

二尖瓣成形术治疗感染性心内膜炎合并 二尖瓣关闭不全的中长期疗效

钟玉斌¹ 夏利民^{2,3} 钱松屹¹ 徐德民^{2,3} 宋凯^{2,3,△}

(¹复旦大学附属中山医院厦门医院心脏外科 厦门 361015; ²复旦大学附属中山医院心外科 上海 200032;

³上海市心血管病研究所 上海 200032)

【摘要】 目的 探讨二尖瓣成形术(mitral valvuloplasty, MVP)治疗感染性心内膜炎(infective endocarditis, IE)合并二尖瓣关闭不全(mitral regurgitation, MR)的中长期疗效。**方法** 2009年6月至2016年11月,选取复旦大学附属中山医院心外科55例MVP治疗IE合并MR的患者作为观察组,47例二尖瓣置换术(mitral valve replacement, MVR)治疗IE合并MR的患者作为对照组,两组IE患者均单纯累及二尖瓣。回顾分析两组患者围术期资料并比较中长期疗效。**结果** 观察组与对照组比较,术前性别、年龄、心功能等临床资料差异无统计学意义。观察组术后总住院时间短于对照组[(7.24±2.32)天 vs. (9.93±2.63)天, $P=0.003$],体外循环时间、主动脉阻断时间、术后辅助通气时间、术后ICU住院时间、围术期输红细胞量、术后24 h引流量差异无统计学意义。对照组围术期死亡1例,观察组0例,两组患者围术期并发症发生率、死亡率差异无统计学意义。随访11~119个月,平均(43±27)个月,总随访率91%。随访期间观察组2例患者因MVP后二尖瓣狭窄伴关闭不全行MVR,对照组再次二尖瓣手术0例。两组再次二尖瓣手术发生率分别为4.0%和0,差异无统计学意义($P=0.543$)。随访期间,观察组华法林抗凝并发症0例,对照组3例,发生率分别为0和7.0%,差异无统计学意义($P=0.059$),两组患者均无复发、无死亡。多因素回归分析发现二尖瓣瓣膜损害、术者经验影响手术方式。**结论** MVP治疗IE合并MR围术期未显著影响手术安全性,中长期疗效明显,对于二尖瓣结构未严重破坏且术者具有较丰富的二尖瓣成形经验,推荐MVP。

【关键词】 感染性心内膜炎(IE); 二尖瓣成形术(MVP); 二尖瓣关闭不全(MR); 中长期疗效

【中图分类号】 R654.2 **【文献标志码】** A **doi:** 10.3969/j.issn.1672-8467.2023.04.008

Mid-long term outcomes of mitral valve reconstruction for infective endocarditis with mitral insufficiency

ZHONG Yu-bin¹, XIA Li-min^{2,3}, QIAN Song-yi¹, XU De-min^{2,3}, SONG Kai^{2,3,△}

(¹Department of Cardiovascular Surgery, Zhongshan Hospital, Fudan University (Xiamen Branch), Xiamen 361015, Fujian Province, China; ²Department of Cardiac Surgery, Zhongshan Hospital, Fudan University, Shanghai 200032, China; ³Shanghai Cardiovascular Disease Institute, Shanghai 200032, China)

【Abstract】 Objective To investigate the mid-long term efficacy of mitral valvuloplasty (MVP) in the treatment of infective endocarditis (IE) with mitral regurgitation (MR). **Methods** From Jun 2009 to Nov 2016, 55 patients with IE combined with mitral MR were treated by MVP in the Department of Cardiology, Zhongshan Hospital, Fudan University, which were selected as observation group, 47 patients with IE complicated with MR were treated by mitral valve replacement (MVR), which were used as the control group. Both groups of IE patients simply involved mitral valve. The perioperative data of the two

厦门市科技计划指导性项目(3502Z20199031)

