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【临床研究】

大动脉调转术治疗婴儿大动脉转位近期疗效观察

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摘要: 目的 探讨大动脉调转术治疗婴儿大动脉转位的近期临床效果。方法 选择2014年6月至2019年7月郑州大学附属儿童医院收治的38例大动脉转位婴儿为研究对象,所有患儿施行大动脉调转术治疗。记录患儿手术时间、主动脉阻断时间、住院时间、术中出血量及监护室入住时间,观察并发症发生情况,并统计患儿术后3个月病死率;分别于术前及术后1、3、5 d采用酶联免疫吸附法检测血清 β -内啡肽(β -EP)、高敏C反应蛋白(hs-CRP)、白细胞介素-6(IL-6)、醛固酮(ALD)水平;术前及术后3个月,应用彩色多普勒超声诊断系统检测术后主动脉瓣环内径、主动脉根部内径、肺动脉内径、肺动脉瓣环内径,观察主、肺动脉发育情况;应用超声心动图仪检测患儿左心室射血分数(LVEF)、左心室舒张末期内径(LVEDD)、左心室收缩末期内径(LVESD)、心脏指数(CI)。结果 38例大动脉转位患儿的手术时间、主动脉阻断时间、住院时间、术中出血量、监护室入住时间分别为(256.31±20.33)min、(149.62±16.69)min、(15.71±3.74)d、(188.65±51.35)mL、(6.04±1.42)d。38例大动脉转位患儿发生低心排血量综合征2例,创口愈合不良2例,肺动脉狭窄1例,心律失常1例,痰培养细菌阳性3例,并发症发生率为23.68%(9/38)。术后1、3 d患儿血清 β -EP、hs-CRP、IL-6、ALD水平均显著高于术前($P<0.05$);术后5 d患儿血清 β -EP、hs-CRP、IL-6、ALD水平与术前比较差异均无统计学意义($P>0.05$)。术后3个月,38例患儿失访3例,死亡4例。获得随访的31例患儿术后3个月主动脉根部内径、肺动脉内径均小于术前($P<0.05$);但术后3个月患儿主动脉瓣环内径、肺动脉瓣环内径与术前比较差异均无统计学意义($P>0.05$)。获得随访的31例患儿术后3个月时LVEF、CI显著大于术前,LVEDD、LVESD显著小于术前($P<0.05$)。结论 大动脉调转术治疗婴儿期大动脉转位近期疗效良好,能有效纠正患儿大动脉畸形,改善心功能。

关键词: 大动脉转位;大动脉调转术;先天性心脏病

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Short-term effect of arterial switch operation in the treatment of transposition of great arteries in infants

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Abstract: **Objective** To investigate the short-term effect of arterial switch operation in the treatment of transposition of great arteries in infants. **Methods** Thirty-eight infants with transposition of great arteries admitted to the Children's Hospital Affiliated to Zhengzhou University from June 2014 to July 2019 were selected as the subjects. All infants were treated with arterial switch operation. The operation time, aortic occlusion time, hospitalization time, intraoperative bleeding and the occupancy time in the intensive care unit were recorded. The complications were observed and the fatality rate of the children within 3 months after operation was counted. The levels of serum β -endorphin (β -EP), high-sensitive C-reactive protein (hs-CRP), interleukin-6 (IL-6) and aldosterone (ALD) were detected by enzyme-linked immunosorbent assay before and 1, 3, 5 days after operation. The internal diameters of aortic annulus, aortic root, pulmonary artery and pulmonary valve annulus were detected by color Doppler ultrasound before and 3 months after operation, so as to observe the development of the aorta and pulmonary arteries. The left ventricular ejection fraction (LVEF), left ventricular end-diastolic diameter (LVEDD), left

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ventricular end-systolic diameter (LVESD) and cardiac index (CI) were measured by echocardiography. **Results** The operation time, aortic occlusion time, hospitalization time, intraoperative bleeding and the occupancy time in the intensive care unit of the 38 patients with transposition of great arteries were (256.31 ± 20.33) min, (149.62 ± 16.69) min, (15.71 ± 3.74) d, (188.65 ± 51.35) mL and (6.04 ± 1.42) d, respectively. There were two cases of low cardiac output syndrome, two cases of poor wound healing, one case of pulmonary artery stenosis, one case of arrhythmia and 3 cases of positive sputum culture, the incidence of complications was 23.68% (9/38). The serum levels of β -EP, hs-CRP, IL-6 and ALD at 1 and 3 days after operation were significantly higher than those before operation ($P < 0.05$). There was no significant difference in serum levels of β -EP, hs-CRP, IL-6 and ALD between 5 days after operation and before operation ($P > 0.05$). Among the 38 cases, 3 cases were lost to follow-up and 4 cases died within 3 months after operation. The internal diameters of aortic root and pulmonary artery at 3 months after operation were less than those before operation in the 31 children who were followed up ($P < 0.05$). There was no significant difference in the internal diameters of aortic annulus and pulmonary valve annulus between 3 months after operation and before operation ($P > 0.05$). The LVEF and CI at 3 months after operation were significantly higher than those before operation in the 31 children who were followed up ($P < 0.05$), and the LVEOD and LVESD at 3 months after operation were significantly less than those before operation in the 31 children who were followed up. **Conclusion** The arterial switch operation can obtain good short-term effect in the treatment of transposition of great arteries in infants, which can effectively correct the malformation of great arteries and improve cardiac function.

