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不用体外循环的异位并列心脏移植实验研究

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摘要　1988年7月至1991年7月，我们在不用体外循环情况下做了70条犬胸内异位并列心脏移植实验。术后供心总复跳率91.42%，犬最长存活13天。供心植入28h后，以多普勒相控阵超声显象诊断仪检查，可见自体心与供心功能均正常。8kg重犬的供心植入后，每分钟排血1.2L，左室收缩增厚率20%。移植后存活13天的供心组织学检查见有明显急性排斥反应改变。

关键词　异位并列心脏移植　　左心辅助　　全心辅助

1960年Demikhov报道用24种术式将供心移植于受体胸内250次实验研究[1]；1974年Barnard首次将异位并列心脏移植用于临床，至今已逾50例[2]，术后病人存活最长达14年。从1988年7月到1991年7月我们不用体外循环进行70次异位并列犬心移植实验研究，探讨左心辅助式和全心辅助式异位并列心脏移植的手术途径与方法、供心的保存与复苏，及术后供心的功能与组织学改变。

材料与方法

选用健康杂种犬140条，其中供心犬70条，体重6～16.5kg，平均10kg；受心犬70条，体重10～21kg，平均15kg。术前肌注东莨菪碱0.3mg及鲁米那0.1g。2.5%硫喷妥钠20mg/kg静脉注射诱导麻醉，气管插管后吸入乙醚并复合用静脉滴注芬太尼4～6mg/kg，安定0.5～1.0mg/kg维持麻醉。术中及围术期记录动、静脉压，同时监测心电图、神经反射、体温、呼吸、出入水量，并根据需要作血气分析及电解质测定；部分实验作了超声心动图检查和多普勒相控阵超声显象诊断仪检查；供心在术后4h、16h及13天作组织学检查。

实验分组：I组，左心辅助式移植(LHT)38条犬。手术经右胸将供心与自体心作左心耳—左房、肺动脉—肺动脉、降主动脉端—升主动脉三处吻合。II组，全心辅助式移植(THT)30条犬。其中20条经右胸进行，除作上述三个吻合外，另加行供心上腔静脉端—自体心上腔静脉侧吻合；余10条犬经左胸进行，供心与自体心作左心耳—左心耳、肺动脉干—肺动脉干、降主动脉端—主动脉弓降部、上腔静脉—右心耳等四处吻合。III组，寄生式移植(PHT)2条犬。仅作供心肺动脉干—自体心右房、供心降主动脉端—自体心升主动脉侧二处吻合。术中自体心犬按3mg/kg静脉推注肝素抗凝。供心热缺血时间1.5～4min，冷缺血时间2～4h。

供心的切取与复苏：供心犬在气管插管全麻下维持正常血压，静脉推注肝素3mg/kg。横断胸骨经双侧第4肋间开胸。阻断供心的血液循环后，在升主动脉根部注入充氧的4℃改良St. Thomas II号[3]液500ml，使供心停于软瘫状态。切除供心与相连之双肺，一并置入含4℃林格氏液的容器中，并继续经供心头臂动脉插管滴入心肌保护液。将供心与相连之双肺分离，供心贮于盛有冰屑之小布袋中保存备用。70条犬移植实验中，各吻合口均用3～4"0"的Prolene线作连续吻合，然后逐步开放夹于供心降主动脉上的Blalock钳，同时在供心胸主动脉根部及左心尖穿刺排气。供心淋热生理盐水并同时以手按压，当出现粗颤时，有17.14%可自动复跳，其余均须电击除颤。供心复跳后，在右心室表面安置起搏电极，在术后12h内使用心外膜起搏。持续给氧并辅助呼吸24h。术后根据血压、周围循环、出入水量及心电图改变等给予输血、补液、强心、升压及利尿等药物，每12小时按1mg/kg皮下注射肝素。

术后供心功能及病理改变：复跳后1、28及48小时对供心作M型超声心动图以测定心排血量及左心室收缩增厚率(ΔT%)，并以多普勒相控阵超声显象诊断仪显示自体心与供心同时跳动的曲线及二尖瓣与三尖瓣瓣口的血流频谱图。供心分别在复跳后4、16h及13天切除，在不同部位取材以HE染色、Pollak's三色染色作组织学检查。

结　果

本组70条不用体外循环的胸内异位并列心脏移植犬中，术毕供心自动复跳12个(17.14%)、电击复跳者52个(74.28%)，总复跳率达91.42%。左心辅助式移植38条犬中，术

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后存活最长者13天；全心辅助式移植30条犬，术后存活最长38h；寄生式移植2条犬术后存活时间均为2h。

供心复跳后其心率多较自体心为慢，仅有2个与自体心同步(2.85%)，不同步者68个(97.15%)。心电图示供心R波多向下、且QRS波群较低平。8kg犬其心脏在移植入受体后1h，超声心动图测定并计算其心排血量为1.2L/min，左心室收缩增厚率(ΔT%)为20%。术后28h以多普勒超声显象诊断仪检查，可见到犬胸内供心与自体心并跳的活动曲线，且其二尖瓣口与三尖瓣口均有正常的血流频谱图。舒张期呈双峰层流频谱，E峰>A峰，无收缩反流信号。对术后存活4及16h的供心作组织学检查，见室间隔、房室传导系统及乳头肌均有部分核浓缩、溃解伴大量血细胞浸润；术后存活13天的实验犬其供心心肌细胞变细，细胞间距增大，间质水肿伴大量白细胞及淋巴细胞浸润，小动脉腔内有的可见血栓形成，属急性排斥反应的病理改变。未见有神经再生。心跳属体液调节。