[△]Corresponding author E-mail: song.kai@zs-hospital.sh.cn

网络首发时间:2023-05-18 15:06:29 网络首发地址: <https://link.cnki.net/urlid/31.1885.R.20230517.1552.007>

groups were retrospectively analyzed and the mid-long term curative effects were compared. **Results** There was no significant difference in clinical data such as gender, age and cardiac function between the observation group and the control group. The total hospital stay of the observation group was (7.24 ± 2.32) days, which was shorter than that of the control group (9.93 ± 2.63) days ($P=0.003$). There was no significant differences in CPB time, aorta blocking time, postoperative auxiliary ventilation time, postoperative ICU stay time, perioperative red blood cell volume and postoperative drainage 24 h. One case died in the control group, and no cases died in the observation group. There was no significant difference in the incidence of perioperative complications and mortality between the two groups. The patients were followed up for 11-119 months, with an average of (43 ± 27) months, and the total follow-up rate was 91%. During the follow-up period, 2 patients in the observation group underwent MVR due to mitral stenosis and insufficiency after MVP, and 0 patients in the control group underwent mitral valve operation again. The incidence of mitral valve re-operation in the two groups were 4.0% and 0 respectively, there was no significant difference between the two groups ($P=0.543$). During the follow-up period, there was 0 patients in the observation group and 3 patients in the control group with warfarin anticoagulation complications in the two groups. The incidence rates were 0 and 7.0%, respectively, with no significant difference ($P=0.059$). In addition, there was no recurrence and death in the two groups. Multivariate regression analysis showed that mitral valve damage and operator experience affected the mode of operation. **Conclusion** In the perioperative period, MVP for IE complicated with MR does not significantly affect the safety of the operation. It has obvious curative effect in the medium and long term. MVP is recommended if mitral valve structure has no serious damage and the operator has rich mitral valvuloplasty technology.

【Key words】 infective endocarditis (IE); mitral valvuloplasty (MVP); mitral regurgitation (MR); mid-long term outcomes

* This work was supported by the Science and Technology Plan Guidance Project of Xiamen (3502Z20199031).

感染性心内膜炎(infective endocarditis, IE)引起的二尖瓣关闭不全(mitral regurgitation, MR)复杂多变,使二尖瓣成形术(mitral valvuloplasty, MVP)治疗IE合并MR相对困难,其疗效值得关注^[1]。Feringa等^[2]在一项Meta分析中表明IE合并MR行MVP仅占40%左右,可能的原因一方面为IE患者术前病情较重,围术期并发症发生率及死亡率相对较高,术后感染易复发,另一方面为急性IE导致瓣膜损害相对严重,增加成形困难,使很多心外科医师更倾向于二尖瓣置换(mitral valve replacement, MVR)^[3]。但国外多中心研究表明MVP治疗IE合并MR围术期及术后疗效优于MVR^[4-9]。

鉴于MVP治疗IE合并MR的临床疗效不确定,本文回顾性分析复旦大学附属中山医院行MVP治疗IE合并MR的围术期及中长期临床疗效,同时选择本单位MVR治疗IE合并MR作为对比。现将研究结果报道如下。

资 料 和 方 法

研究对象 选择2009年6月至2016年11月于复旦大学附属中山医院心外科行MVP治疗IE仅累及二尖瓣导致MR的患者55例作为观察组,其中男性38例,女性17例,年龄8~71(42 ± 13)岁。术前病程中发热53例,无发热2例。术前合并症22例(其中高血压6例、糖尿病5例、脑梗塞5例、高血压合并糖尿病6例),无合并症33例。术前心功能(NYHA分级)Ⅰ~Ⅱ级33例,Ⅲ级20例,Ⅳ级2例。选取本单位MVR治疗IE合并MR的患者47例作为对照组,其中男性33例,女性14例,年龄14~76(43 ± 11)岁;术前病程中发热46例,无发热1例。术前合并症15例(其中高血压5例、糖尿病3例、脑梗塞5例、高血压合并糖尿病2例),无合并症32例。术前心功能NYHA分级Ⅰ~Ⅱ级28例,Ⅲ级18例,Ⅳ级1

例。两组年龄、性别、术前病程发热、术前合并症、术前心功能比较,差异无统计学意义,具有可比性。本研究是回顾性研究,患者权益不被侵犯,通过电话沟通获得患者或家属知情同意,因此豁免伦理批准。

