

• 专家共识 •

心脏外科围手术期脑保护中国专家共识(2019)

中国研究型医院学会神经再生与修复专业委员会心脏重症脑保护学组

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【摘要】 心脏术后脑部神经系统并发症是影响患者预后、康复的主要因素之一。认识、了解、预防和改善脑神经系统并发症具有重要的临床意义。为了减少心脏术后脑损伤,减少脑神经系统并发症,促进患者康复,中国研究型医院学会神经再生与修复专业委员会心脏重症脑保护学组组织国内心脏外科、重症监护、体外循环、麻醉、急诊等医学专家,从脑损伤的分型、危险因素、处理对策、术中脑神经功能的监测、重症加强治疗病房(ICU)脑保护常规、药物治疗等方面,制定了《心脏外科围手术期脑保护中国专家共识(2019)》,以期指导临床工作。

【关键词】 心脏外科; 脑保护; 围手术期

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Chinese consensus guideline for cerebral protection in the perioperative period of cardiac surgery (2019)

Cerebral Protection in Cardiac Intensive Care Group, Neural Regeneration and Repair Committee, Chinese Research Hospital Association

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【Abstract】 Cerebral complication in the postoperative period of cardiac surgery is one of the most important elements for the prognosis and rehabilitation. It is significant for the clinicians to recognize, comprehend, prevent and ameliorate the complications of cerebral nervous system. For the purpose of down-regulating brain injury and cerebral complications after cardiac surgery, promoting nosocomial rehabilitation, Cerebral Protection in Cardiac Intensive Care Group, Neural Regeneration and Repair Committee, Chinese Research Hospital Association organizes Chinese medical experts who specialize in cardiac surgery, critical care medicine, extracorporeal circulation, anesthesiology and emergency medicine cooperatively draft *Chinese consensus guideline for cerebral protection in the perioperative period of cardiac surgery (2019)*. Its content includes brain injury classifying risk factors recognizing, treatment protocols formulating, intra-operative cerebral function monitoring, brain protection in intensive care unit (ICU) and drug administration in order to guide the clinical practice.

【Key words】 Cardiac surgery; Cerebral protection; Perioperative period

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脑损伤是除心功能不全以外导致心脏外科手术患者预后不良的最主要因素之一。研究显示,心脏外科围手术期脑卒中发生率明显高于其他类型手术,非心脏、非神经、非大血管手术脑卒中发生率均低于1%,而复杂重症瓣膜置换术后脑卒中发生率为9.7%,单纯二尖瓣手术者为8.8%,瓣膜合并冠状动脉旁路移植术(CABG)者为7.4%,单纯主动脉瓣手术者为4.8%,单纯CABG者为3.8%^[1]。幸存患者致残率超过50%,增加了患者的痛苦和医疗费用^[2-3]。

主动脉粥样硬化、既往脑卒中病史、颈动脉疾病是临床常见的导致心脏术后脑神经功能障碍的危险因素,高龄则是导致心脏围手术期脑损伤的独立危险因素^[1, 4-5]。术前筛查以及围手术期使用脑监测设备有利于早期发现神经功能障碍,从而给予干预治疗,降低脑损伤的发生率,继而改善心脏手术患者的预后^[6-8]。

1 脑损伤的分型

2004年美国心脏病学会将心脏术后的脑神经

损伤分为两大类型^[9]: I型包括致死性或非致死性的卒中、昏迷或运动障碍; II型包括认知功能障碍、记忆力减退、癫痫发作或者谵妄。谵妄又分为3个亚型,即高活动型、低活动型和混合型。高活动型谵妄是导致围手术期患者躁动、非计划性脱管以及使用呼吸机时人机对抗等的主要因素。CABG术后患者多见于低活动型谵妄。脑损伤可延长患者住院时间、增加致残率以及病死率^[10]。脑损伤常见危险因素包括:高龄、抑郁、脑卒中病史、认知功能障碍、糖尿病、心房颤动(房颤)、体外循环、手术时间过长、低灌注以及炎症反应等^[11]。有研究表明,胆碱能神经递质释放的变化以及皮质醇分泌的中断也会造成脑功能损伤^[12]。

