·论著·

经左胸前外侧微创冠脉搭桥治疗冠心病多支病变

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[摘 要] **目的**:评估经左胸前外侧微创冠脉搭桥术(minimally invasive cardiac surgery coronary artery bypass grafting, MICS CABG)治疗冠心病多支病变的可行性、安全性及近中期临床疗效。**方法**:选择2015年11月—2017年11月在北京大学第三医院完成的经左胸前外侧微创冠脉搭桥术患者作为实验组(MICS CABG组),同期收集接受常规正中开胸非体外循环冠脉搭桥手术(off-pump coronary aortic bypass grafting, OPCABG)患者,应用倾向性评分匹配法,按照年龄、性别、左心室射血分数、体重指数、冠脉血管病变程度以及是否存在吸烟、糖尿病、高血压病、高脂血症、肾功能不全、脑血管意外史、慢性阻塞性肺病史与接受MICS CABG的患者进行1∶1配对作为对照组(OPCABG组)。比较两组患者住院临床资料及近中期随访结果。**结果**:MICS CABG组共入选85例患者,其中男性68例(80.0%),女性17例(20%),平均年龄(63.8±8.7)岁;OPCABG病例451例,经倾向性评分匹配出85例作为对照组(OPCABG组),匹配后两组基线水平一致(P均>0.05)。MICS CABG组平均搭桥(2.35±0.83)支/例,对照组平均(2.48±0.72)支/例(P=0.284),MICS CABG组无中转正中开胸者,两组均无中转体外循环手术。MICS CABG组与对照组相比,其术后主要不良心脑血管事件(major adverse cardiacand cerebrovascular events, MACCE)发生率[1.17%(1/85) *vs.* 3.52%(3/85)]、二次手术率[2.34%(2/85) *vs.* 3.52%(3/85)]、术后新发心房纤颤率[4.70%(4/85) *vs.* 3.52%(3/85)]及新发肾功能不全率[1.17%(1/85) *vs.* 0%(0/85)]差异无统计学意义(均P>0.05)。MICS CABG组手术时间较OPCABG组长[(282.8±55.8) min *vs.* (246.8±56.9) min, P<0.05],但术后呼吸机使用时间[(16.9±7.8) h *vs.* (29.6±15.9) h]、术后监护病房住院时间[(29.3±20.8) h *vs.* (51.5±48.3) h]及住院时间[(18.3±3.2) d *vs.* (25.7±4.2) d]均较短(均P<0.05)。术后冠脉造影检查,MICS CABG组总体桥血管通畅率(A+B级)为96.5%。术后随访1年,两组患者MACCE累积发生率差异无统计学意义[1.18%(1/85) *vs.* 3.61%(3/83), P>0.05]。**结论**:经左胸前外侧小切口微创冠状动脉搭桥手术安全可行,近中期随访结果良好,MICS CABG出院更早,恢复更快。

[关键词] 左胸前外侧小切口;微创;非体外循环冠状动脉旁路移植术;冠脉多支病变;疗效结果
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Feasibility and safety of minimally invasive cardiac coronary artery bypass grafting surgery for patients with multivessel coronary artery disease: Early outcome and short-mid-term follow up results

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ABSTRACT **Objective**: To explore the feasibility, safety and mid-term outcome of minimally invasive cardiac surgery coronary artery bypass grafting (MICS CABG) surgery. **Methods**: Data of patients who underwent MICS CABG between November 2015 and November 2017 in Peking University Third Hospital were retrospectively analyzed. Results were compared with the patients who underwent off-pump coronary aortic bypass grafting (OPCABG) surgery over the same period. The two groups were matched in propensity score matching method according to age, gender, left ventricular ejection fraction, body mass index, severity of coronary artery disease, smoking, diabetes mellitus, hypertension, hyperlipidemia, renal insufficiency, history of cerebrovascular accident, and history of chronic obstructive pulmonary disease (COPD). **Results**: There were 85 patients in MICS CABG group, including 68 males (80.0%) and 17 females (20%), with an average age of (63.8±8.7) years; 451 patients were enrolled in OPCABG group, and 85 patients were matched by propensity score as control group (OPCABG group). There was no significant difference in general clinical characteristics (P>0.05). The average grafts of MICS CABG