手术方法 麻醉成功后,术前常规行经食管超声心动图检查。MVP治疗IE合并MR的具体步骤:常规消毒铺巾,经胸骨正中切口或右胸前外侧小切口入路,充分显露二尖瓣,观察瓣膜赘生物、穿孔及瓣膜脱垂的严重程度,结合食管超声心动图及术中探查结果评估二尖瓣成形的可行性及成形策略。切除瓣体及瓣缘赘生物后行MVP,包括前叶三角形切除、后叶楔形或矩形切除、缘对缘缝合、内交界缝闭、脱垂瓣膜折叠缝合、穿孔直接缝合或赘生物瓣膜部分切除后自体心包修补、植入人工腱索、成形环缩二尖瓣后瓣环等。所有行MVP患者术中经左心室注水试验或术中食管超声心动图评估成形效果。手术原则是彻底切除赘生物及感染组织、恢复二尖瓣阀门功能。对照组具体步骤:经胸骨正中切口或右胸前外侧小切口入路,充分显露二尖瓣,切除二尖瓣前后叶,保留部分无感染的后瓣叶和瓣下结构,测瓣环,根据瓣环大小植入合适的人工二尖瓣生物瓣或机械瓣,术后经食管超声心动图评估人工二尖瓣功能。两组均在中低温体外循环下,经主动脉根部顺行灌注De-Nido停跳液使心脏停跳及保护心肌。

术后处理 所有患者出院前复查经胸心超确认MVP术后无明显反流(轻度及以下反流可接受)、人工瓣膜功能良好、无赘生物残余、排除心包积液,心脏收缩功能尚可则予以出院。术后给予华法林抗凝治疗(国际正常化比值,INR维持在2.0~3.0),MVP术后常规抗凝3个月,生物瓣置换术后抗凝6个月,机械瓣终身抗凝。

观察指标及评估标准 比较两组患者体外循环时间、主动脉阻断时间、术后辅助通气时间、ICU住院时间、术后24 h引流量、输血量、总住院时间、围术期并发症发生率、死亡率等,比较两组患者感染复发率、华法林抗凝并发症、二尖瓣再次手术(与本次二尖瓣手术相关、引起需再次二尖瓣手术)发生率、总生存率等。两组患者术后随访资料经电话方式获得。

统计学分析 采用SPSS 21.0统计学软件进行

统计分析。计量资料用 $\bar{x} \pm s$ 表示,采用 t 检验或Mann-Whitney U检验;计数资料用 $n(\%)$ 表示,采用 χ^2 检验或Fisher精确概率法检验。Kaplan-Meier法完成免再次手术生存分析并作生存曲线,以Log-Rank检验比较组间差异。MVP的手术危险因素采用Logistic回归分析。 $P < 0.05$ 为差异有统计学意义。

结 果

一般资料比较 术前两组性别、年龄、发热、合并症、心功能比较,差异无统计学意义(表1)。

手术结果比较 观察组共55例,其中赘生物直接切除17例,后叶楔形切除18例,脱垂瓣膜折叠缝合7例,植入人工腱索3例,后叶矩形切除2例,内交界缝闭2例,赘生物瓣膜部分切除自体心包修补2例,瓣叶穿孔直接缝合2例,前叶三角形切除1例,部分前后叶缘对缘缝合1例。所有患者均植入“C”型人工瓣环:Sovering或Edwards或Medtronic 28号10例,30号19例,32号22例,34号4例。对照组47例,二尖瓣切除后植入生物瓣膜3例,机械瓣44例。

