

Caregiver experience of in-hospital transport in 12 patients treated with VA-ECMO

JIANG Hongyun

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

【 Abstract 】 Objective: To share the care of in-hospital transport for patients treated with veno arterial extracorporeal membrane oxygenation (VA-ECMO). **Methods:** Since the initiation of ECMO in our hospital from June 2019, 12 patients who had VA-ECMO implemented in-hospital were discussed. **Results:** In this group, 8 patients with acute myocardial infarction were successfully transferred to the catheterization room, and after PCI, they were successfully transferred to the ICU to make a seamless street for monitoring and treatment after the transfer energy, and no catheter shift and cardiac arrest occurred. **Conclusions:** First, the objectives of transshipment should be clarified, a transshipment team should be formed, the responsibilities should be clarified, the risk of transshipment should be assessed, second, a standardized transshipment process should be drawn up, verification documents should be applied to guide transshipment efforts, and finally, a contingency plan should be initiated for emergency situations to ensure safety.

【 Key words 】 VA-ECMO;Transport;Nursing

Extracorporeal membrane oxygenation (ECMO) is the introduction of venous blood from the human body into the body, and the blood is pumped into the body by centrifugal pump after oxygenation and carbon dioxide discharge through membrane oxygenator[1]. According to the route of blood transfusion, it can be divided into veno-arterial extracorporeal membrane oxygenation (VA-ECMO) and veno-venous extracorporeal membrane oxygenation (VV-ECMO). VA-ECMO is an auxiliary treatment for patients with cardiac arrest. Through the volume conversion of venous blood, it can reduce pulmonary artery pressure, overload right atrium and right ventricle pressure, improve hypoxemia, and provide circulatory and respiratory support[2]. With more and more clinical applications of ECMO, patients treated with ECMO often need to be transported in hospital due to special reasons. Ensuring the transport safety of patients treated with ECMO for critical illness has become an essential ability of the ECMO team. Since ECMO was carried out in our hospital in June 2019, 12 patients with VA-ECMO have been transferred in the hospital and achieved satisfactory results. The report is as follows:

1 Data and methods

1.1 Clinical data

Since ECMO was carried out in June 2019, 12 patients with VA-ECMO were selected for in-hospital transfer. There were 10 males and 2 females in this group. The age is 20-68 years old. Primary disease: 8 cases of acute myocardial infarction, 1 case of toxic cardiomyopathy, 1 case of electric injury, and 2 cases of valvular heart disease. Reasons for ECMO application: 9 cases, respiratory and cardiac arrest, lactic acid 12.1~2.0 mmol/L

after cardiopulmonary resuscitation; Two patients with valvular heart disease had cardiogenic shock and hemodynamic instability after cardiac valve replacement; One case of toxic cardiomyopathy, cardiogenic shock and hemodynamic instability. All 12 cases met the indications for VA-ECMO use. Transport reasons: 8 patients with myocardial infarction needed to open coronary artery by emergency cardiac catheterization; One patient with electric injury needs to be transferred to ICU for further treatment; 2 patients with valvular heart disease need to be transferred to ICU after operation; One patient with toxic cardiomyopathy needs to be transferred to ICU for hemoperfusion treatment.

1.2 Care

1.2.1 The ECMO transfer team is composed of an ICU doctor with a deputy senior title, two ICU specialist nurses and a respiratory therapist. The team members need to work in ICU for more than 5 years, and must have received ECMO professional training, master the use of various instruments and equipment, and master the observation notes, emergency rescue measures and emergency response plan for emergencies[3]. Clear responsibilities, clear positions and unified command.

1.2.2 The whole process of formulating standardized transfer process includes evaluation before transfer, communication with family members, signing of informed consent, plan before transfer, transfer preparation, observation during transfer, and handover after transfer[3].