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and OPCABG were 2.35 ± 0.83 and 2.48 ± 0.72 respectively (P = 0.284). No conversion to thoracotomy in MICS CABG group or cardiopulmonary bypass in neither group occurred. There was no significant difference in the major adverse cardiovascular events (MACCEs, 1.17% *vs.* 3.52%), reoperation (2.34 *vs.* 3.52%), new-onset atrial fibrillation rate (4.70% *vs.* 3.52%) or new-onset renal insufficiency rate (1.17% *vs.* 0%) between MICS CABG group and OPCABG group (P > 0.05). The operation time in MICS CABG group was longer than that in OPCABG group [(282.8 ± 55.8) min *vs.* (246.8 ± 56.9) min, P < 0.05], while the time of ventilator supporting(16.9 h *vs.* 29.6 h), hospitalization in ICU [(29.3 ± 20.8) h *vs.* (51.5 ± 48.3) h] and total hospitalization [(18.3 ± 3.2) d *vs.* (25.7 ± 4.2) d] in MICS CABG group were shorter than those in OPCABG group (P < 0.05). The total patency rate (A + B levels) of MICS CABG was 96.5% after surgery. There was no significant difference in MACCEs rate between the two groups [1.18% (1/85) *vs.* 3.61% (3/83), P > 0.05] in 1-year follow up. **Conclusion**: The MICS CABG surgery is a safe and feasible procedure with good clinical results in early and mid-term follow-up.

KEY WORDS Minimally invasive cardiac surgery; Minimally invasive; Off-pump coronary aortic bypass grafting; Multiple coronary artery lesions; Clinical effect

冠心病发病率逐年上升,已经成为威胁人类健康的第一杀手,对于解剖学比较复杂及 SYNTAX (the synergy between percutaneous coronary intervention with TAXUS and cardiac surgery)评分较高的患者,冠状动脉搭桥手术(coronary artery bypass grafting, CABG)仍然是不可取代的冠脉血运重建方法[1-2]。随着冠脉搭桥术不断成熟,在一些大的心脏中心,常规搭桥手术的死亡率已经降到 1% 以下[3],如何在微创下安全实施手术以及获得更好的远期效果成为研究热点。本研究总结和评估 2015 年 11 月至 2017 年 11 月在北京大学第三医院经左胸前外侧小切口微创冠脉多支搭桥手术(minimally invasive cardiac surgery coronary artery bypass grafting, MICS CABG)的临床经验及手术的可行性、安全性及近中期临床疗效。

1 资料与方法

1.1 一般资料

本研究采用倾向性评分匹配队列研究方法,选择 2015 年 11 月至 2017 年 11 月在北京大学第三医院行 MICS CABG 患者共 85 例作为实验组(MICS CABG 组)。

入选标准:(1)确诊冠心病,冠状动脉多支病变狭窄 > 70%,影响日常生活、工作,内科保守治疗无效;(2)初次单纯搭桥手术。

排除标准:(1)急诊手术者;(2)严重肺气肿患者,胸膜黏连;(3)心功能明显下降者,左心室射血分数(left ventricular ejection fraction, LVEF) < 40%,左心室舒张末期内径(left ventricular and diastolic dimension, LVDd) > 60 mm;(4)严重心律失常者,血流动力学不稳定;(5)严重肝肾功能不全者。

