conversion to laparotomy or death. The patient undergoing robotic SADI-S was considered to meet the TO standard when meeting the above 5 criteria. The TO rate was calculated by cumulative sum analysis (CUSUM) method. The curve was drawn by case number as X-axis and CUSUM (TO rate) as Y-axis so as to understand the learning curve of robotic SADI-S. **Results** The operative time of 77 robotic SADI-S was (182.9 $\pm$ 37.5) minutes, and the length of postoperative hospital stay was 6 (4-55) days. There was no conversion to laparotomy or death. Seven patients suffered from complications (7/77, 9.1%). Four patients had grade II complications (5.2%), including one with duodeno-ileal anastomotic leakage, one with abdominal bleeding, one with peritoneal effusion and one with delayed gastric emptying; two patients were grade IIIb complications (2.6%) and both of them were diagnosed with gastric leakage; one patient was grade IV complication diagnosed with postoperative respiratory failure (1.3%), and all of them were cured successfully. A total of 51 patients met the textbook outcome standard, and the TO rate was positive and was steadily increasing after the number of surgical cases accumulated to the 46th case. Taking the 46th case as the boundary, all the patients were divided into learning stage group ( $n=46$ ) and mastery stage group ( $n=31$ ). There were no significant differences between the two groups in terms of gender, age, weight, body mass index, waist circumference, ASA classification, standard liver volume, operative time and morbidity of postoperative complication (all  $P>0.05$ ). The percent of abdominal drainage tube in learning stage group was higher than that in mastery stage group (54.3% versus 16.1%,  $P<0.05$ ). The length of postoperative hospital stay in learning stage group was longer than that in mastery stage group [6 (4-22) d versus 6 (5-55) d,  $P<0.05$ ]. **Conclusion** The Da Vinci robotic SADI-S is safe and feasible with a learning curve of 46 cases.

**【Key words】** Obesity; Da Vinci robot; Single anastomosis duodenal-ileal bypass with sleeve gastrectomy; Complication; Learning curve; Safety

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单吻合口十二指肠回肠旁路联合袖状胃切除术 (single anastomosis duodenal - ileal bypass with sleeve gastrectomy, SADI-S) 是治疗肥胖及其代谢病最有效的减重术式之一, SADI-S 又被称为单吻合口

十二指肠转位术 (one anastomosis duodenal switch, OADS) 或保留幽门的胃肠减重手术 (stomach intestinal pylorus sparing surgery, SIPS)<sup>[1-4]</sup>。SADI-S 手术的操作要点为胃袖状切除、游离并切断十二

指肠球部后将近端十二指肠与距回盲部 300 cm 处的回肠吻合。一方面,由于受到肝脏等邻近器官的影响,十二指肠球部的局部解剖空间比较狭小;另一方面,离断十二指肠后近端十二指肠的长度非常有限,所以近端十二指肠与回肠之间的吻合不宜采用吻合器,而采用手工吻合,这两个因素决定了十二指肠回肠吻合是 SADI-S 手术的重点与难点。与传统腹腔镜技术相比,达芬奇机器人具有高清三维成像系统、震颤过滤、机器人控制台符合人体工程学以及灵活的纤细机械臂等诸多优点,这些优点有助于降低 SADI-S 的操作难度、提高手术质量和改善患者的临床结局<sup>[5-8]</sup>。目前,达芬奇机器人已被应用于各种减重手术中,如袖状胃切除术、Roux-en-Y 胃旁路术及胆胰转流十二指肠转位术<sup>[9-11]</sup>。然而目前,国内外关于机器人 SADI-S 的文献较少。本中心 2020 年 3 月 9 日完成了首例达芬奇机器人 SADI-S<sup>[12]</sup>。此后至今,我们已经完成了 77 例达芬奇机器人 SADI-S,现对这部分肥胖患者的临床资料进行总结分析,进而探讨 SADI-S 的安全性及学习曲线。

## 资料与方法

### 一、一般资料

采用描述性病例系列研究方法。回顾性收集吉林大学中日联谊医院减重与代谢外科 2020 年 3 月至 2021 年 5 月期间,收治的 77 例肥胖患者行达芬奇机器人 SADI-S 的临床资料。男 31 例,女 46 例,中位年龄 33(18~59)岁,术前体质量(123.0±26.2) kg,体质指数(42.2±7.1) kg/m<sup>2</sup>,腰围(127.6±16.3) cm。本研究通过医院伦理委员会审批(审批号:20211130018)。所有患者均获知情同意。