Key words: transposition of great arteries; arterial switch operation; congenital heart disease

大动脉转位是婴儿期最常见的发绀型先天性心脏病,占先天性心脏病的7%~9%^[1]。目前,外科手术是治疗大动脉转位的唯一手段,尤其是大动脉调转术,与生理纠治术相比,其可保持左心室-二尖瓣-主动脉解剖结构和功能,规避房性心律失常,缓解病情^[2]。国内开展大动脉调转术较晚,病例累积较少,且缺乏术后随访研究数据。大动脉转位如未及时诊断或处理不当,可导致病情加重,增加手术难度。炎症反应是大动脉转位婴儿常见的病理生理变化,同时手术创伤会进一步加重炎症反应,影响主动脉、肺动脉发育及心功能^[3-5]。基于此,本研究对大动脉转位患儿大动脉调转术前后主动脉、肺动脉、心功能及炎症反应水平变化进行观察,旨在为临床合理制定手术方案提供参考。

1 资料与方法

1.1 一般资料 选择2014年6月至2019年7月郑州大学附属儿童医院胸心外科收治的大动脉转位婴儿为研究对象,所有患儿符合大动脉转位诊断标准^[6],并经心电图检查、胸部X线片、超声心动图、心血管造影等确诊,并排除合并其他严重先天性疾病、器官衰竭者。本研究共纳入大动脉转位婴儿38例,其中男25例,女13例;年龄1~103(52.67±21.33)d;并发症:室间隔缺损28例,卵圆孔未闭32例,动脉导管未闭25例,冠状动脉畸形18例;大血管分布:主动脉右前、肺动脉左后33例,完全性前后位5例。本研究通过医院医学伦理委员会批准,所

有患儿家属签署知情同意书。

1.2 手术方法 所有患儿施行大动脉调转术治疗。术前进行超声心动图检查,根据3节段诊断顺序分别检查肝脏、胃、心房,判断左、右心室及位置;结合大动脉分支鉴别主、肺动脉及其与心室连接情况;探查合并畸形种类、数量、程度。术前给予心电、呼吸监测,血氧饱和度<70%时予以前列腺素E1治疗,出现呼吸困难患儿经口插管呼吸机辅助通气(以低氧气浓度通气);心脏功能不全时予以地高辛制剂、多巴胺、利尿剂等改善心功能;术前禁食6 h,禁饮水4 h。患儿入手术室前维持室温28℃,调节变温毯至40℃;术前静脉维持药物泵入。静脉-吸入复合麻醉,麻醉诱导:外周静脉注射咪达唑仑(宜昌人福药业有限责任公司,国药准字H20067040)0.1 mg·kg⁻¹、丙泊酚(英国Aspen Pharma Trading Limited,进口药品注册证号H20171275)2.0 mg·kg⁻¹、舒芬太尼(宜昌人福药业有限责任公司,国药准字H20054171)0.5~1.0 μg·kg⁻¹、维库溴铵(成都天台山制药有限公司,国药准字H20063411)0.1 mg·kg⁻¹。麻醉维持:静脉微量泵泵入丙泊酚8.0~10.0 mg·kg⁻¹·h⁻¹、舒芬太尼0.1~0.3 μg·kg⁻¹·h⁻¹、维库溴铵0.1 mg·kg⁻¹·h⁻¹、右美托咪定(扬子江药业集团有限公司,国药准字H20183219)0.5 μg·kg⁻¹·h⁻¹,间断吸人体积分数1%~3%七氟烷,根据患儿体质量及年龄选取适宜不带囊气管插管,经口气管插管;连接麻醉机,呼吸频率每分钟25次,潮气量12~15 mL·kg⁻¹。患儿取仰卧位,常

