First aid and monitoring of a patient with recurrent cardiac arrest successfully rescued by extracorporeal membrane oxygenation

RAO Junling, JIANG Hongyun, LUO Jianling, MAO Jiehua, CHU Chunxiang, LI Jinjuan

Guangdong north people's Hospital, Guangzhou Guangdong 512000, China

【**Abstract**】Cardiopulmonary resuscitation (CPR), which refers to the implementation of arteriovenous extracorporeal membrane oxygenation (VA-ECMO)to provide temporary circulation and oxygenation support to patients who have used traditional CPR without restoring spontaneous heart rate, or who have suffered repeated cardiac arrest without maintaining spontaneous heart rate, under the premise that the underlying, reversible etiology can be removed. After ECPR in this patient with cardiac arrest, the patient was discharged from the hospital with an uneventful recovery, including the care of anticoagulation with eCom and bleeding, the care of brain protection with hypothermia after CPR, the care of volume management, the monitoring and nursing of complications, and the early rehabilitation care of the neurological system.

【**Key words**】Cardiac arrest;Extracorporeal membrane oxygenation;Case care

Extracorporeal cardiopulmonary resuscitation (ECCPR)is a technology that, on the premise that the potential and reversible causes can be removed, can implement extracorporeal membrane oxygenation of arterial and venous blood to provide temporary circulatory and oxygenation support for patients who have used traditional cardiopulmonary resuscitation to recover their autonomic heart rate, or can not maintain their autonomic heart rate due to repeated cardiac arrest. According to the data, the recovery rate of autonomic circulation in patients with cardiac arrest treated by extracorporeal cardiopulmonary resuscitation (ECPR)can be as high as 95%, and the survival rate can reach 27. 6%~50%[1-4]. On May 30, 2022, our hospital admitted a patient with cardiac arrest who underwent emergency ECPR. After active treatment and careful care, he was successfully treated. This case provides a case for future clinical practice to exchange nursing experience, so that similar patients can get better nursing treatment. Now the patient's nursing experience is reported as follows.

1 Clinical data

The patient was a 44-year-old male who suffered from repeated ventricular fibrillation due to"chest pain for 4 hours and sudden cardiac arrest for 3 hours". The emergency rescue room was given electric defibrillation for 10 times and continuous cardiopulmonary resuscitation. The intensive care department was requested to consult the emergency ECPR operation and VA-ECMO treatment. The patient's heart rate and spontaneous respiration recovered about 10 minutes after the operation, and was still in deep coma. The ECG monitoring showed that the heart rate was 90 times/minute and the blood oxygen saturation was 100%. Therefore, the patient was transferred to our department for further treatment. Admission diagnosis: cardiac arrest, ventricular fibrillation, acute myocardial infarction?Cardiogenic shock, respiratory failure, acute renal failure;Ischemic hypoxic

encephalopathy after cardiopulmonary resuscitation;Hypertension grade 2 very high risk group;After kidney stone surgery. When the patient entered the department, he was in a coma, his pupils dilated on both sides, his light reflex disappeared, his heart rate was 93 times/minute, his blood oxygen saturation was 93%, and his body temperature was 36. 3℃;Endotracheal intubation ventilator-assisted breathing, ventilator mode SIMV, inhaled oxygen concentration 35%, set tidal volume 300ml, pressure support 15cmH2O, positive end-expiratory pressure 10cmH2O, respiratory rate (set)10 times/minute. After admission, mild hypothermia treatment was given immediately, right internal jugular vein puncture and catheterization were performed to open the central vein channel, right radial artery puncture and catheterization were performed to monitor invasive blood pressure, and bedside blood gas was checked urgently to correct internal environment disorder and acid-base imbalance.

2 Postoperative care of ECPR

2.1 Nursing of ECMO anticoagulation and bleeding

During ECPR assistance, the balance of the coagulation system is broken, and the whole balance is inclined to the direction of coagulation promotion. To reduce