心脏术后神经系统并发症的发生与原发病有关。例如: I型脑卒中在不同病种中发生率不同, CABG为1%~5%,瓣膜修复或置换术为5%~9%, CABG联合瓣膜手术为7%,接受双瓣膜或三瓣膜手术为10%,主动脉置换术为5%~10%;而II型中认

知功能障碍 CABG 术后患者可高达 70%^[13]。

2 脑损伤的危险因素以及处理对策

心脏术后患者出现脑卒中和认知功能障碍的主要原因是缺血,还有小部分原因为出血(发生率<2%)^[14]。脑核磁加权成像可以作为一种有效的手段来评估术后脑卒中发生的情况^[15]。

心脏手术引起缺血性脑损伤的机制主要有栓塞、缺血、炎症反应和代谢紊乱。此外,还与心脏手术时的技术管理问题(例如:深低温停循环),体外循环本身导致血脑屏障发生障碍,以及已存在的脑血管、房颤、遗传易感性和遗传性疾病及病史有关^[16-20]。

2.1 栓塞:脑血管栓子由空气、动脉粥样硬化斑块的碎片、脂肪或手术源性的颗粒物质等组成。空气栓塞大多与体外循环过程中各种插管、操作不当以及开放的左室等因素密切相关。动脉粥样硬化尤其是主动脉粥样硬化的病变程度与脑损伤呈正相关。食道超声心动图(TEE)以及术中触诊有助于排查到术前漏诊的主动脉内大的非钙化斑块;主动脉外超声扫描(EAS)对于排查动脉壁内的斑块较触诊以及 TEE 有更好的优越性,遗憾的是,目前还没有成为临床的标准检查流程^[21]。涉及到主动脉的手术操作,例如阻断钳的开放闭合可能导致动脉壁内斑块的脱落^[22]。临床中空气栓塞与颗粒或碎片栓塞难以鉴别,但颗粒或碎片导致的脑栓塞危险性相对要高于空气栓塞^[23-24]。尸检的组织学与磁共振结果证实,心脏术后患者的脑血管中有大量直径<200 μm 微小栓子,其主要成分为脂滴。这些微小栓子主要来源于术中暴露的术野(心包、纵隔的表面等),脂滴经吸引器吸到体外循环管路进入血液循环,直接导致脑部细小毛细血管动脉堵塞。因体外循环过滤保护装置对此类血栓清除作用有限,不推荐加用该装置来减少脂滴导致的脑血管栓塞事件^[25]。由于手术过程以及体外循环管路可以影响栓子的发生概率、性状(气栓或脂肪栓;管路的长度并不影响栓子的数量),这提示我们使用优质的、合适的体外循环管路和氧合器有利于减少栓子的形成^[26-27],二氧化碳预充体外循环整个管路可减少预充液中微小气栓的形成^[28]。使用脑栓子保护设备虽然不能有效减少术后 7 d 脑梗死率,但是在减少术后谵妄、认知功能障碍等方面可获益。建议体外循环术中注意充分排气后再开放升主动脉,胸腔内置入二氧化碳吹管可以有效减少气栓的量。大量气体意外进入主动

脉的急救措施为:①立即停泵,头低脚高位,剪断主动脉泵管,由根部先排出部分气体。②将断开的主动脉管与上腔插管连接进行暂时性逆行性灌注,灌注流量 1~2 L/min,灌注时间 5~8 min,压力 20~30 mmHg(1 mmHg=0.133 kPa)。全身降温,注意脑保护(局部降温、激素、脱水降颅压)。另外,术中维持较高的灌注压,吸 100% 氧气,有利于气体的吸收和排出^[29-30]。回重症加强治疗病房(ICU)后进行冬眠疗法,根据情况采用高压氧治疗。

既往脑血管疾病史是心脏术后患者出现脑神经功能障碍的独立危险因素^[31]。老年人容易合并全身性血管性疾病,较年轻人出现脑神经损伤的概率更高,未经诊断的脑血管疾病是老年群体围手术期脑卒中和认知功能障碍的重要危险因素^[32]。“动脉对动脉”栓塞,即头部及颈部大动脉以及颅内小动脉的粥样硬化,与围手术期神经功能损伤有密切联系。因此,术前筛查脑血管疾病对于预防术后脑功能障碍具有重要的指导意义^[33-34]。同时,加强围手术期患者的心理干预治疗,减少心理和精神压力有助于减轻术后脑神经系统并发症,特别是对于那些心理脆弱的患者具有重要的临床意义^[34]。心脏术后房颤增加了脑卒中的发生率,行左心耳闭合术对降低心脏术后房颤患者的脑卒中发生率可能有一定效果^[35-37]。