规消毒铺巾,胸部前正中切口,锯开胸骨,切除胸腺,充分显露升主动脉和肺动脉,游离双侧胸膜,尽量留取较大的自体心包(以体积分数0.6%戊二醛固定)备用,注意留取心包时避开膈神经;悬吊双侧心包,观察心脏颜色、大动脉相对位置、冠状动脉分布;完全游离升主动脉和近弓部、主肺动脉及左、右肺动脉至肺门分叉处,游离过程中注意控制血压,若血压过低暂停操作,待血压恢复;选取升主动脉远端近右头臂干起始处做一主动脉荷包,荷包内动脉壁纵行切开,置入主动脉插管,然后调整插管方向、深度,固定;插管排气,连接预充体外循环液的体外循环管道;自右心耳缝成荷包状,放置静脉插管行转体外循环,先结扎离断合并的动脉导管未闭,两端以5/0号Prolene线缝合加固,注意保护喉返神经;于下腔静脉入右心房处缝合荷包,置入下腔静脉插管,收紧上、下腔静脉控制带;采取涤纶补片或自体心包修补室间隔缺损。术后2~7 d根据患儿恢复情况逐步去除血管活性药物、脱离呼吸机,转普通病房。

1.3 观察指标 (1)围术期指标:记录患儿手术时间、主动脉阻断时间、住院时间、术中出血量及监护室入住时间。(2)并发症:观察患儿低心排血量综合征(low cardiac output syndrome, LCOS)、创口愈合不良、肺动脉狭窄、心律失常、痰培养细菌阳性等并发症发生率。(3)炎症反应血清学指标:分别于手术前及术后1、3、5 d采集患儿晨起空腹静脉血2 mL,置于非抗凝真空管,3 500 r·min⁻¹离心10 min,取上层血清,采用酶联免疫吸附法检测血清β-内啡肽(β-endorphin, β-EP)、高敏C反应蛋白(high sensitive C-reactive protein, hs-CRP)、白细胞介素-6(interleukin-6, IL-6)、醛固酮(alosterone, ALD)水平;所用试剂盒由上海酶联生物科技有限公司提

表1 大动脉转位患儿手术前后血清β-EP、hs-CRP、IL-6、ALD水平比较

Tab. 1 Comparison of the levels of serum β-EP, hs-CRP, IL-6 and ALD before and after operation in children with transposition of great arteries

时间	n	β-EP/(ng·L ⁻¹)	hs-CRP/(mg·L ⁻¹)	IL-6/(ng·L ⁻¹)	ALD/(nmol·L ⁻¹)
术前	38	110.41±15.88	4.65±1.23	8.42±1.18	133.12±12.51
术后1 d	38	131.74±16.52 ^a	10.61±1.44 ^a	12.61±1.37 ^a	158.96±17.73 ^a
术后3 d	38	153.98±17.64 ^a	14.12±1.53 ^a	14.46±1.41 ^a	176.61±18.62 ^a
术后5 d	38	116.97±15.72	4.86±1.23	9.03±1.04	147.74±16.05

注:与术前比较^a P<0.05。

2.4 病死率 术后3个月,38例患儿失访3例,死亡4例(11.43%)。院内死亡2例,1例为早产儿,出生体重1.72 kg,心功能、吮吸功能低下,出生7 d时施行手术,术后出现LCOS,最终因心脏骤停死亡;1例患儿出生即出现严重低氧血症,急诊大动脉调转术后出现严重LCOS,24 h内死亡。院外死

亡2例,均因心功能差于术后2个月死亡。

2.5 术后主动脉、肺动脉发育情况 结果见表2。获得随访的31例患儿术后3个月主动脉根部内径、肺动脉内径均小于术前,差异有统计学意义(P<0.05);术后3个月主动脉瓣环内径、肺动脉瓣环内径与术前比较差异均无统计学意义(P>0.05)。

2 结果

2.1 围术期指标 38例大动脉转位患儿的手术时间、主动脉阻断时间、住院时间、术中出血量、监护室入住时间分别为(256.31±20.33)min、(149.62±16.69)min、(15.71±3.74)d、(188.65±51.35)mL、(6.04±1.42)d。

2.2 并发症 38例患儿发生LCOS 2例,创口愈合不良2例,肺动脉狭窄1例,心律失常1例,痰培养细菌阳性3例(7.89%),并发症发生率为23.68%(9/38)。

2.3 手术前后患儿炎症反应血清学指标比较 结果见表1。术后1、3 d患儿血清β-EP、hs-CRP、IL-6、ALD水平显著高于术前,差异均有统计学意义(P<0.05);术后5 d患儿血清β-EP、hs-CRP、IL-6、ALD水平与术前比较差异均无统计学意义(P>0.05)。

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表2 大动脉转位患儿术后主动脉、肺动脉发育情况

Tab. 2 Development of aorta and pulmonary artery of the children with transposition of great arteries after operation

时间	n	主动脉根部内径/mm		肺动脉内径/mm	
		术前	术后3个月	t	P
	31	15.92 ± 2.63	5.05 ± 1.46	12.48 ± 1.89	11.65 ± 2.27
		20.120		1.565	>0.05
		<0.05		<0.05	<0.05