Anticoagulation is the most important link in the treatment of ECMO[5]. The right femoral vein of the patient was intubated with 21F vein, with a depth of 45cm, and the right femoral artery was intubated with 15F artery, with a depth of 18cm. Heparin sodium was micro-pumped into the vein, and the heparin dosage was adjusted according to the results of APTT, ACT and thromboelastogram. During the period of ECMO treatment, the patient's ACT was maintained at about 200s, and the recommended range of ACT maintenance was 160s-200s. After 8 hours of ECMO intubation, there was more blood leakage around the perfusion orifice, and the orifice was sutured for 1 needle, and the bleeding stopped;Check the strength of arterial pulsation of both lower limbs of patients during each shift. During anticoagulation treatment, invasive treatment and nursing operations, such as arteriovenous puncture, should be avoided as far as possible. On May 30, a large amount of bloody liquid was drained from the stomach and mouth of the patient, and a small amount of bloody sputum was aspirated from the airway. The patient was given gastrointestinal decompression, adjusted the dosage of heparin, and Esomeprazole was used to protect the stomach;The sputum suction operation should be as gentle and rapid as possible to avoid aggravating respiratory tract and lung bleeding, and closely observe the situation of oral mucosa and stomach bleeding;Observe the color of urine. On June 1, the gastric tube drainage was not obviously bloody, and enteral nutrition was given;On June 4, the patient's sputum changed from bloody sputum to yellow sputum;After ECMO was removed, the intravenous micro-pump of heparin was stopped, and the blood coagulation spectrum and hematological indexes of patients were closely monitored. After the ECMO tube was removed, the place where the tube was placed was compressed for 24 hours with a pressure device. In order to prevent VTE in patients, the bedside color ultrasound examination of both lower limbs should be improved to dynamically assess whether there is thrombosis in both lower limbs;Both lower limbs were treated with pneumatic pump to promote venous reflux of lower limbs.

2.2 Mild hypothermia brain protection nursing after CPR

Hypothermic brain protection is a treatment method that reduces the body temperature or local brain temperature of patients through artificial physical methods, thereby reducing brain oxygen consumption and promoting the recovery of brain function[6]. Mild hypothermia can effectively improve the prognosis of brain function and has significant brain protection effect[7-8]. Mild hypothermia treatment after CPR can significantly reduce the mortality of patients with cardiac arrest and reduce the damage of nerve function. Immediately apply ice on the head, use the controllable electronic temperature-regulating water blanket, and adjust the ECMO water temperature box to 35℃, or maintain the patient's temperature at 35~36℃by directly cooling the circulating blood flow of continuous blood purification treatment. When the patient turned out, he was conscious, and the head CT examination showed that the cerebral ischemia and hypoxia changes.

2.3 Capacity management care

In order to monitor the hemodynamic indexes of the patients, the right radial artery was selected for indwelling the arterial catheter for invasive blood pressure monitoring;During the monitoring process, pay attention to observe the waveform of arterial blood pressure, such as: the wave peak is blunt, the wave amplitude is reduced, the ascending and descending branches slow down, and the reentry notch disappears, which can be seen in the blockage of arterial blood pressure monitoring pipeline, decreased myocardial contractility, and insufficient blood volume;Low flat wave, low amplitude, increased slope of ascending and descending branches, seen in severe hypotension and low cardiac output syndrome;The wave amplitude is different, the shape is different, and the wave spacing is different. It can be seen in arrhythmia, such as atrial fibrillation[9]. The average arterial pressure should be maintained at 50-60mmHg. The patient's admission blood pressure is 88/53mmHg, the skin temperature of the limbs is low, the ECMO drainage tube repeatedly shakes, the flow is unstable, and there is no abnormality after rapid expansion, and the rehydration components are mainly crystal liquid, albumin, and blood products;Measure the patient's central venous pressure every hour and maintain the central venous pressure below 8 mmHg. Pay attention to the perfusion of the patient's limbs, and evaluate it by measuring the circumference of both lower limbs, observing the color of the skin and touching the temperature of the skin.

2.4 Monitoring and nursing of complications

The prevention, early detection and intervention of complications are very important for the prognosis of patients. The incidence of complications of ECPR is high, especially during catheterization and ECMO, the most common one is bleeding. The patient chose ultrasound vaginal percutaneous femoral vessel catheterization to reduce the bleeding risk of ECMO catheterization. Intracranial hemorrhage is a serious complication. It is necessary to observe the change of pupil and light reflex of the patient every hour, and timely conduct CT examination in case of abnormality to eliminate cerebral hemorrhage. Patients are left with central venous catheter, arterial catheter, VA-ECMO tube, blood filter tube and other pipes, so it is very important to prevent catheter-related blood flow infection. Hand hygiene and aseptic operation technology should be strictly implemented, and sterile, transparent and breathable dressing should be used for covering. Before injection of drugs, 75%alcohol should be used to disinfect the connection port of the catheter. It is strictly prohibited to add drugs, transfuse blood, and infusion on the ECMO pipeline to reduce the operation at