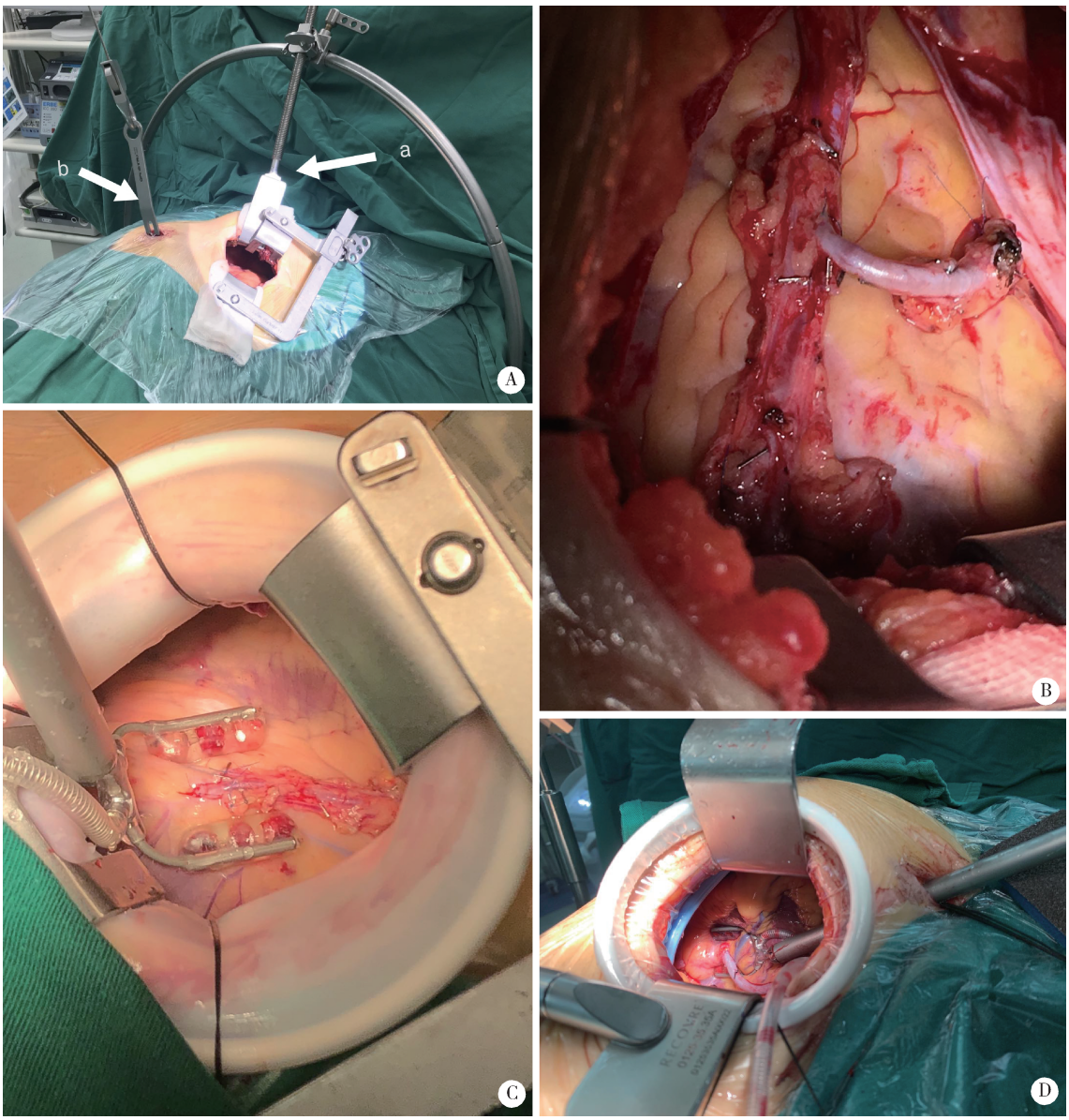
选择同一时期完成的常规正中开胸非体外循环多支搭桥手术(off-pump CABG, OPCABG)患者 451 例,应用倾向性评分匹配法,以年龄、性别、左心室射血分数、体重指数、冠脉血管病变程度、是否有心肌梗死、吸烟、糖尿病、高血压病、高脂血症、肾功能不全、脑血管意外、慢性阻塞性肺疾病为基线资料,采用最邻匹配法,按优先完全匹配方式与接受 MICS CABG 的患者以 1 ∶ 1 比例进行配对作为研究对照组(OPCABG 组)。