1.2.3 Before transfer

The first-out doctor assesses the benefits and risks of transportation and decides whether the patient needs transportation. Hemodynamic instability, inability to maintain effective airway opening, ventilation and oxygenation are the relative contraindications of patient transportation. The ICU specialist nurse assessed the possible risks and the patient's tolerance to the risks, fully aspirated sputum before transport, kept the airway unobstructed, and kept the hemodynamics basically stable. The arterial oxygen partial pressure ≥ 60 mmHg (1 mmHg=0.133kPa), arterial oxygen saturation $\geq 90\%$, systolic pressure ≥ 90 mmHg, and mean arterial pressure ≥ 65 mmHg[4]. Do a good job in explaining the patient's family members, perform the obligation of informing, and medical risk awareness is the hospital managers and medical staff's ideological understanding and behavioral attitude to medical risk[5], and sign the informed consent form.

Determine the transfer personnel, clarify the division of labor, and the ICU has the doctor's unified command to be responsible for the normal operation of ECMO. Pre-adjust the hand pump in the functional position to ensure that the emergency can be started immediately. Respiratory therapists are responsible for the monitoring of the ventilator and the safety of the patient's airway, and the simple respirator assisted breathing in emergency. Two specialist nurses jointly reviewed the ECMO transfer checklist items and drugs, respectively responsible for intravenous administration and observation of vital signs, evaluation of the completeness of the items and drugs, evaluation of the time required for transfer, planning of the route, advance notification of the receiving department and medical elevator to be ready, and evaluation of whether the transfer channel and elevator meet the ECMO transfer space; Contact the special elevator to wait in advance, reduce the transfer time as much as possible, and ensure smooth and safe transfer[6].

The establishment of the transfer list can guide the preparation of ECMO patients for in-hospital transfer. The contents shall include personnel, instruments and equipment, drugs, catheters, etc. Two persons shall check whether the instruments and equipment are complete and in standby state. The oxygen reserve for transfer shall be increased for 30 minutes on the basis of fully meeting the transfer demand. The transfer instrument requires sufficient power and portable power supply. Use the integrated ECMO special transfer lathe. Ensure that the drug allowance is sufficient and the standby drugs are complete. In order to prevent the occurrence of unplanned extubation, the position of each pipeline should be checked before transportation, and appropriate sedation and analgesia should be carried out. Confirm that all pipelines are unblocked and ECMO connection ports are tightly connected to prevent ECMO pipeline air embolism. ACT maintains 180-220S, APTT maintains 50-70S to prevent ECMO thrombosis. Gastrointestinal nutrition was stopped 30 minutes before transfer. After connecting and transferring the ventilator, observe the working status of the ventilator and the patient's condition in the monitoring room for 5 to 10 minutes[6].

1.2.4 In transit

The respiratory therapist stands at the head side of the patient and is responsible for observing the patient's mental pupil, respiration, facial color, ventilator parameters, fixed endotracheal intubation, ventilator pipeline, etc. The ICU doctor stands on the right side of the patient and is responsible for observing the patient's blood pressure, ECMO flow, air flow, blood color of arteriovenous pipeline and fixing ECMO pipeline. The specialist nurse A stands on the right side of the patient and is responsible for observing the patient's vital signs, maintaining the patency of the venous pipeline and intravenous medication. Specialist nurse B stands at the foot side of the patient and is responsible for the delivery of materials and drugs, telephone communication and contact, and observing the limb circulation of the patient. During the examination or operation, the ICU doctor is accompanied throughout the process. In case of an emergency, the ICU doctor will give unified command to start the emergency plan. The MBP is maintained at more than 65mmHg and the SPO is more than 290% during transportation. ECMO should observe the color changes of blood at the arterial and venous ends of the injection, and observe the abnormalities such as clots, air and trembling of the catheter in the pipeline[4].

1.2.5 After transfer

Assess the stability of the patient's vital signs, and transfer the patient to the bed unit together with the responsible nurse and the doctor in charge; The team leader and the receiving medical staff shall hand over the patient's condition, vital signs, whether there is any change in the condition during the transfer, current medication, pipeline conditions, ECMO parameters, and operation of other equipment and instruments, and jointly check the patient. After confirmation, both parties shall sign and make the handover record[7].