the pipeline interface. Put patients in a single ward, strengthen the work of medical staff and planned centralized treatment and nursing, and avoid frequent access of medical staff to the ward. To prevent the ECMO pipeline from falling out, the elastic tape with a length of more than 40cm shall be used to fix the pipeline to prevent the pipeline from pulling or discounting. To prevent the occurrence of air embolism and thromboembolism, tighten each chain interface of ECMO pipeline. During continuous renal replacement therapy, replace the empty replacement fluid bag in time. When replacing the fluid bag, pay attention to clamp the pipeline to prevent air from entering the pipeline;Adjust the dosage of heparin according to the patient's coagulation function to avoid pipeline coagulation;Each shift uses flashlight to irradiate the pipeline, centrifugal pump and oxygenator for thrombosis. To prevent hemolysis, observe whether the patient has chills, high fever, hypotension, shock, etc.

2.5 Early rehabilitation nursing of nervous system

Due to cerebral ischemia and hypoxia in patients with cardiac arrest, the intervention of early rehabilitation nursing measures can effectively improve the outcome of coma patients. Early rehabilitation should be carried out when the patient's respiratory, circulatory and nervous systems are stable and there is no obvious risk of rehabilitation treatment. During the use of sedatives and analgesics, patients should use the restless sedation score (RASS table)to promote wakefulness every day, stop the use of analgesics and sedatives regularly every morning, and the patients'family members should call the patients'names and communicate with them in encouraging and inquiring language, and play the music and radio programs that the patients are familiar with and like;Move in bed, massage the patient's limbs and trunk, and turn over and pat the patient's back every two hours. Hyperbaric oxygen therapy can increase tissue oxygen content, reduce brain edema and reduce intracranial pressure;Before hyperbaric oxygen, provide psychological care for patients, such as introducing the environment in the hyperbaric oxygen chamber, telling the purpose of oxygen therapy, and how to cooperate with oxygen therapy to reduce discomfort. The rehabilitation program of patients'limb movement: ①placement of good limb positions to reduce muscle spasm and abnormal patterns;②Passive movement, maintain joint range of motion to prevent joint contracture;③Progressive exercise mode: bed (bed head raised 30°~80°), sitting (bedside and bedside seats), bedside standing and walking training. It is recommended to complete 2~3 times a day at each stage, 30~60 minutes each time, until it can be fully tolerated. EEG monitoring can help judge the brain function and the degree of nerve injury, and help formulate personalized rehabilitation nursing plan for patients[10].

3 Conclusion

This patient is critically ill. VA-ECMO provides circulatory support for patients with cardiac arrest and buys valuable time for treatment. The care of anticoagulation and bleeding after ECPR not only ensures the normal operation of cardiopulmonary resuscitation machine, but also reduces the occurrence of complications of the disease;Effective volume management ensures the circulating blood supply of all organs of the body and prevents organ failure;Early brain protection and neurological rehabilitation nursing have greatly improved the prognosis of patients with cardiac arrest;It improves the success rate of patients'treatment, and finally makes

patients recover and discharge smoothly.

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一例体外膜肺氧合成功救治心脏反复停搏患者的急救和监护

饶俊玲，蒋红云，罗健玲，毛洁花，楚春香，李金娟

粤北人民医院，广东韶关 512000

【摘要】体外心肺复苏，是指在潜在的、可逆病因能够去除的前提下，对已使用传统心肺复苏不能恢复自主心率，或反复心脏停搏而不能维持自主心率的患者，实施动静脉体外膜肺氧合（VA-ECMO），提供暂时的循环及氧合支持的技术。通过对该心脏停搏患者的ECPR术后患者的急救和监护，包括ECOM抗凝与出血的护理、CPR术后亚低温的脑保护护理、容量管理护理、并发症的监测与护理和神经系统的早期康复护理，使患者顺利康复出院。