2.6 患儿手术前后心功能比较 结果见表3。获得随访的31例患儿术后3个月时LVEF、CI显著大

于术前,LVEDD、LVESD显著小于术前,差异均有统计学意义($P < 0.05$)。

表3 大动脉转位患儿手术前后心功能比较

Tab. 3 Comparison of the cardiac function of the children with transposition of great arteries before and after operation

时间	n	LVEDD/mm		LVEF/%		CL/(L · min ⁻¹ · m ⁻²)	
		术前	术后3个月	t	P	($\bar{x} \pm s$)	
	31	31.02 ± 4.24	26.91 ± 4.31	38.01 ± 5.15	49.36 ± 4.98	34.82 ± 4.93	30.89 ± 5.05
		3.785		8.821	<0.05	3.101	<0.05
		<0.05		<0.05		8.179	<0.05

3 讨论

大动脉转位的主要病理生理特征是2个独立的循环,即体循环静脉血自右心室至主动脉,而肺静脉的动脉血自左心室至肺动脉,从而诱发严重低氧血症,引起发绀^[7-8]。大动脉转位的临床治疗原则在于纠正血液循环畸形,保护心脏功能,挽救患儿生命^[9]。

目前,大动脉调转术是治疗发绀型大动脉转位的最佳选择,其优点是可操作性强、安全性高^[10-11]。有研究显示,大动脉调转术主动脉阻断时间和手术时间为(115.10 ± 41.03)、(302.14 ± 35.26)min,术式安全,远期疗效佳^[12]。本研究结果显示,38例大动脉转位患儿主动脉阻断时间和手术时间为(149.62 ± 16.69)、(256.31 ± 20.33)min,与上述研究接近。有学者认为,大动脉调转术后常见吻合后肺动脉瓣上狭窄,影响手术效果,主张术中采用可吸收缝合线吻合大动脉^[13]。本研究38例大动脉转位患儿出现9例并发症,其中肺动脉狭窄1例,而痰培养细菌阳性发生率最高,为7.89%;其主要原因可能为本研究所选病例均为4个月内婴儿,其各项生理功能发育尚未完全,加之手术创伤,自身抵抗力差,易出现呼吸系统感染。

炎症反应是外科手术中常见的机体生理反应,属于机体保护防御机制的快速反应,但过度炎症反应会加重局部组织损害,影响术后恢复^[14]。 β -EP、hs-CRP、IL-6、ALD均是炎症反应相关的常用评价指标。 β -EP具备内源性阿片肽样免疫活性,既有促单核细胞、淋巴细胞等免疫细胞趋化、增殖作用,又能抑制抗体形成,是一种双向调节激素。研究证实,生理范围内 β -EP具有调节内环境稳定作用,超出生理范围则对机体有害^[15]。IL-6为炎症反应的重要标志物,参与调节机体免疫及炎症反应^[16]。hs-CRP

是机体受微生物入侵、组织损伤等炎症刺激时肝细胞生成的急性时相反应蛋白,炎症开始数小时hs-CRP水平即显著升高^[17]。ALD通过诱发炎症、胶原蛋白形成、纤维蛋白变性及坏死、内皮功能紊乱等机制,引起大动脉僵硬度增加,能直接反映伤害性刺激对机体的影响^[18]。本研究38例患儿行大动脉调转术后1、3 d 血清 β -EP、hs-CRP、IL-6、ALD水平显著升高,这可能与手术创伤有关,但术后5 d 基本恢复至术前水平,说明大动脉调转术对机体的不良刺激相对较小,进一步证实大动脉调转术安全性高。

有研究显示,大动脉调转术后随时间延长部分患儿可出现右心功能不全、晚期三尖瓣闭合不全,甚至出现猝死^[19]。本组患儿术后随访3个月,死亡4例,均因患儿自身生理功能差而导致死亡,并未出现上述因素诱发的死亡病例,尚待继续随访观察。大动脉调转术的操作重点在于冠状动脉纽扣的设计,冠状动脉口附近主动脉壁组织既要满足缝合需要又要避免冠状动脉开口狭窄,以便后期缝合;移植时减少冠状动脉开口狭窄,但需避开窦部薄弱主动脉壁,以免影响与心包补片缝合^[20];移植部位需结合冠状动脉长度而定,若回旋支自右冠状动脉分出,移植时应在稍高位置缝合,避免扭曲^[21]。本研究还发现,大动脉转位患儿术后3个月主动脉根部内径、肺动脉内径、LVEDD、LVESD均小于术前,LVEF、CI均大于术前,表明大动脉转位术可显著纠正患儿主动脉畸形,改善心功能。本研究未对患儿实施长期随访研究,患儿生长发育和青春期后心功能如何,尚需进一步随访研究。

综上所述,大动脉调转术治疗婴儿期大动脉转位效果良好,能有效纠正患儿大动脉畸形,改善心功能,是治疗婴儿期大动脉转位的一种较理想手术方案。

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