观察组正中切口37例,右侧小切口18例;对照组正中切口37例,右侧小切口10例,两组比较差异无统计学意义。观察组二尖瓣伴赘生物41例(赘生物 < 10 mm 30例、 > 10 mm 11例),不伴赘生物14例,伴腱索断裂32例,无腱索断裂23例。对照组伴赘生物46例(赘生物 < 10 mm 29例、 > 10 mm 17例),不伴赘生物1例,伴腱索断裂16例,无腱索断裂31例。两组赘生物($P=0.002$)、赘生物大小($P=0.001$)、腱索断裂($P=0.015$)比较差异有统计学意义。观察组前叶穿孔7例,后叶穿孔3例,前后叶穿孔0例,无瓣叶穿孔45例;对照组前叶穿孔5例,后叶穿孔7例,前后叶穿孔3例,无瓣叶穿孔32例;两组比较差异无统计学意义。观察组二尖瓣反流:中度9例、中重度20例、重度26例;对照组二尖瓣反流:中度9例、中重度9例、重度29例;两组比较差异无统计学意义。详见表1。

围术期情况比较 由表2可知,观察组在体外循环时间、主动脉阻断时间、术后辅助通气时间、ICU住院时间与对照组比较,差异无统计学意义;观察组术后总住院时间短于对照组,差异有统计学意义 $[(7.24 \pm 2.32)$ 天 vs. (9.93 ± 2.63) 天, $P=0.003$]。

表1 两组一般资料及手术结果比较

Tab 1 Comparison of general data and surgical results between the two groups

[$\bar{x} \pm s$ or $n(\%)$]

Parameters	Observation group ($n=55$)	Control group ($n=47$)	t/χ^2	P
Age (y)	42.42 \pm 12.92	42.68 \pm 11.24	0.081	0.936
Male	38 (69.1)	33 (70.2)	0.015	0.902
Preoperative fever	53 (96.4)	46 (97.9)	0.202	0.653
Preoperative complications	22 (40.0)	15 (31.9)	0.717	0.397
Preoperative cardiac function			0.222	0.893
I – II	33 (60.0)	28 (59.6)		
III	20 (36.4)	18 (38.3)		
IV	2 (3.6)	1 (2.1)		
Perforation of valve			7.717	0.052
Anterior leaflet	7 (12.7)	5 (10.6)		
Posterior leaflet	3 (5.5)	7 (14.9)		
Both leaflet	0 (0)	3 (6.4)		
Neoplasm	41 (74.5)	46 (97.9)	9.213	0.002
Neoplasm size (mm)			14.131	0.001
≤ 10	30 (73.2)	29 (63.0)		
> 10	11 (26.8)	17 (27.0)		
Mitral regurgitation			3.732	0.155
Moderate	9 (16.4)	9 (19.1)		
Moderate-severe	20 (36.4)	9 (19.1)		
Severe	26 (47.2)	29 (61.8)		
Rupture of chordae tendineae	32 (58.2)	16 (34.0)	5.928	0.015
Operative incision			3.393	0.183
Mid-sternal incision	37 (67.3)	37 (78.7)		
Right minimally incision	18 (32.7)	10 (21.3)		
Postoperative complications	5 (9.1)	5 (10.6)	0.068	0.794
Perioperative death	0 (0)	1 (2.1)	0.006	0.937
Complications of warfarin	0 (0)	3 (7.0) ⁽¹⁾	1.888	0.059
Reoperation	2 (4.0)	0 (0) ⁽¹⁾	0.371	0.543
Recurrence of infection	0 (0)	0 (0) ⁽¹⁾	0	1.000
Follow-up survival	50 (100)	43 (100) ⁽¹⁾	0	1.000

⁽¹⁾Warfarin anticoagulation complications, reoperation, infection recurrence, and follow-up survival belong to the follow-up data. The observation group and the control group were successfully followed-up in 50 and 43 cases, respectively.

由表1可知,两组患者术后并发症发生率分别为9.1%、10.6%;观察组围术期死亡0例,对照组围术期死亡1例(2.1%),死于脑出血、脑疝。两组患者围术期并发症发生率、死亡率比较,差异无统计学意义。

表2 两组围术期情况比较

Tab 2 Comparison of perioperative conditions between the two groups

($\bar{x} \pm s$)

Groups	n	CPB (min)	ACC (min)	PAV (h)	ICU stay time (d)	TPHS (d)
Observation	55	82.3 \pm 23.19	46.24 \pm 11.94	11.98 \pm 2.45	1.26 \pm 0.32	7.24 \pm 2.32
Control	47	77.4 \pm 18.99	45.30 \pm 10.89	14.45 \pm 3.69	1.40 \pm 0.45	9.93 \pm 2.63
t		0.995	0.299	1.057	0.766	3.073
P		0.322	0.766	0.293	0.446	0.003

CPB: Cardiopulmonary bypass; ACC: Aortic cross clamping; PAV: Postoperative assisted ventilation; TPHS: Total postoperative hospital stay.