2.2 低灌注:体外循环过程中脑血流量减少是导致缺血性脑损伤的主要原因,存在脑血管病史的患者发生脑损伤风险增加。通过磁共振成像检查发现,高达 50% 以上的择期心脏手术患者术前就已经发生了无症状脑梗死(亦称沉默型脑损伤),术中低灌注会进一步加重此类患者术后脑损伤^[38]。围手术期造成脑低灌注的因素包括:低血压、低心排综合征、脑血管疾病、颈动脉狭窄、严重贫血、体外循环术中血流不稳定等^[39-40]。颈动脉狭窄是脑损伤的独立预测性因素,颈动脉狭窄者心脏手术围手术期发生脑损伤的发生率为 22% 以上^[41],建议对择期行 CABG、大血管手术的患者,术前常规行颈动脉筛查。对于无临床症状的双侧颈动脉狭窄超过 75% 以及有症状的单侧颈动脉狭窄的患者,术前予以干预性治疗^[42]。建议体外循环术中平均动脉压(MAP)>50 mmHg 以维持足够的脑灌注流量^[43]。高血压、老年患者以及合并严重主动脉粥样硬化病变等高风险患者应维持较高水平 MAP(>70 mmHg)。20% 体外循环患者会出现脑血流自主调节功能的

丧失,这类患者更易出现围手术期脑卒中,脑部微小血管、脑血管疾病、男性、体外循环温度过高均影响脑血流的自主调节,使用颈颅多普勒(TCD)和近红外线光谱(rSO_2)技术(脑氧饱和度监测设备)可预知脑血流自主调节功能的丧失^[39,44]。术中贫血可以明显增加脑卒中的发生风险,建议体外循环术中血细胞比容(HCT)大于0.22^[45];但是输入过多的异体血可能是增加术后脑卒中的危险因素之一^[46]。良好体外循环灌注压、血气指标(避免高碳酸血症)、通畅的静脉回流(避免高静脉压)等规范化手术操作和体外循环操作都有助于减少脑神经功能损伤^[47-48]。

2.3 全身炎症反应和代谢紊乱:目前没有确切证据证实体外循环围手术期的全身炎症反应综合征(SIRS)与术后患者认知功能障碍和脑卒中等相关性脑损伤呈正相关,但是降低体外循环围手术期炎症反应会使患者在总体水平上获益。类固醇类、他汀类药物、血管紧张素转换酶抑制剂(ACEI)类药物有助于减少体外循环术后炎症反应^[49-50]。使用肝素涂层管路可以降低炎症反应和凝血途径的激活,但没有证据表明可以降低重要器官并发症和病死率^[47]。人体内的代谢紊乱(包含SIRS途径引起)可以进一步加重脑神经功能的损伤^[51]。其中,高血糖和高体温都会加重缺血性脑损伤、血脑屏障破坏、神经递质释放增加、活性氧大量产生以及能量代谢异常等^[52-53]。合理的血糖(成人 <10 mmol/L)和体温控制(体外循环过程中鼻咽温度 <37 °C)可降低心脏术后脑卒中和认知功能障碍的发生率^[54],推荐在长时间体外循环以及高风险的患者中进行连续的血糖监测与体温管理^[53,55]。

2.4 深低温停循环(DHCA):DHCA技术增加围手术期脑血管不良事件(脑低灌注、脑缺血及癫痫发作等)的发生率^[56]。对于哪种灌注方式(顺行性脑灌注和逆行性脑灌注)对脑保护更加有益目前尚存在争议,但国内外多数单位倾向采用顺行性脑灌注方式^[57-59],术中根据TCD和 rSO_2 技术(脑氧饱和度监测)对灌注模式(单侧还是双侧脑灌注)具有指导作用^[60-61]。由于深低温对凝血功能的破坏作用以及手术技术的提升,中度低温的管理模式将越来越多地被采用^[62-64]。根据体外循环不同阶段联合使用pH稳态血气管理方法(低温停循环脑灌注期间pH稳态有着更好的脑氧输送结果)和 α 稳态的血气管理模式更有利于患者的脑保