讨 论

一、胸内异位并列心脏移植的存活率

Kriett在1991年统计了全球开展临床异位并列心脏移植共332例，其5年生存率为45%[4]。1990年Lansman[5]收集全球胸内异位并列心脏移植实验的论文，证实术后犬存活的最长时间为32天，系Demikhov经过250例实验所获得[1]；Downie术后犬最长存活时间为10天；Mann为8天；Carrell及Marcus分别为2天[5]。本组70条犬实验研究中，术后最长存活时间为13天。影响存活的因素有心肌保护不良、低心输出量综合征等。

二、供心的保存

近年来国外认为美国Wisconsin大学溶液(UW)保存心脏的效果优于Collins液及Stanford液，可使兔心停搏并保存在4℃历时8小时。但1991年Choong等[6]通过实验研究证明充氧的St. Thomas II号液可使兔心停搏并保存于4℃下历时10小时，且左室功能及心肌储能均良好。本组采用后者，故供心经冷缺血4h左右，仍有91.45%复跳率。

三、异位并列心脏移植的适应证

多数学者[5,7,8]认为其适应证有二：(1)心脏病终末期伴有不可逆的肺血管阻力增高>500 Wood单位(40kPa·s/L)。(2)拟行原位心脏移植的病人，但术中供心过小。Cooper[8]认为适应证尚应包括：(1)病毒性或风湿性心肌炎病人，其心肌尚有可能复原者。(2)经药物和搭桥手术均不能缓解的严重的心绞痛病人，当其左室功能尚好时，不宜切除心脏作原位移植；而一个功能良好的异位并列供心，可减少自体心对氧的需求，从而缓解心绞痛。

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of Esophagus *Wang-kou Ma, Qi-yuang Song, Yang-rong Zhu. Department of Thoracic Cardiovascular Surgery, Affiliated Hospital of Nanjing Railway Medical College, Nanjing* 210009

The result of surgical treatment of 14 cases of spontaneous rupture of esophagus from 1962 to 1990 was reported. Twelve patients underwent primary repair, 7 of them were repaired between 26～432 hours (average 148 hours) after rupture. Ten patients (83%) survived. In the other two patients exteriorization of cervical segment of the esophagus and ligation of the cardia were first perfomed, and then the esophagus was replaced with colon. One patient died. The authors emphasized that the choice of the surgical procedure should be considered according to the general condition of the patients rather than the time after rupture. The technique of repairing the rupture, the choice of tissue for covering the suture line and the postoperative management were discussed.

Key words: Rupture of esophagus; Repair of esophagus

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Experimental Study Using Ligation Technique for Closure of Bronchial Stumps Following Pulmonary Resection *Ke-neng Chen, Guo-liang Yang, Hong-ying Yuan. Institute of Oncology, Hubei Medical University, Wuhan* 430071

Little is known about the endurance to distension pressure of the ligated bronchial stumps following pulmonary resection. In this experiment, multiple lobectomies (n = 90) were performed on 15 mongrel dogs, weighting 11～20kg, and 165 bronchial stumps were treated with three different methods, ligation, stapling and manual interrupted sutures on 75 fresh cadavers. The treated bronchial stumps were subjected to distension endurance test at different interval after the operation on animals and immediately after the procedure on the fresh cadavers.

The results of the study showed that ligated stumps can resist higher pressure than those treated with the other two methods. The data also suggest that the ligation is simple and speedy.

Key words: Pulmonary resection; Ligation of bronchial stumps; Animal experiment; Fresh cadaver

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Experimental Study of Heart Preservation——Heart Preservation for 2～6 Hours with Cold Storage *Chang-zhi Chen, Ke-jian Cao, Da-wen Li, et al. Department of Cardiothoracic Surgery, Ganquan Hospital, Shanghai Railway Medical College,* 200061

In order to explore large animal heart preservation, 13 adult porcine hearts which are similiar to human's in size were used in this experiment. After being infused with cardioplegic solution, the hearts were stored at 4℃ for 2.5～6.08 h with the average of 4.68 h. Two hearts were studied histologically and the other 11 were resuscitated by a heart-lung machine and warm blood cardioplegia was infused to reduce reperfusion injury. During this time all hearts showed no electric or mechanical activities, while the mean MVO_2 was 1.5 ± 0.93 ml%. After resuming oxygenated blood perfusion, 7 hearts resuscitated spontaneously and 4 required defibrillation. Cardiac output was 1500～4250ml/min with an average of 2725 ± 875ml/min. One heart preserved for 6.08 h had a CO of 4200ml/min. Myocardial histology showed that there was no irreversible damage except a slight interstitial and myofibrillar edema.

Key words: Heart preservation; Cold storage; Warm blood cardioplegia; Reperfustion

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Experimental Study of Heterotopic Heart Transplantation without Cardiopulmonary Bypass *Yuan-zhong Shen, Liang-hua Zhang, You-min Pan, et al. Department of Thoracic and Cardiovascular Surgery, Tongji Hospital, TongJi Medical University, Wuhan* 430030

From 1988 to 1991, 70 heterotopic heart transplantions (HHT) on canines were performed under normothermia with endotracheal anesthesia but without cardiopulmonary bypass. The total recovery rate of donor heart-beat after transplantation was 91.42%. The longest survival time after HHT. was 13 days. M-mode echocardiography revealed good function of both recipient's and transplanted hearts. The cardiac output (CO) of donor's heart from canine weighing 8 kg was 1.2 L/min and the thickening rate of left ventricular wall during contraction was 20%. In the meantime, the phased array ultrasonic imaging system echocardiography showed normal heart beat of the transplanted hearts as well as the recipient's hearts with good mitral and tricuspid valvular function. The pathologic change of donor heart after survival for 13 days showed evidence of acute rejection.

Key words: Heterotopic heart transplantation; Left heart assist; Canine total heart assist

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