随访结果比较 随访11~119个月,平均(43±27)个月,观察组、对照组患者失访分别为5例、4例,总随访率91%。随访期间,观察组2例患者因MVP后出现二尖瓣狭窄伴关闭不全,分别于术后12、62个月行MVR,对照组再次二尖瓣手术0例。两组再次二尖瓣手术发生率分别为4.0%和0,差异无统计学意义($P=0.053$)。两组患者术后常规华法林抗凝,观察组未发生华法林抗凝并发症,对照组3例(其中2例广泛皮下出血,1例颅内出血,均未危及生命),其发生率分别为0和7.0%,差异无统计学意义($P=0.059$)。两组患者无感染复发、无死亡,差异无统计学意义($P=1.000$,图1、表1)。

影响二尖瓣成形的多因素分析 影响IE合并MR患者行MVP与MVR手术的选择与后叶穿孔、

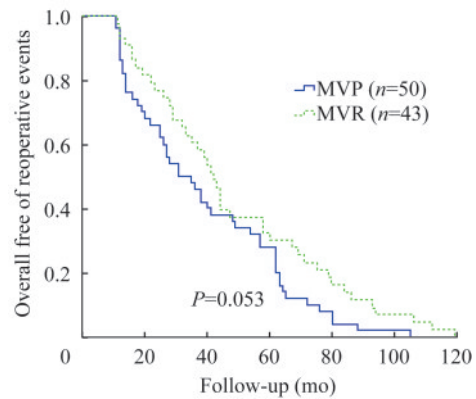


图1 两组免再次手术Kaplan-Meier生存曲线比较
Fig 1 Comparison of Kaplan-Meier survival curve between the two groups without reoperation

赘生物大小、反流程度和术者的经验相关(表3)。

表3 影响MVP与MVR手术方式的多因素Logistic回归分析结果

Tab 3 Results of multivariate Logistic regression analysis on the influences of MVP and MVR surgical methods

Factors	β	SE	Exp(B)	P	Wald	95%CI
PPL	-1.933	0.956	0.145	0.043	4.087	0.022-10.733
MSR	1.578	0.732	4.844	0.031	4.647	1.154-20.335
Neoplasm (<10 mm)	3.128	1.454	22.826	0.031	4.628	1.321-394.459
Surgeon A	3.331	1.412	27.956	0.018	5.567	1.757-444.711

PPL: Perforation of posterior leaflet; MSR: Moderate to severe regurgitation.

讨 论

MVP被认为是治疗退行性二尖瓣关闭的首选治疗方式,其效果优于MVR^[10-11],退行性MR患者行二尖瓣成形的比例达90%^[12]。生物瓣膜置换后瓣膜钙化、增厚、粘连等影响瓣膜的寿命,机械瓣置换术后需终身抗凝,长期服用华法林等抗凝药可引起栓塞或出血等风险,降低患者生活质量;而二尖瓣成形保留自身瓣膜,对左心室功能影响较小,术后无需长期抗凝。随着二尖瓣成形技术的提高,部分复杂的二尖瓣病变引起的MR也能通过MVP获得满意效果。对于IE患者,由于二尖瓣瓣叶、瓣环、瓣下结构的广泛毁损,以及急性期行MVP存在感染复发的可能,MVP的疗效及耐久性值得关注^[13-14]。

Dreyfus等^[15]于1990年首次报道将瓣膜成形术运用于40例急性IE患者(其中单纯累及二尖瓣28例,二尖瓣伴主动脉瓣7例,主动脉瓣3例,三尖瓣2例),围术期死亡1例,平均随访30个月,再次手术1