本研究开始前获得北京大学第三医院伦理委员会审查批准[(2018)医伦审(1701-01)],所有研究对象包括病例组患者和对照组均签署知情同意书。

1.2 方法

1.2.1 MICS CABG(图 1) 全身麻醉,双腔气管插管,仰卧位,左胸垫高 30°。右前及左后胸壁贴自动除颤电极,连接体外自动除颤仪。术前根据胸片选择心尖所在位置作为切口中点,行 6 cm 左右小切口[4],进入胸腔后,放置悬吊式乳内动脉牵开系统(图 1A)向左上牵引胸壁以暴露术野[5]。如需取右侧乳内动脉(right internal mammary artery, RIMA)时,在剑突下额外做另一 1.5 cm 切口,使用 Rultract Skyhook 牵开器系统(图 1A)从剑突下切口向上牵引胸骨下段以提供更好的视野。应用双侧乳内动脉搭桥时,先游离 RIMA:分离前纵隔,打开右侧胸膜,保留左肺单肺通气,调整 Rultract 牵引装置及体位,从乳内动脉中段无脂肪肌肉覆盖区应用电刀(30 J),上至第 1 肋下至第 5 或 6 肋乳内血管分叉处小心游离 RIMA。游离完 RIMA 后改右肺单肺通气,接着游离左乳内动脉(left internal mammary artery, LIMA)。双乳内动脉游离好后,如果桥血管长度足够,可以原位保留 RIMA 行双乳内动脉原位搭桥,如果桥血管长度不够则可在 RIMA 根部离断血管后端,侧吻合于 LIMA 中部,成“Y”形复合血管桥(图 1B)。完成 LIMA-LAD 搭桥后(图 1C),非左前

降支血管(left anterior descending artery,LAD)如果应用大隐静脉桥(saphenous vein graft,SVG)时,可通过腔镜获取下肢 SVG 后[6],应用链式主动脉侧壁钳临时钳夹升主动脉,应用腔镜执笔式针持直视下完成大隐静脉-主动脉近端吻合[7],然后将 SVG 序贯与多个靶血管依次吻合,完成多支搭桥手术(图 1D)。所有手术均在非体外循环心脏跳动下完成,血管吻合在腔镜型心脏稳定器辅助下完成。冠脉切开后,常规放置冠脉分流栓以避免冠脉缺血诱发心室颤动或严重血流动力学紊乱。



A, internal thoracic artery (IMAs) exposed, the LIMA could be well exposed by using a new type of internal mammary artery traction system (a) used to pull the chest wall forward from the upper edge of the incision with a small incision rib retractor, and the RIMA could be exposed by pulling the chest wall from the xiphoid process through the Rutract traction device (b) and cooperating with the suspension type internal mammary artery traction system; B, double internal artery (DIMAs) bypass, RIMA end to side anastomosed in the middle of LIMA forming a "LIMA-Y-RIMA" composite bridge, left anterior descending coronarg artery (LAD) and OM were anastomosised in the end of the composite bridge respectively; C, LAD anastomosis, LAD bypassed through small incision by LIMA; D, posterior descending artery (PDA) anastomosis, PDA exposured by appling of endoscopic cardiac stabilizer and bypassed with SVG.

图 1　左胸前外侧微创冠状动脉搭桥手术

Figure 1　Minimally invasive cardiac coronary artery bypass grafting surgery (MICS CABG) via left minithoracotomy

1.2.2　围手术期管理　术前常规检查:血常规、生化、凝血功能、心电图、胸片、心脏彩超等。完善锁骨下动脉血管彩超或电子计算机断层扫描血管造影检查(CTA)以了解乳内动脉情况。术前 7 d 停服波立维,继续口服阿司匹林(100 mg,每日 1 次)直到术前 1 d。术后入心脏重症监护病房(intensive care unit,ICU),术后拔除气管插管即开始口服阿司匹林(100 mg,每日 1 次)和氯吡格雷(75 mg,每日 1 次)