### 二、纳入标准和排除标准

纳入标准:(1)接受 SADI-S 治疗、且手术通过达芬奇机器人手术系统完成者;(2)单纯肥胖者体质指数≥37.5 kg/m<sup>2</sup>;(3)28 kg/m<sup>2</sup><体质指数<37.5 kg/m<sup>2</sup> 时同时合并有 2 型糖尿病或两项代谢综合征、或肥胖合并症。

排除标准:(1)行 SADI-S 以外的其他减重术式;(2)腹腔镜 SADI-S;(3)达芬奇机器人 SADI-S 作为修正手术者。

### 三、手术方法

参照文献<sup>[12]</sup>执行。

## 四、观察指标和评价标准

1. 手术安全性:手术并发症的严重程度按 Clavien-Dindo 标准<sup>[13]</sup>进行分类。

2. 手术结局:采用教科书效果(textbook outcome, TO)来分析达芬奇机器人 SADI-S 的手术结果。TO 是由多项参数组成的综合指标,常被用于全面反映手术患者的临床结局,其代表一种理想的预后<sup>[14]</sup>。结合既往文献,达芬奇机器人 SADI-S 的 TO 定义如下<sup>[15-21]</sup>:(1)手术时间小于或等于患者手术时间的第 75 百分位数(210 min);(2)术后住院时间小于或等于患者术后住院时间的第 75 百分位数(7 d);(3)并发症分级低于 Clavien grade II 级;(4)无再次入院;(5)无中转开腹及死亡。当机器人 SADI-S 患者同时满足上述 5 个条件时,则该患者被认为达到了 TO 标准,具有理想的临床结局。

## 五、学习曲线分析

将所有患者按手术日期先后顺序依次编为 1~77 号。根据 TO 标准,将所有患者的临床结局进行分类量化,即达到 TO 标准的临床结局,用 1 表示;未达到 TO 标准的临床结局,用 -1 表示。采用累积和分析法(cumulative sum analysis, CUSUM)方法计算患者的 TO 率,以手术例数为横坐标, CUSUM(TO 率)为纵坐标绘制散点图,进而分析该术式的学习曲线。

## 六、统计学方法

用 SPSS 22.0 进行统计学分析,符合正态分布的计量资料以  $\bar{x} \pm s$  表示,采用两独立样本的 *t* 检验进行比较;不符合正态分布的计量资料以 *M*(范围)表示,组间比较采用 Wilcoxon 秩和检验;计数资料以例(%)表示,组间比较采用  $\chi^2$  检验。*P*<0.05 表示差异具有统计学意义。

## 结 果

### 一、手术情况

全组 77 例患者均成功完成达芬奇机器人 SADI-S,无中转开腹及死亡病例。手术时间为(182.9±37.5) min。其中 8 例患者因术前患有胆囊结石而一并行胆囊切除术。术后首次下床活动时间为 2(1~9) d,术后首次排气时间为 2(2~6) d,术后首次进食时间为 3(2~25) d,术后住院时间为 6(4~55) d。

### 二、术后并发症

有 7 例(7/77, 9.1%)出现并发症。其中 4 例(5.2%)为 II 级并发症,包括十二指肠回肠吻合口

漏、腹腔出血、腹腔积液和胃肠功能恢复延迟各 1 例,均通过保守治疗后痊愈出院。2 例(2.6%)为 IIIb 级并发症,均为胃漏患者,其中 1 例漏口位于胃大弯胃底处,经包括手术修补在内的多种治疗后痊愈;另 1 例于术后第 2 天突发左上腹剧烈疼痛,腹部 CT 见胃大弯胃底处漏口,急诊行胃漏修补术,现已痊愈,其术后住院时间为 55 d。1 例(1.3%)IV 级并发症,为术后呼吸功能衰竭,在重症监护室经呼吸机支持治疗后痊愈出院,其术后住院时间为 20 d。