【关键词】心脏停搏；体外膜肺氧合；个案护理

体外心肺复苏，是指在潜在的、可逆病因能够去除的前提下，对已使用传统心肺复苏不能恢复自主心率，或反复心脏停搏而不能维持自主心率的患者，实施动静脉体外膜肺氧合，提供暂时的循环及氧合支持的技术。有资料显示, 体外心肺复苏 (ECPR)治疗心脏停搏患者自主循环恢复率可高达 9 5%, 存活率达 2 7. 6%~5 0%[1-4]。我院 2022 年 5 月 30 日收治了一例心跳骤停予紧急 ECPR 术的患者，经积极治疗，精心护理，成功救治。本个案为今后临床实践提供案例，交流护理经验，以便同类患者得到更好的护理救治，现将患者个案护理体会报道如下。

1 临床资料

患者男性，44 岁，因“胸痛 4 小时，心跳骤停 3 小时”，反复室颤，急诊抢救室予电除颤 10 次，持续心肺复苏，请重症医学科会诊后紧急 ECPR 术，VA-ECMO 治疗，术后约 10 分钟患者心跳及自主呼吸恢复，仍深昏迷，心电监护示心率 90 次/分，血氧饱和度 100%，故予转我科继续治疗。入院诊断：心跳骤停，室颤，急性心肌梗死？心源性休克，呼吸衰竭，急性肾衰竭；心肺复苏后，缺血缺氧性脑病；高血压病 2 级很高危组；肾结石术后。患者入科时神志昏迷，双侧瞳孔散大，对光反射消失，心率 93 次/分，血氧饱和度 93%，体温 36. 3℃；气管插管呼吸机辅助呼吸，呼吸机模式 SIMV，吸入氧浓度 35%，设置潮气量 300ml，压力支持 15cmH2O，呼气末正压 10cmH2O，呼吸频率（设置）10 次/分。入科后立即予亚低温治疗，行右颈内静脉穿刺置管开通中心静脉通道，行右桡动脉穿刺置管监测有创血压，急查床旁血气，纠正内环境紊乱及酸碱失衡。

2 ECPR 术后护理

2.1 ECMO 抗凝与出血的护理

ECPR 辅助期间，凝血系统的平衡被打破，整个平衡向促凝方向倾斜。为了减少

促凝活性、预防血栓及消耗性出血，抗凝是 ECMO 治疗中最重要的环节[5]。患者右股静脉置入 21F 静脉插管，置管深度 45cm，右股动脉置入 15F 动脉插管，置管深度 18cm，予肝素钠静脉微量泵入，根据患者 APTT、ACT 和血栓弹力图结果调整肝素用量。本患者在 ECMO 治疗期间，ACT 维持在 200s 左右，推荐 ACT 维持范围为 160s-200s，ECMO 置管 8h 后灌注管口周围渗血较多，管口荷包缝合 1 针，出血停止；每班交接班检查患者双下肢动脉搏动的强弱。抗凝治疗期间，尽量避免有创的治疗和护理操作，如动、静脉穿刺。5 月 30 日患者胃内与口腔引流出大量血性液体，气道内吸出少量血性痰，予胃肠减压，调节肝素用量，艾司奥美拉唑护胃；吸痰操作时应尽量轻柔、迅速以避免加重呼吸道及肺部出血,

密切观察口腔粘膜和胃出血的情况；注意观察尿液的颜色。6 月 1 日胃管引流无明显血性，予肠内营养；6 月 4 日患者痰液由血性痰转为黄色浓痰;ECMO 撤机后再停止肝素静脉微量泵入，并密切监测患者凝血谱、血液学指标。拔除 ECMO 管后，置管处用加压装置压迫 24h。为防止患者发生 VTE，予完善床边双下肢彩超检查，动态评估双下肢有无血栓形成；双下肢进行气压泵治疗，促进下肢静脉回流。

2.2 CPR 术后亚低温脑保护护理

低温脑保护为通过人工物理的方法降低患者全身体温或者局部脑温，进而降低脑氧耗、促进脑功能恢复的一种治疗方法[6]。亚低温可以有效改善脑功能预后，具有显著的脑保护作用[7-8]。CPR 后的亚低温治疗能显著降低心搏骤停患者的病死率，减轻神经功能损伤。入科立即予头部冰冒冰敷，使用可控电子调温式水毯，并调节 ECMO 水温箱 35℃，也可通过直接冷却持续性血液净化治疗的循环血流使患者体温维持在 35~36℃。患者转出时神志清醒，头颅 CT 检查提示缺血缺氧性脑改变。