双联抗血小板治疗。MICS CABG 手术组出院前行冠脉造影检查,采用国际上通用的 Fitzgibbon 分级标准来评价吻合口及桥血管通畅情况。

1.2.3 观察指标 手术时间、手术中转率、术中主动脉球囊反搏(intra-aortic balloon pump,IABP)、体外膜肺氧合(extracorporeal membrane oxygenation,ECMO)植入率、术后主要心脑血管事件(major adverse cardiac and cerebral events,MACCE)发生率、任何原因的二次手术(包括出血、桥血管问题),以及术后引流量、呼吸机使用时间、重症监护病房停留时间、住院时间和术后并发症(新发房颤、肾功能不全等)情况。

1.2.4 随访 按随访计划表在术后 1 个月、6 个月和 12 个月定期随访,随访主要终点为 MACCE 事件,包括死亡、心肌梗死、血运重建、脑血管意外。

1.3 统计学分析

应用 SPSS 22.0 软件,计量资料以均数 ± 标准差表示,组间比较采用 t 检验。计数资料以率描述,组间比较采用卡方检验,理论频数过小者采用 Fisher 确切概率法,$P<0.05$ 认为差异有统计学意义。生存相关资料采用中位数及四分位间距进行描述,采用 Kaplan-Meier 生存分析曲线进行分析,应用 Log rank 法对累积发生率分布差异性进行检验。

2 结果

2.1 两组患者的基线资料比较

2.1.1 匹配前两组患者基线比较 与同期行 OPCABG 手术治疗的患者相比,MICS CABG 组男性患者较多[80.0%(68/85) *vs.* 67.4%(304/451),$P<0.05$],冠脉病变≥3 支的患者比例[61.2%(52/85) *vs.* 86.0%(388/451),$P<0.05$]较低;既往心梗[7.05%(6/85) *vs.* 15.6%(48/307)]及糖尿病[29.4%(25/85) *vs.* 41.3%(127/307),$P<0.05$]患者比例较低;两组患者间其他人口学特征情况、冠状动脉和心功能指标,以及心源性并发症、非心源性并发症等指标,差异均无统计学意义($P>0.05$)。

2.1.2 匹配后两组患者基线比较 应用倾向性评分匹配方法筛选出 85 例 OPCABG 患者(OPCABG 组,以下 OPCABG 组无特殊说明均指匹配后 OPCABG 患者),再次评估两组患者各项基数指标,差异无统计学意义($P>0.05$,表 1)。

表 1 匹配后两组患者临床特征基线资料比较

Table 1 Clinical characteristics after match

Items	MICS CABG ($n=85$)	OPCABG ($n=85$)	t/χ^2 value	P value
General characteristics				
Age/years, $\bar{x}\pm s$	63.8 ± 8.7	63.1 ± 13.2	0.408	0.684
Male, n(%)	68 (80.0)	66 (77.6)	0.141	0.707
BMI/(kg/m^2), $\bar{x}\pm s$	25.5 ± 2.7	25.1 ± 3.3	0.865	0.388
Coronary artery and cardiac function				
Coronary artery lesions≥3, n(%)	52 (61.2)	54 (63.3)	0.100	0.752
History of PCI, n(%)	29 (34.1)	21 (24.7)	1.813	0.178
LVDd/mm, $\bar{x}\pm s$	48.4 ± 8.4	47.9 ± 9.8	0.357	0.772
EF/%, $\bar{x}\pm s$	52.2 ± 5.7	53.3 ± 8.5	−0.991	0.323
Cardiac-related complications				
HBP, n(%)	50 (58.8)	52 (61.2)	0.098	0.754
History of myocardial infarction, n(%)	17 (20.0)	21 (24.7)	0.542	0.461
Congestive heart failure, n(%)	2 (2.3)	1 (1.2)	0.339	1.000
Non-cardiac-related complications				
Hypercholesterolemia, n(%)	12 (14.1)	11 (14.0)	0.050	0.823
Diabetes, n(%)	25 (29.4)	33 (38.9)	1.675	0.196
Chronic lung disease, n(%)	0 (0.0)	5 (5.9)	5.152	0.059
History of cerebrovascular disease, n(%)	5 (5.8)	3 (3.8)	0.525	0.720
Peripheral vascular disease, n(%)	1 (1.2)	2 (2.3)	0.330	1.000
Creatinine /(μmol/L), $\bar{x}\pm s$	66.7 ± 15.2	72.5 ± 22.5	−1.969	0.051