### 三、手术结局

有 51 例患者的临床手术结局达到了 TO 标准 (TO 组), 26 例未达到 TO 标准(非 TO 组)。两组患者在性别、年龄、体质量、体质指数、腰围、美国麻醉医师协会分级(American Society of Anesthesiology, ASA)及标准肝体积等方面比较,两组差异均无统计学意义( $P>0.05$ )。TO 组的手术时间和术后住院时长短于非 TO 组,并发症发生率及腹腔引流管留置比均显著低于非 TO 组,术者经验、助手经验及器械护士经验水平均显著高于非 TO 组(均  $P<0.05$ )。见表 1。

### 四、学习曲线

采用 CUSUM 方法计算患者的 TO 率结果显示,本组第 46 例后为正值、且稳步上升,提示术者度过学习曲线需要积累 46 例。见图 1。

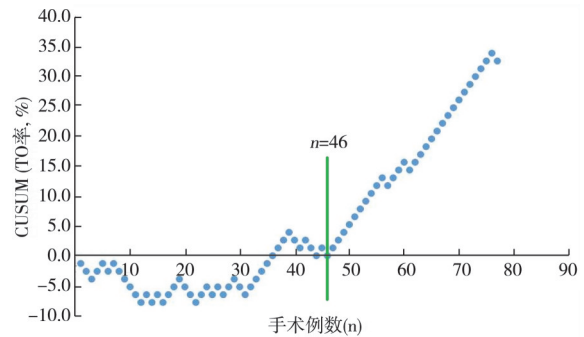


图 1 达芬奇机器人 SADI-S 的学习曲线图 教科书效果(TO)率的 CUSUM 值在第 46 例后为正值且稳步上升

以 46 例为分界点,学习曲线由此可分为学习提高阶段和熟练掌握阶段。将本组 77 例患者分为学习提高组(46 例,第 1~46 例)和熟练掌握组(31 例,第 47~77 例),两组患者在性别、年龄、体质量、体质指数、腰围、ASA 分级、标准肝体积及手术时间、术

表 1 本组 77 例行达芬奇机器人单吻合口十二指肠回肠旁路联合袖状胃切除术肥胖患者临床手术结局达到教科书效果(TO)组与非 TO 组临床资料的比较

组别	例数	性别 [男/女,例(%)]	年龄(岁, $\bar{x}\pm s$ )	体质量(kg, $\bar{x}\pm s$ )	体质指数(kg/m <sup>2</sup> , $\bar{x}\pm s$ )
TO 组	51	19(37.3) / 32(62.7)	33.6±8.7	121.7±26.1	41.8±7.4
非 TO 组	26	12(46.2) / 14(53.8)	33.5±8.6	125.6±26.6	43.0±6.6
统计值		$\chi^2=0.567$	$t=-0.042$	$t=0.628$	$t=0.660$
P 值		0.451	0.966	0.532	0.511
组别	例数	腰围(cm, $\bar{x}\pm s$ )	标准肝体积(cm <sup>3</sup> , $\bar{x}\pm s$ )	ASA 分级 <sup>a</sup> [ II / III,例(%)]	手术时间(min, $\bar{x}\pm s$ )
TO 组	51	126.5±17.5	1 613.4±193.2	32(62.7) / 19(37.3)	166.0±24.7
非 TO 组	26	129.8±13.8	1 639.6±194.5	16(61.5) / 10(38.5)	216.0±36.6
统计值		$t=0.852$	$t=0.563$	$\chi^2=0.011$	$t=7.103$
P 值		0.397	0.575	0.918	<0.001
组别	例数	并发症 [例(%)]	留置腹腔引流管 [例(%)]	再次入院 [例(%)]	术后住院时间[d, M(范围)]
TO 组	51	0	15(29.4)	0	6(4~7)
非 TO 组	26	7(26.9)	15(57.7)	1(3.8)	7(5~55)
统计值		-	$\chi^2=5.791$	-	$Z=-4.010$
P 值		<0.001 <sup>b</sup>	0.016	0.338 <sup>b</sup>	<0.001
组别	例数	术者经验 <sup>c</sup> [例, M(范围)]	助手经验 <sup>c</sup> [例, M(范围)]	器械护士经验 <sup>c</sup> [例, M(范围)]	
TO 组	51	49(4~76)	20(1~51)	4(1~15)	
非 TO 组	26	22(1~77)	8(1~52)	2(1~12)	
统计值		$Z=-3.630$	$Z=-2.780$	$Z=-2.548$	
P 值		<0.001	0.005	0.011	