例,无复发,远期死亡1例。随后,多中心报道MVP治疗IE合并MR的可行性及有效性,并获得较好的中长期效果^[4-9]。本组研究55例MVP和47例MVR治疗IE合并MR,术前两组性别、年龄、发热、合并症、心功能具有可比性;两组围术期体外循环时间、主动脉阻断时间、术后辅助通气时间、ICU住院时间比较,差异无统计学意义;观察组术后总住院时间短于对照组,差异有统计学意义($P=0.003$),表明MVP治疗IE合并MR术后恢复比MVR快。两组患者术后并发症发生率分别为9.1%、10.6%;观察组围术期死亡0例,对照组1例(2.1%),死于脑出血、脑疝。两组患者围术期并发症发生率、死亡率比较,差异无统计学意义。随访11~119个月,观察组2例患者因MVP后出现二尖瓣狭窄伴关闭不全分别于术后12、62个月行MVR,对照组再次二尖瓣手术0例。两组再次二尖瓣手术发生率分别为4.0%和0,差异无统计学意义,两组感染复发率、死亡率均为0。表明MVP治疗IE合并MR围术期未显著影响手术安全性,中长期疗效满意。

治疗IE手术时机至关重要,手术治疗IE的目

的是预防严重并发症如顽固性心力衰竭、不可控制的感染、栓塞等^[16]。在IE早期,瓣膜炎症水肿,成形难度大,但仍有部分学者认为尽早手术干预是必要的^[17-18]。炎症可导致瓣膜进一步毁损,增加成形困难,且面临感染复发及赘生物脱落的风险。Solari等^[3]指出:针对瓣膜损害导致的无法控制的心力衰竭,赘生物>1 cm,且不稳定容易脱落或反复出现栓塞,敏感抗生素治疗无效的菌血症等,建议早期手术,无上述风险的建议完成抗感染后择期手术。本研究两组患者术前虽然均出现5例脑栓塞,但是经过神经科医师评估,无危及生命体征表现,继续完成4周抗感染治疗后行二尖瓣手术,术后脑梗症状也未加重。本组患者均完成4周有效抗感染治疗,术前复查血培养阴性后择期手术,术后继续抗感染治疗2~4周。

二尖瓣成形技术方面,充分显露二尖瓣,探查二尖瓣病变的分区及损坏的严重程度,结合食道超声结果,评估二尖瓣成形术的可行性及成形方法。首先彻底清除赘生物,然后基于Carpentier成形的原则及方法完成二尖瓣修复。具体步骤如下:小穿孔(<5 mm)直接5-0 Prolene连续缝闭,较大穿孔或部分缺损瓣膜用自体心包修补或牛心包修补。对于前叶病变(赘生物、穿孔、脱垂)可行三角形切除或植入人工腱索;对于后叶病变(赘生物、穿孔、脱垂)可行楔形切除。脱垂瓣膜折叠缝合,前后部分瓣叶缘对缘缝合。瓣环扩大或中重度反流植入合适大小二尖瓣成形环。瓣膜广泛毁损或经积极成形后仍有大量反流,切除病变二尖瓣,植入人工二尖瓣。

影响IE合并MR手术方式选择的原因多样,本研究多因素Logistic回归分析显示,后叶穿孔、赘生物(<10 mm)、中重度反流是MVP的危险因素。因此,我们认为后叶的穿孔容易修补可能与后叶的瓣膜面积较大、穿孔后可直接缝闭或心包补片修补后不影响二尖瓣后叶的功能有关;赘生物小则二尖瓣损毁一般较轻,并且容易完整清除,这表明赘生物小的IE患者适合二尖瓣成形。中重度二尖瓣反流相对于重度二尖瓣反流,可能病程相对较短,对二尖瓣的损害相对较轻,容易修复。IE合并MR比退行性病变的MR行MVP手术更复杂,需要主刀医师在MVP技术上有较高水平及丰富的临床经验。Iung等^[13]报道了一组10年间78例IE行MVP的患者,81%行MVP,而其余行MVR的患者一半以上