护^[65]。血红蛋白是携氧的载体,术中维持足够的HCT有助于脑部的供氧。

2.5 遗传因素:基因[P-选择素、C-反应蛋白(CRP)、载脂蛋白E ϵ 4等位基因等]或多或少地参与了心脏术后认知功能障碍的发生,但是根据基因筛查来预测术后脑损伤目前还不具有实际操作意义^[66-67]。

3 术中脑神经功能的相关监测方法

3.1 脑血流的监测:建议通过TCD和 rSO_2 技术对脑灌注进行无创评估,适当采用颈静脉血氧饱和度($SjvO_2$)监测进行有创评估^[68-70]。当术中TCD流速变小或者 $rSO_2 < 50$ 或低于绝对值20%,或者 $SjvO_2 < 0.50$ 时,应当根据具体情况采取相应措施以保证脑部血流和氧供^[68-69]。建议高危患者围手术期进行脑核磁弥散加权成像发现潜在无症状的早期脑部病变^[71]。

3.2 脑功能的监测:使用脑电图(EEG)可以提示脑缺血、缺氧情况,有效监测非惊厥性癫痫进而指导临床进行干预治疗^[72]。体感诱发电位(SSEPs)可以完整监测整个神经系统功能,包括监测末梢神经和中枢神经系统中所有感觉传导通路以及脑血流改变,缺点是它只能监测感觉皮质及皮质下的感觉传导通路的缺血性损伤,不能有效监测感觉皮质和感觉传导通路以外的神经区域缺血,临床多用于监测指导停循环后体外循环最佳体温,从而预防术后神经系统并发症^[73-74]。推荐使用脑电双频指数(BIS)来评价术中患者意识程度和麻醉深度,BIS <60 可以使发生意识障碍的风险下降82%,同时BIS的应用可以优化镇静镇痛方案以避免其引起MAP下降等并发症^[75-77]。

3.3 生化标志物的监测:S100B蛋白、神经元特异性烯醇化酶(NSE)、血清泛素C端水解酶L1(UCH-L1)可以作为脑损伤的特异性标志物^[78-81]。

4 ICU脑保护常规处理意见

术后患者意识恢复差,应警惕脑损伤的存在。脑电图、脑CT、眼底检查等有助于判定脑损伤的情况,脑核磁加强成像有助于发现没有临床症状以及更早期脑损伤(沉默型脑损伤)。术后患者高热增加机体以及脑部的氧耗,建议控制体温,脑局部低温保护(水毯、冰帽),颈部、腋下、腹股沟等部位放置冰袋,降温幅度注意个体化差异,降至患者只需要最小剂量镇静药物即可保持平稳的血流动力学、呼吸以及肌肉松弛,同时需注意皮肤护理,防止冻伤与压

伤。根据具体情况采取镇静、脱水、激素、降颅压等措施,特别注意预防主动过度换气引起的颅内压升高,对于意识不清者适度给予镇静、肌松,必要时及时采取高压氧治疗。适当应用改善脑细胞营养代谢的药物。抗菌药物、营养的合理应用以及维持良好的内环境均有助于改善脑神经系统的预后。

5 药物治疗与脑保护

目前,对于心脏手术中预防性应用神经保护药物还没有达成一致意见^[82-83]。可以根据实际情况有选择性地使用巴比妥类药物、丙泊酚、七氟醚、右美托咪定等麻醉药物^[84-87]。理论上,兴奋性氨基酸受体拮抗剂、钙离子通道阻滞剂以及氧自由基清除剂有一定的效果^[88-89]。术中应用某些改善凝血功能的药物(例如:氨甲环酸)可能加重某些高危风险 CABG 患者术后出现脑卒中的概率,应根据出血状况和风险因素仔细考虑其应用^[90-91]。推荐躁动型患者使用氟哌啶醇,慎用卡马西平、苯妥英钠等抗癫痫及其他抗精神病药物,如果有必要应在专科医师的指导下应用^[92-94]。

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