注:<sup>a</sup>美国麻醉医师协会分级(American Society of Anesthesiology, ASA);<sup>b</sup>表示统计学分析方法采用 Fisher 精确概率检验;<sup>c</sup>以其参与的手术例数表示,参与的手术例数越多,表明其经验水平越高;“-”表示无数据

后并发症发生率、再次手术率及再次入院率等方面比较,差异均无统计学意义( $P>0.05$ );学习提高组的腹腔引流管留置比高于熟练掌握组,术后住院时间长于熟练掌握组(均 $P<0.05$ );见表2。

## 讨 论

据统计,目前全球范围内达芬奇机器人装机数量已超过5 000台,手术量已超过600万台次<sup>[22]</sup>。比利时教授Cadiere等<sup>[23]</sup>于1999年报道了世界首例机器人减重手术以来,机器人就逐渐应用在各种减重术式中。但Edelson等<sup>[24]</sup>研究发现,与腹腔镜胃绑带手术相比,机器人胃绑带手术并无明显优势。Wilson和Sudan<sup>[6]</sup>研究发现,机器人应用在袖状胃切除术中,其手术时间(113 min)反而长于腹腔镜袖状胃切除术(91 min)。一项关于机器人胃旁路与腹腔镜胃旁路手术的对比研究表明,机器人胃旁路的胃肠道漏的发生率显著低于腹腔镜胃旁路(0比1.7%, $P=0.04$ )<sup>[25]</sup>。Sudan等<sup>[11]</sup>研究发现,机器人胆胰转流十二指肠转位术的病死率远低于腹腔镜胆胰转流十二指肠转位术。更重要的是,与腹腔镜手术相比,机器人在修正手术中的优势更加明显,其能大幅降低胃肠道漏的发生率和病死率,具有更高的安全性<sup>[26-28]</sup>。综上,达芬奇机器人的优势在相对简

单的减重手术(如胃绑带、袖状胃切除术)中体现的并不明显,其似乎更适合于难度较大的减重手术(如Roux-en-Y胃旁路术、胆胰转流十二指肠转位术)等。

目前,仅有数篇关于机器人SADI-S手术的文獻报道,且这些研究的样本量较小<sup>[29-32]</sup>。Palomares等<sup>[29]</sup>报道了机器人SADI-S作为初始手术治疗一例肥胖合并脐疝的患者,其手术时间为165 min。Tat等<sup>[30]</sup>报道了12例机器人SADI-S手术(11例作为袖状胃切除术的修正手术,1例为初始手术),其平均手术时间为204 min。Vilallonga等<sup>[32]</sup>报道了3例机器人SADI-S手术(均是袖状胃切除术的修正手术),其平均手术时间为145 min。本研究结果显示,达芬奇机器人SADI-S的平均手术时间为182.9 min,随着术者手术经验(手术例数)的增加,手术时间呈下降趋势,这种趋势在学习提高阶段最为明显,当术者度过学习曲线进入熟练掌握阶段后,手术时间趋于稳定。

虽然SADI-S的手术并发症发生率不高,但仍不可避免。Cirera de Tudela等<sup>[33]</sup>对包括2 318例SADI-S的15篇文献进行回顾性分析,其研究结果显示,SADI-S的总并发症发生率为3.2%,而漏是众多并发症中最常见的一种(1.0%)。Moon等<sup>[34]</sup>研究发现,在SADI-S术后需要手术干预的各种并发症中,漏