1.2.6 Document records

The vital signs (body temperature, heart rate, systolic pressure, diastolic pressure, oxygen saturation, respiratory rate), ECMO pump speed, blood flow, oxygen flow, oxygen concentration, exposed length of arterial catheter, exposed length of venous catheter, temperature of ECMO water tank, ventilator parameters, drug use and adverse events during transportation were recorded.

2. Results

In this group, 8 patients with acute myocardial infarction were successfully transferred to the cardiac catheterization room, and some patients were successfully transferred to the ICU for treatment after PCI, so as to achieve seamless street connection for monitoring and treatment after energy transfer, without catheter displacement and cardiac arrest. Among them, 1 case of ECMO had obvious blood leakage at the puncture port, and the medical staff changed the dressing together before the transfer, and the sandbag was pressurized. The transfer time of 8 cases to cardiac catheter room was 10-19 minutes. In one case, ECMO stopped the pump and immediately started the manual centrifugal pump after 10 minutes of transfer. During the inspection and troubleshooting, it was found that the mobile power supply connection was loose, the ECMO battery was exhausted, and the recalibrated ECMO operated normally. No adverse events occurred in the other 4 cases. One case of toxic cardiomyopathy was transferred from the emergency department to ICU for 12 minutes. One case of electric injury was transferred to ICU in the emergency department, and the transfer took 14 minutes. 2 The patients with valvular heart disease were transferred from the operating room to the ICU after operation, which took 6 minutes and 8 minutes respectively.

3. Discussion

As an advanced form of severe transport technology, ECMO transport technology provides an effective method for transferring patients with refractory cardiopulmonary failure who cannot be transported under conventional technical conditions to the advanced life center for treatment, thus providing a new choice for the treatment of patients[7]. Our hospital took the lead in setting up an ECMO professional team in northern Guangdong, and through the establishment of ECMO, we can help critical patients with reversible conditions to survive the crisis. ECMO solves the safety problem of cardiopulmonary failure for patients and makes further treatment possible through safe transport[8]. Pay attention to the main clinical problems during the transfer of patients, prepare the transfer personnel and equipment according to the highest possible risk of the patient's condition, and select adequate and effective response measures to ensure the safety of the patient's transfer[9]. A purposeful and planned emergency plan can reduce the risk of transshipment[10]. First of all, it is the basis of safe transfer to clarify the transfer objectives, establish a transfer team, clarify responsibilities, evaluate transfer risks, implement risk notification, check relevant instruments, equipment, articles, drugs, etc. , communicate with relevant departments in advance, and plan transfer routes. During the transfer process, each member should clarify the division of labor, homogenize the monitoring and care with ICU[11], launch the emergency plan in case of emergency, ensure safety, develop standardized transfer process, and apply the checklist to guide the transfer work, which can reduce the occurrence of adverse events[12].

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12 例 VA-ECMO 治疗患者院内转运的护理体会

蒋红云

粤北人民医院, 广东韶关 512000

【摘要】目的：针对静脉-动脉体外膜肺氧合（VA-ECMO）治疗患者院内转运的护理进行分享。方法：针对我院从2019年6月开展ECMO以来，12例实施VA-ECMO患者进行了院内转运的情况进行讨论。结果：本组8例急性心肌梗死患者成功转至心导管室，PCI术后成功转入ICU治疗，做到转运前后监测和治疗的无缝衔接，无导管移位和心跳骤停等情况发生。结论：首先明确转运目标，组建转运团队，明确职责，评估转运风险，其次，制订标准化转运流程，应用核查单指导转运工作，最后，紧急情况启动应急预案，确保安全。