MICS CABG, minimally invasive cardiac surgery coronary artery bypass grafting; OPCABG, off-pump coronary aortic bypass grafting; BMI, body mass index; PCI, percutaneous coronary intervention; LVDd, left ventricular end diastolic dimension; EF, ejection fraction; HBP, high blood pressure.

2.2　两组患者围手术期情况比较

MICS CABG 共搭桥 200 支,平均(2.35 ±0.83)支/例,无中转正中开胸手术病例;OPCABG 组搭桥 211 支,平均(2.48 ±0.72)支/例。两组患者均无中转体外循环手术。MICS CABG 组术中输血率,术中 IABP 植入率,术后 MACCE 发生率、二次手术率以及术后新发心房纤颤率、肾功能不全率与 OPCABG 组差异无统计学意义(均 $P>0.05$)。MICS CABG 组手术时间较长,术后呼吸机使用时间、术后监护病房住院时间及住院时间均较短,两者差异有统计学意义(P 均 <0.05, 表 2)。

2.3　MICS CABG 组搭桥情况及桥血管通畅率

MICS CABG 组共吻合 200 支血管桥,其中 LIMA-前降支(LAD)84 支(42.5%), LIMA-对角支(D)1 支, RIMA-LAD 1 支, LIMA-Y-RIMA-D 25 支(13.0%), LIMA-Y-RIMA-中间支(RAMUS)4 支(2%), Ao-SVG-OM 或 LCX 58 支(29.0%); Ao-SVG-OM-PL 或 PDA 29 支(14.5%)。平均每例搭桥(2.35 ±0.83)支。出院前血管造影吻合口总体通畅率 96.5%, PL、PDA 吻合口通畅率较 LAD、D、RAMUS、OM、LCX 均较低,差异有统计学意义($P<0.05$, 表 3)。

表 2　两组患者围手术期情况比较

Table 2　Perioperative conditions in MICS CABG group and OPCABG group

Items	MICS CABG ($n=85$)	OPCABG ($n=85$)	t/χ^2 value	P value
Ventilator supporting time after operation/h, ($\bar{x}\pm s$)	16.9 ±7.8	29.6 ±15.9	−6.611	<0.001
Hospitalization in ICU/h, ($\bar{x}\pm s$)	29.3 ±20.8	51.5 ±48.3	−3.892	<0.001
Total hospitalization/d, ($\bar{x}\pm s$)	18.3 ±3.2	25.7 ±4.2	−12.921	<0.001
Blood transfusion during operation, n(%)	26 (30.5)	30 (35.2)	0.426	0.514
IABP during operation, n(%)	1 (1.17)	2 (2.35)	0.330	1.000
Impaired wound healing, n(%)	0 (0)	1 (1.17)	1.006	1.000
Re-exploration for hemorrhage, n(%)	2 (2.34)	3 (3.52)	0.206	1.000
New-onset atrial fibrillation after operation, n(%)	4 (4.70)	3 (3.52)	0.149	1.000
New-onset renal insufficiency after operation, n(%)	1 (1.17)	0 (0.00)	1.006	1.000
MACCE, n(%)	1 (1.17)	2 (2.35)	0.330	1.000
Death, n(%)	0 (0)	1 (1.17)	1.006	1.000
Perioperative myocardial infarction, n(%)	1 (1.17)	1 (1.17)	0.000	1.000
Cerebrovascular complications, n(%)	0 (0)	0 (0)	–	–
Revascularization, n(%)	0 (0)	0 (0)	–	–

MICS CABG, minimally invasive cardiac surgery coronary artery bypass grafting; OPCABG, off-pump coronary aortic bypass grafting; MACCE, major adverse cardiacand cerebrovascular events; IABP, intra-aortic balloon pump; ICU, intensive care unit.