表2 本组77例行达芬奇机器人单吻合中十二指肠回肠旁路联合袖状胃切除术肥胖患者学习提高组与熟练掌握组临床资料的比较

组别	例数	性别 [男/女,例(%)]	年龄(岁, $\bar{x}\pm s$ )	体质量(kg, $\bar{x}\pm s$ )	体质指数(kg/m <sup>2</sup> , $\bar{x}\pm s$ )	腰围(cm, $\bar{x}\pm s$ )
学习提高组	46	19(41.3)/27(58.7)	34.6±9.5	125.2±29.4	42.9±7.8	129.3±16.5
熟练掌握组	31	12(38.7)/19(61.3)	32.0±6.9	119.8±20.4	41.2±5.8	125.1±15.9
统计值		$\chi^2=0.052$	$t=1.270$	$t=0.887$	$t=0.981$	$t=1.118$
P值		0.820	0.202	0.378	0.330	0.267
组别	例数	标准肝体积 (cm <sup>3</sup> , $\bar{x}\pm s$ )	ASA 分级 <sup>a</sup> [ II/III, 例(%)]	手术时间 (min, $\bar{x}\pm s$ )	术后住院时长 [d, M(范围)]	留置腹腔引流管 [例(%)]
学习提高组	46	1 632.6±214.2	30(65.2)/16(34.8)	189.2±36.6	6(4~22)	25(54.3)
熟练掌握组	31	1 606.8±157.8	18(58.1)/13(41.9)	173.6±37.5	6(5~55)	5(16.1)
统计值		$t=0.575$	$\chi^2=0.404$	$t=1.812$	$Z=-2.337$	$\chi^2=11.375$
P值		0.567	0.525	0.074	0.019	0.001
组别	例数	中转开腹率	再次手术率 [例(%)]	再次入院率 [例(%)]	病死率	并发症发生率 [例(%)]
学习提高组	46	0	1(2.2)	1(2.2)	0	6(13.0)
熟练掌握组	31	0	1(3.2)	0	0	1(3.2)
统计值		-	0.000	- <sup>b</sup>	-	$\chi^2=1.135$
P值		-	1.000	1.000	-	0.287

注:<sup>a</sup>为美国麻醉医师协会(American Society of Anesthesiology, ASA);<sup>b</sup>采用Fisher精确概率检验;“-”表示无数据

居首位,为6.9%(10/144)。本组病例术后的总并发症发生率为9.1%(7/77),其中胃漏占2.6%(2/77);7例中的前6例均为术者度过学习曲线之前,当术者度过学习曲线后仅发生1例并发症。对于减重手术的并发症而言,漏的诊治一直是减重代谢外科的重点与难点,该并发症一旦处理不当,就会产生极为严重的后果,甚至给患者带来生命危险。即使是经验丰富的减重外科医生,漏的诊治仍具有一定的挑战性。关于SADI-S术后漏的治疗,目前尚无统一的观点,不同文献所报道的处理措施也不尽相同。Sánchez-Pernaute等<sup>[35]</sup>报道的3例SADI-S术后漏均通过保守治疗后痊愈。Nelson等<sup>[36]</sup>则是将SADI-S改成Mini胃旁路,患者漏口愈合良好。本研究结果提示,除胃漏患者外,其余并发症的诊疗较为顺利,均通过保守治疗痊愈出院。就本中心处理SADI-S术后胃漏的体验而言:2例胃漏患者均采用包括手术修补在内的综合治疗措施,但效果均不理想,与我们既往治疗袖状胃切除术后胃漏的经历相比较,SADI-S术后胃漏的处理难度大幅增加,且漏口较难愈合,整个诊疗过程颇感棘手。因此,SADI-S术后胃漏值得重视,其愈合困难的原因是值得探讨和研究的。

有文献报道,机器人袖状胃切除术的学习曲线为20~25例<sup>[9,37]</sup>。另有研究报道,机器人Roux-en-Y胃旁路的学习曲线为14~84例<sup>[10,21,38-39]</sup>。Sudan等<sup>[11]</sup>报道,机器人胆胰转流十二指肠转位术的学习曲线为50例。本研究结果表明,达芬奇机器人SADI-S的学习曲线为46例。

对于开展一项新技术,人们往往担心的是在学习曲线的学习提高阶段可能出现较高的并发症发生率。我们的研究表明,学习提高阶段和熟练掌握阶段之间的并发症发生率等指标比较,差异并无统计学意义,这提示学习提高阶段并不会显著影响该项技术的安全性。术者度过学习曲线的初级阶段进入熟练掌握阶段后,腹腔引流管留置比例显著下降,这表明术者的操作技能越来越娴熟的同时,也反映了术者的自信。

综上,达芬奇机器人SADI-S的并发症发生率不高,是安全可行的;该术式的学习曲线为46例。

**利益冲突** 所有作者均声明不存在利益冲突

**作者贡献声明** 王伦:起草文章及修改文章,采集数据,分析数据,统计分析;赵玉会、王泽雨、于洋、王金发:查阅文献,采集数据,分析数据;姜涛:实施研究,研究指导,对文章的知识性内容作批评性审阅

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