【关键词】VA-ECMO；转运；护理

体外膜肺氧合（ECMO）是将人体内的静脉血引到体外，经过膜式肺氧合器氧合和二氧化碳排出后由离心泵将血液泵入体内^[1]。根据血液回输的途径分为静脉-动脉体外膜肺氧合（VA-ECMO）和静脉-静脉体外膜肺氧合（VV-ECMO）。VA-ECMO是心脏骤停患者的抢救辅助治疗手段，通过静脉血的容量转换，降低肺动脉压力、超负荷的右心房和右心室压力，改善低氧血症，提供循环和呼吸支持^[2]。随着ECMO越来越多的临床应用，ECMO治疗患者由于特殊原因常常需要院内转运，保障危重症ECMO治疗患者转运安全，成为ECMO团队的必备能力。我院从2019年6月开展ECMO以来，已有12例实施VA-ECMO患者进行了院内转运，取得了满意的效果，现报道如下。

1 资料与方法

1.1 临床资料

选择从2019年6月开展ECMO以来，12例实施VA-ECMO患者进行院内转运。本组男10例，女2例。年龄20~68岁。原发病：急性心肌梗死8例，中毒性心肌病1例，电击伤1例，心脏瓣膜病2例。应用ECMO原因：9例，呼吸心跳骤停，心肺复苏后，乳酸12.1~20.0 mmol/L；2例心脏瓣膜病心脏瓣膜置换术后，心源性休克，血流动力学不稳定；1例中毒性心肌病，心源性休克，血流动力学不稳定。12例均符合VA-ECMO使用指征。转运原因：8例心肌梗死患者需紧急转至心导管室开通冠状动脉；1例电击伤患者需转ICU进一步治疗；2例心脏瓣膜病患者术后需转ICU治疗；1例中毒性心肌病患者，需转ICU行血液灌流治疗。

1.2 护理

1.2.1 成立ECMO转运小组小组成员由一名副高职称ICU医生，两名ICU专科护士，一名呼吸治疗师。小组成员需ICU工作5年以上，必须经过ECMO专业培训，熟练掌握各种仪器设备的使用，掌握病情观察要、紧急抢救措施以及突发事件应急预案^[3]。职责明确，站位清晰，统一指挥。

1.2.2 制定标准化转运流程整个流程包括转运前的评估，与家属的沟通，签署知情同意书，转运前的计划，转运准备，转运过程中的观察，及转运后的交接等^[3]。

1.2.3 转运前

先由医生评估转运的获益及风险，决定该患者是否需要转运，血流动力学不稳定、不能维持有效气道开放、通气和氧合是患者转运的相对禁忌。由ICU专科护士对可能发生的风险及患者对风险的耐

受程度进行评估,转运前充分吸痰,保持气道通畅,维持血流动力学基本稳定,动脉血氧分压 ≥ 60 mmHg (1 mmHg=0.133kPa),动脉血氧饱和度 $\geq 90\%$,收缩压 ≥ 90 mmHg,平均动脉压 ≥ 65 mmHg^[4]。做好患者家属的解释工作,行告知义务,医护风险意识是医院管理者和医务人员对医疗风险的思想认识和行为态度^[5],签署知情同意书。

确定好转运人员,明确分工,ICU有医生统一指挥,负责ECMO正常运行,预先调整手摇泵处于功能位,确保紧急情况可以立即启动。呼吸治疗师负责呼吸机监测及患者气道安全,紧急情况简易呼吸器辅助呼吸。两名专科护士共同复核ECMO转运核查表物品及药品,分别负责静脉用药和观察生命体征,评估物品、药品是否完好,评估转运所需时间,规划好路线,预先通知接收科室以及医用电梯做好准备,评估转运通道和电梯是否满足ECMO转运空间;联系专用电梯提前等候,尽可能压缩转运时间,保证转运畅通、安全^[6]。