表 3　MICS CABG 组患者冠脉造影吻合口通畅情况

Table 3　The patency of coronary angiography anastomosis in MICS CABG group

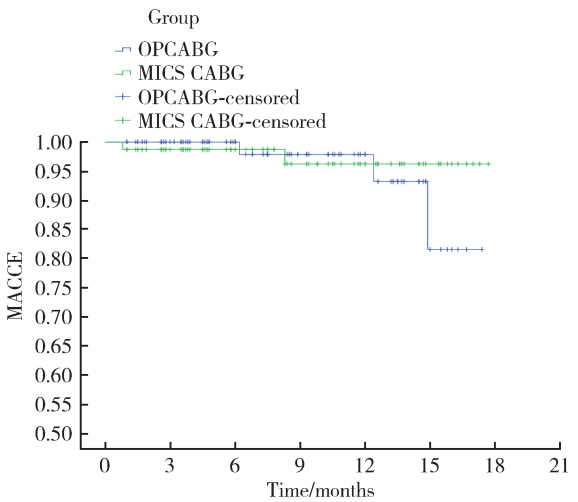
n(%)

Bypass grafts	n	O	B	A	A + B
LAD	85	1 (1.18)	2 (2.35)	82 (96.5)	84 (98.8)
D	26	1 (3.85)	0 (0.00)	25 (96.2)	25 (96.2)
RAMUS	4	0 (0.00)	0 (0.00)	4 (100.0)	4 (100.0)
OM, LCX	56	1 (1.79)	4 (7.14)	51 (91.1)	55 (98.2)
PL, PDA	29	4 (13.79)	0 (0.00)	25 (86.2)	25 (86.2)
Total	200	7 (3.50)	6 (3.0)	187 (93.5)	193 (96.5)

Fitzgibbon graft patency classification, A means the graft vessel is completely unobstructed, B means the graft vessel stenosis (graft vessel stenosis ≥ 50% or caliber <50% coronary artery), O means the graft vessel is completely occluded. LAD, left anterior descending coronary artery; D, diagonal branch; RAMUS, ramus medianus; OM, Rama marginal obtusa; LCX, left circumflex artery; PL, posterior branch of left ventricle; PDA, posterior descending artery.

2.4 MACCE 事件随访

MICS CABG 组随访患者 85 例,失访率为 4.7%(4/85),随访期间死亡 1 例(发生于术后 1 个月内,死亡原因为胸腔出血导致多脏器功能衰竭),余无术后心梗、再次靶血管血运重建及脑血管意外发生,MACCE 累积发生率为 1.18%(1/85)。OPCABG 组纳入随访患者 84 例(1 例院内死亡),失访率为 4.8%(4/84),随访期间死亡 1 例(发生于术后 12 个月,死亡原因为消化道大出血),术后心梗 1 例,脑血管意外发生率为 1 例,MACCE 累积发生率为 3.60%(3/84)。两组 MACCE 免除率分布的差异无统计学意义($P>0.05$,图 2)。



Log rank $\chi^2=0.234$, $P=0.628$. MICS CABG, minimally invasive cardiac surgery coronary artery bypass grafting; OPCABG, off-pump coronary aortic bypass grafting.

图 2 两组患者 MACCE 累积发生率 Kaplan-Meier 生存曲线图

Figure 2 Kaplan-Meier survival curve of major adverse cardiacand cerebrovascular events (MACCE) accumulation rate in two groups

3 讨论

早在 1967 年,体外循环技术仍未成熟之前,前苏联 Kolessov 医生就成功经左胸前外侧切口实施了非体外循环下将 LIMA 与 LAD 搭桥的手术,其后很多学者为这项术式的推广作出了努力,然而终未能得到普及,主要原因考虑可能有两点,一是小切口下 LIMA 获取难度较常规开胸大,需要较长时间的训练才能掌握,二是传统小切口冠脉搭桥手术一般只能处理 LAD 单支病变,手术适应证限制了其临床应用[8]。