2.3 容量管理护理

为监测患者血流动力学指标，选择右桡动脉留置动脉导管，进行有创血压监测；监测过程中注意观察动脉血压的波形，如：波峰钝圆，波幅降低，上升支及下降支减慢，重搏切迹消失，见于动脉血压监测管路堵塞、心肌收缩力降低、血容量不足；低平波，波幅低，上升支、下降支斜率变大，见于严重的低血压、低心排综合征；波幅高低不等，形态不一，波形间距不等，见于心律失常，如心房纤颤[9]，平均动脉压应维持 50-60mmHg。患者入室血压 88/53mmHg，四肢皮温低，ECMO 引流管反复出现抖管，流量不稳定，予迅速扩容后未出现异常，补液成分以晶体液、白蛋白、血制品为主；每小时测量患者中心静脉压，维持中心静脉压低于 8mmHg。注意患者肢体的灌注情况，通过测量双下肢的周径、观察皮肤的颜色和触摸皮肤的温度进行评估。

2.4 并发症的监测与护理

并发症的预防、早期发现和干预对于患者预后非常关键。ECPR 的并发症几率较高，特别是置管和 ECMO 期间，最常见的是出血，该患者选择超声阴道下经皮股血管置管，减小了 ECMO 置管的出血风险。颅内出血是严重的并发症，需每小时观察患者的瞳孔的变化及对光反射，发现异常及时行 CT 检查，排除脑出血。患者留置中心静脉导管、动脉导管、VA-ECMO 管、血滤管等管道，因此预防导管相关性血流感染非常重要，严格执行手卫生和无菌操作技术，使用无菌透明、透气性好的敷料覆盖，注射药物前用 75%酒精消毒导管链接端口，严禁在 ECMO 管路上进行加药、输血、输液，减少管路接口处的操作。将患者置于单间病房，加强医务人员的工作与计划性集中治疗护理，避免医务人员频繁进出病房。预防 ECMO 管道脱出应用长度大于 40cm 的弹力胶布固定管道，避免管道拉扯或打折。预防发生空气栓塞和血栓栓塞，拧紧 ECMO 管道各个链接口，连续性肾脏替代治疗的期间，要及时更换空的置换液袋，更换液袋时注意夹闭管道，防止空气进入管道；根据患者的凝血功能情况调整肝素用量，避免管道凝血；每班用手电筒照射管道、离心泵和氧合器有无血栓形成。预防发生溶血，注意观察患者有无寒战、高热、低血压、休克等。

2.5 神经系统的早期康复护理

由于心脏停搏患者大脑缺血缺氧，而导致神经功能障碍，早期康复护理措施的介入能有效改善昏迷患者的结局。早期康复时机应选择在患者呼吸、循环、神经系统稳定，且不存在明显康复治疗风险时开展。患者使用镇静镇痛剂期间，使用躁动-镇静评分（RASS 表），进行每日促醒，每天早晨定时停止镇

痛镇静剂的使用，患者家属呼唤患者姓名并以鼓励、询问语言进行交流，播放患者熟悉喜爱的音乐、广播节目；在床上活动，对患者的四肢及躯干进行按摩，每两小时为患者翻身拍背。高压氧疗可以增加组织氧含量，减轻脑水肿，降低颅内压；在进行高压氧前对患者进行心理护理，比如：介绍高压氧舱内的环境、告知氧疗的目的、如何配合氧疗减轻不适感。患者肢体运动康复方案：①良肢位的摆放，减轻肌肉痉挛和异常模式的发生；②被动活动，维持关节活动度预防关节挛缩；③采取渐进式活动方式：床上（床头抬高 30°~80°），坐（床边和床边座椅），床边站和步行训练，推荐每一阶段每天完成 2~3 次，每次 30~60 min，直到能够完全耐受。脑电图监测可以帮助判断脑功能和神经损伤程度，帮助制定患者的个性化康复护理方案[10]。

3 结论

本例患者病情危重，VA-ECMO 为心脏停搏患者提供了循环支持，给患者争取了治疗的宝贵时间，ECPR 术后抗凝与出血的护理既保证了体外心肺复苏机器的正常运转，又减少了该疾病并发症的发生；有效的容量管理保证了全身各脏器的循环血供，防止器官功能衰竭；早期脑保护和神经系统康复护理极大改善了心脏停搏患者的预后；提高了患者救治的成功率，最终使患者顺利康复出院。

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