制定转运清单能指导ECMO患者院内转运的准备工作。内容应包括人员、仪器设备、药物、导管等。双人核查仪器设备是否齐全,且备用状态,转运氧气储备应在充分满足转运需求的基础上增加30 min。转运仪器要求电量充足,并携带移动电源。使用一体化ECMO专用转运车床。确保药物余量充足,备用药物齐全。为预防非计划拔管的发生,转运前应先检查各管道位置,适当的镇静镇痛。确认各管路通畅,确认ECMO各连接口连接紧密,预防ECMO管路气栓。ACT维持180-220S,APTT维持50-70S预防ECMO血栓形成。转运前30min停胃肠营养。连接转运呼吸机后,应在监护室观察5~10 min呼吸机工作状态及患者的情况^[6]。

1.2.4 转运中

呼吸治疗师站在患者头侧,负责观察患者神志瞳孔、呼吸、面色、呼吸机参数及固定气管插管、呼吸机管路等。ICU医师站患者右侧,负责观察患者血压、ECMO流量、气流量、动静脉管路血液颜色及固定ECMO管路。专科护士A站患者右侧,负责观察患者生命体征,维持静脉管路通畅,静脉用药。专科护士B站患者脚侧,负责用物、药物传递,电话沟通联系,观察患者肢端循环情况。检查或手术过程中由ICU医生全程陪同。如遇突发事件,有ICU医师统一指挥,启动应急预案。转运过程中维持MBP为65mmHg以上,SPO₂90%以上。ECMO要关注动脉端、静脉端血液的颜色变化,管道内有凝血块、空气、导管抖动等异常观察^[4]。

1.2.5 转运后

评估病人生命体征平稳,转运小组和责任护士、主管医生共同把患者转移至床单位;由组长与接收医护人员交接病人病情、生命体征、转运途中是否出现病情变化、目前用药、管路情况、ECMO参数、其他设备仪器运转情况等,共同查看病人,确认无误后双方签字并做好交接记录^[7]。

1.2.6 文书记录

记录病人转运前、转运中、转运后的生命体征(体温、心率、收缩压、舒张压、氧饱和度、呼吸频率)、ECMO泵转速、血流量、氧流量、氧浓度、动脉导管外露长度、静脉导管外露长度、ECMO水箱温度、呼吸机参数、药物使用情况及转运过程中不良事件发生情况。

2. 结果

本组8例急性心肌梗死患者成功转至心导管室,PCI术后有成功转入ICU治疗,做到转运能后监测和治疗的无缝衔接,无导管移位和心跳骤停等情况发生。其中1例ECMO动脉管穿刺口渗血明显,转

运前医护共同更换敷料,沙袋加压。8例转运至心导管室时间为10-19min。1例在转运10min时,ECMO停泵,立即启动手工离心泵。在检查排除故障时,发现移动电源连接松脱,ECMO电池耗尽,重新定标ECMO运转正常。其余4例转运均无不良事件发生。1例中毒性心肌病,由急诊科转运至ICU,转运时间为12min。1例电击伤,有急诊科转运至ICU,转运用时14min。2心脏瓣膜病患者术后从手术室转运至ICU,分别用时6min和8min。

3. 讨论

ECMO转运技术作为重症转运技术的高级形态,为将常规技术条件下无法转运的难治性心肺功能衰竭患者转至高级生命中心接受治疗提供了一种有效方法,从而为患者的救治提供了新的选择^[7]。我院在粤北地区率先组建ECMO专业团队,通过建立ECMO为病情可逆的危重症患者度过危机时刻。ECMO为患者解决心肺衰竭的安全问题,并通过安全转运让进一步治疗成为可能^[8]。关注患者转运过程中的主要临床问题,依据患者病情可能出现的最高风险,按相应分级进行转运人员和装备的准备,并选用充分有效的应对手段,以保证患者转运安全^[9]。有目的和计划的应急预案可降低转运风险^[10]。首先明确转运目标,组建转运团队,明确职责,评估转运风险,落实风险告知,核查相关仪器设备、物品、药品等,预先与相关科室沟通预约,规划转运路线等都是安全转运的基础。转运过程中,各成员明确分工,与ICU同质化监测护理^[11],紧急情况启动应急预案,确保安全,制订标准化转运流程,应用核查单指导转运工作,可减少不良事件的发生^[12]。

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