由于二尖瓣病变较严重和术者缺乏经验。虽然本组二尖瓣成形率仅53.9%(55/102),但是临床经验丰富的术者二尖瓣手术44例,其中成形36例,二尖瓣成形率81.8%($P=0.018$),远高于平均水平,表明二尖瓣成形成功与否与术者临床经验密切相关。

综上所述,MVP治疗IE合并MR围术期末未显著影响手术安全性,中长期疗效明显。患者二尖瓣结构未严重破坏,且术者具有较丰富的二尖瓣成形经验,推荐MVP。

作者贡献声明 钟玉斌 文献调研和整理,研究构思和设计,数据整理和分析,论文撰写。夏利民 研究构思和设计。钱松屹,徐德民 论文修订。宋凯 研究构思,论文修订。

利益冲突声明 所有作者均声明不存在利益冲突。

参 考 文 献

- [1] DEFAUW RJ, TOMSIC A, VAN BRAKEL TJ, *et al.* A structured approach to native mitral valve infective endocarditis: is repair better than replacement? [J]. *Eur J Cardiothorac Surg*, 2020, 58(3): 544-550.
- [2] FERINGA HH, SHAW LJ, POLDERMANS D, *et al.* Mitral valve repair and replacement in endocarditis: a systematic review of literature [J]. *Ann Thorac Surg*, 2007, 83(2): 564-571.
- [3] SOLARI S, NAVARRA E, DE KERCHOVE L, *et al.* Mitral valve repair for endocarditis [J]. *Card Surg*, 2022, 37(12): 4097-4102.
- [4] OLIVER L, LEAUTHIER M, JAMME M, *et al.* Mitral valve repair is better than mitral valve replacement in native mitral valve endocarditis: results from a prospective matched cohort [J]. *Arch Cardiovasc Dis*, 2022, 115(3): 160-168.
- [5] TOYODA N, ITAGAKI S, EGOROVA NN, *et al.* Real-world outcomes of surgery for native mitral valve endocarditis [J]. *Thorac Cardiovasc Surg*, 2017, 154(6): 1906-1912.
- [6] LEE HA, CHENG YT, WU VC, *et al.* Nationwide cohort study of mitral valve repair versus replacement for infective endocarditis [J]. *Thorac Cardiovasc Surg*, 2018, 156(4): 1-11.
- [7] LIU JZ, LI XF, MIAO Q, *et al.* Surgical treatment of active native mitral infective endocarditis: a meta-analysis of current evidence [J]. *Chin Med Assoc*, 2018, 81(2): 147-154.

- 肿瘤患者生存报告[J]. 中国癌症杂志, 2020, 30(1): 11-24.
- [12] MAKARY MA, SEGEV DL, PRONOVOST PJ, *et al.* Frailty as a predictor of surgical outcomes in older patients [J]. *J Am Coll Surg*, 2010, 210 (6): 901-908.
- [13] CHEN S, MA T, CUI W, *et al.* Frailty and long-term survival of patients with colorectal cancer: a meta-analysis [J]. *Aging Clin Exp Res*, 2022, 34(7): 1485-1494.
- [14] 王强, 钟秉政, 曹杰. 改良衰弱指数在预测老年腹腔镜结直肠癌手术患者术后并发症中的应用[J]. 实用医学杂志, 2019, 35(12): 1975-1978.
- [15] DEVEREUX N, ELLIS G, DOBIE L, *et al.* Testing a proactive approach to frailty identification: the electronic frailty index [J]. *BMJ Open Qual*, 2019, 8(3): e000682.
- [16] AMBAGTSHEER RC, BEILBY J, DABRAVOLSKAJ J, *et al.* Application of an electronic Frailty Index in Australian primary care: data quality and feasibility assessment [J]. *Aging Clin Exp Res*, 2019, 31(5): 653-660.
- [17] LANSBURY LN, ROBERTS HC, CLIFT E, *et al.* Use of the electronic Frailty Index to identify vulnerable patients: a pilot study in primary care [J]. *Br J Gen Pract*, 2017, 67 (664): e751-e756.
- [18] HOLLINGHURST J, FRY R, AKBARI A, *et al.* External validation of the electronic frailty index using the population of wales within the secure anonymised information linkage databank [J]. *Age Ageing*, 2019, 48 (6): 922-926.
- [19] ABBASI M, KHERA S, DABRAVOLSKAJ J, *et al.* A cross-sectional study examining convergent validity of a frailty index based on electronic medical records in a Canadian primary care program [J]. *BMC Geriatr*, 2019, 19 (1): 109.
- [20] BRUNDLE C, HEAVEN A, BROWN L, *et al.* Convergent validity of the electronic frailty index [J]. *Age Ageing*, 2019, 48(1): 152-156.
- [21] MAHANNA-GABRIELLI E, ZHANG K, SIEBER FE, *et al.* Frailty is associated with postoperative delirium but not with postoperative cognitive decline in older noncardiac surgery patients [J]. *Anesth Analg*, 2020, 130 (6): 1516-1523.
- [22] CHAO YS, WU HC, WU CJ, *et al.* Index or illusion: The case of frailty indices in the health and retirement study [J]. *PLoS One*, 2018, 13(7): e0197859.