本研究通过应用 Rultract 牵引装置及悬吊式胸壁牵开系统,成功完成左前外侧小切口多支搭桥手术,平均(2.35 ± 0.83)支/例,手术时间(282.8 ± 55.8) min,术中出血、中转体外循环、手术期并发症及术后 MACCE 等指标均不亚于对照组,术后造影近期桥血管通畅率达 96.5%,与国内外文献报道冠脉搭桥近期通畅率基本一致[9-10],取得较为良好的近期临床效果,而且 MICS CABG 在术后呼吸机使用时间、监护室停留时间、住院时间等方面均优于常规正中切口 OPCABG 组,MICS CABG 组患者恢复更快,出院更早,但由于本研究 MICS CABG 病例为北京大学第三医院开展 MICS CABG 手术初期入选的患者,考虑到手术安全性,入选的病例血管病变及身体条件均较好,可能有一定选择偏倚,尽管采取了倾向性评分匹配的方法来对两组患者基线进行了匹配调整。

MICS CABG 手术由于切口小、操作空间狭窄、视野差,对术者具有一定的挑战性。如何有效进行心前区空间的暴露是成功实施 MICS CABG 手术的关键。本课题组的经验是,首先合理的选择手术切口位置,切口位置直接关系到术中血管的暴露,在左胸前外侧第 5 肋间心尖所在位置为切口中点进胸,可兼顾心脏前面、侧面及膈面的操作。为避免牵开器引起的肋骨骨折或胸肋关节脱位,应尽可能向切口外侧面切断肋间肌肉,减少牵拉力量,并且给与充分肌松及镇痛以利于减少肌肉对抗;其次,从剑突下置入一个紧贴胸骨背面的牵引拉钩(Rultract 牵引装置),可以进一步向上牵引胸壁,获得更大的视野及操作空间;另外,通过利用腔镜型心肌稳定器(NUVO stabilizer)将右肺往右下牵拉,同样可以获得更多的视野及操作空间[4,11]。

对于桥血管数量及长度的限制的问题,一方面可以通过获取双侧乳内动脉原位搭桥,另一方面也可以将 RIMA 离断后与 LIMA 中远段端侧吻合形成 Y 形桥,LIMA 远端完成前降支或对角支的血管吻合,LIMA-RIMA Y 型桥途中可以与钝缘支及左心室后支序贯吻合,从而实现冠脉完全再血管化[12-13]。也有学者通过额外获取桡动脉,将 RA-LIMA 端端吻合增加桥血管长度完成全血管化[14],或者通过小切口完成双侧乳内动脉-心前、侧壁血管搭桥后再经剑突下横切口打开腹膜进腹,获取胃网膜右动脉行心膈面血管搭桥[15],然而这都额外增加手术切口。本研究除了成功应用双侧乳内动脉多支搭桥外,还成功应用 SVG 静脉桥完成多支冠脉血管的再血管化,直至 2017 年 12 月本课题组已经完成小切口 SVG 多支搭桥 50 例,无术中主动脉大出血被迫转常规手术情况,取得了一定成效。由于左侧胸壁小切口离升主动脉距离较远,升主动脉的暴露是 MICS CABG 静脉桥吻合的关键点和难点。本研究的经验是:(1)通过心血管活性药物管理及容量管理,减少右

心室充盈;(2)调整体位及增加右肺呼气末正压和潮气量,以易于心脏的左抬;(3)多级心包悬吊;(4)在上腔静脉与升主动脉右后方之间填塞纱布,使主动脉向左前位移;(5)在右心室流出道左后方放置心肌稳定器将右心室流出道向左后下方牵开,通过专用侧壁阻断钳部分阻断升主动脉,可完成桥血管近端吻合。

本研究由于病例数仍较少,随诊时间也较短,术后中远期冠脉造影或者 CTA 资料欠缺,MICS CABG 手术临床价值尚仍有待更大规模、多中心以及长期的随访研究来进一步评估。

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