(收稿日期: 2022-08-27; 编辑: 王蔚)

(上接第 539 页)

- [8] PERROTTA S, FROJD V, LEPORE V, *et al.* Surgical treatment for isolated mitral valve endocarditis: a 16-year single-centre experience [J]. *Eur J Cardiothorac Surg*, 2018, 53(3): 576-581.
- [9] TEPSUWAN T, RIMSUKCHAROENCHAI C, TANTRAWORASIN A, *et al.* Comparison between mitral valve repair and replacement in active infective endocarditis [J]. *Gen Thorac Cardiovasc Surg*, 2019, 67 (12): 1030-1037.
- [10] LAZAM S, VANOVERSCHDELDE JL, TRIBOUILLOY C, *et al.* Twenty-year outcome after mitral repair versus replacement for severe degenerative mitral regurgitation: analysis of a large, prospective, multicenter, international registry [J]. *Circulation*, 2017, 135(5): 410-422.
- [11] HENDRIX RJ, BELLO RA, FLAHIVE JM, *et al.* Mitral valve repair versus replacement in elderly with degenerative disease: analysis of the STS adult cardiac surgery database [J]. *Ann Thorac Surg*, 2019, 107(3): 747-753.
- [12] COUTINHO GF, ANTUNES MJ. Current status of the treatment of degenerative mitral valve regurgitation [J]. *Rev Port Cardiol (Engl Ed)*, 2021, 40(4): 293-304.
- [13] IUNG B, ROUSSEAU PJ, CORMIER B, *et al.* Contemporary results of mitral valve repair for infective endocarditis [J]. *J Am Coll Cardiol*, 2004, 43(3): 386-392.
- [14] EL GM, HAIDARI Z, MOURAD F, *et al.* Outcomes of mitral valve repair in acute native mitral valve infective endocarditis [J]. *Interact Cardiovasc Thorac Surg*, 2019, 29 (6): 823-829.
- [15] DREYFUS G, SERRAF A, JEBARA VA, *et al.* Valve repair in acute endocarditis [J]. *Ann Thorac Surg*, 1990, 49 (5): 706-711.
- [16] NABER CK, ERBEL R, BADDOUR LM, *et al.* New guidelines for infective endocarditis: a call for collaborative research [J]. *Int J Antimicrob Agents*, 2007, 29(6): 615-616.
- [17] HABIB G, LANCELOTTO P, ANTUNES MJ, *et al.* 2015 ESC Guidelines for the management of infective endocarditis: the Task Force for the Management of Infective Endocarditis of the European Society of Cardiology (ESC). Endorsed by: European Association for Cardio-Thoracic Surgery (EACTS), the European Association of Nuclear Medicine (EANM) [J]. *Eur Heart J*, 2015, 36(44): 3075-3128.
- [18] PETERSSON GB, HUSSAIN ST. current AATS guidelines on surgical treatment of infective endocarditis [J]. *Ann Cardiothorac Surg*, 2019, 8(6): 630-644.

(收稿日期: 2022-05-19; 编辑: 王蔚)