

*** Experience sharing ***

Two cases of combined heart lung transplantation, CHLT, the extraction and the preservation of donors' heart and lung

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Combined Heart Lung Transplantation, CHLT, has been recognized as an effective method in treating the patient at the terminal stage of heart and lung diseases. As the implementations of the operation techniques, organ preservation and the immune inhibitors, globally, the CHLT operation cases have been increasing rapidly currently. According to the 1994 Report of The International Association of Heart Lung Transplantation, more than 1200 cases of CHLT operations have been completed in the world since 1981[1]. Because of the scarcity of the donors, the procurement and the preservation of the donors heart lung has become the critical step in the success of a CHLT[2]. The main principles in the operations are to reduce the warm ischemia time for heart and lung as much as possible, to perfuse the donors heart and lung thoroughly, and to preserve the organs into the low-temperature perfectly[2]. Our hospital has completed two cases of CHLT so far, now we would share our experience in the procurement and the preservation of the donors heart and lung during the operation.

Materials and methods: there are two recipients, the first one is a 30 year old male, the second one is a 33 year old female. Pre-Operational diagnosis were all congenital heart disease CHD, ventricular septal defect VSD, severe pulmonary hypertension, Eisenmenger's syndrome, pre-operational cardiac functionality ranged Class III-IV, which were suitable for CHLT, the operation date was picked after donors were chosen.

Operational procedures: after the donors entered the operation room, they were treated with routine anesthesia and endotracheal intubation, they were treated with intravenous injection of 1g of Methylprednisolone Sodium Succinate (Sou-Medrol), and heparin (3mg/kg). After the anesthesia took effect, routine disinfection was conducted and the cloth was laid on, the cut was taken right in the middle, a routine operational procedure was implemented to quickly thrust into the thoracic cavity, the pericardium was opened by the upside down T-shaped cutting, the aorta and the pulmonary artery were freed up, using 4-0 prolene thread, a purse was made at the root of the aorta and the bifurcation of the pulmonary artery, then a Sans perfusion needle and the big-gauged pulmonary artery perfusion tube (14 F) were inserted. Then PGE1 was perfused via

pulmonary artery perfusion tube at the speed of $25\mu\text{g}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$ in order to resist the blood vessels constrictions due to the low-temperature perfusion [3], in the mean time, due to its effect in expanding the pulmonary blood vessels, it will also make the lung perfusion thorough and uniform. The dose of perfusion was doubled after two minutes, then doubled again after another two minutes. The pleura was cut on both sides behind the sternum, the thoracic cavity was fully opened on both sides, and the pericardium was cut off. The aorta was blocked, the root of the aorta was perfused with 4°C HTK cardiac muscle perfusion solution, in the meantime the inferior vena cava was cut off, and the left atrial appendage (LAA) was cut open to minimize the pressure within the heart chamber. The lungs were perfused with HTK lung perfusion solution via lung perfusion tube, the surfaces of the heart and the both sides of lungs were watered with ice mud, the temperature was reduced rapidly, when the perfusion was satisfactory, the aorta was cut a high-level, the anesthesiologist was informed to expand the lungs slightly. The trachea was jawed and cut at a high-level, the esophagus and the posterior mediastinum tissues surrounding the descending aorta was separated at the direction from the head to the tail, the ligament at the lower lungs was clamped and cut, the entire heart and lung were taken out and emerged into the ice mud saline, and delivered quickly.

Discussion: Our experience is that the keys in the success of the operation are to thoroughly perfuse, to reduce the temperature quickly as well as to minimize the pressure effectively.

1. Regarding the perfusion solution, we used the heart lung perfusion solutions popular in Europe, i.e. HTK heart perfusion and lung perfusion solutions. The recipe of both solutions are based on BredSchneider solution, only a couple of elements are different, even though these two perfusion recipes are very similar, but they must be distinguished strictly from each other when you use them. Because the lung perfusion solution has an element of colloid, which would block the microcirculation if it is used in the heart. Most of the reports indicated that St. Thomas solution was used for heart perfusion, this method is relatively popular, and there is no special requirements for perfusion, but none of the reports mentioned the time interval between perfusions. This kind of perfusion must be repeated every 20 minutes, even during the process of stitching, it is relatively tedious, and also would prolong the operation time, therefore it is difficult to perform especially when long-distance delivery is involved and it is not safe either.
2. Regarding the volumes of perfusion, most reports indicated that the perfusion volumes for heart and lung must reach 3000 and 4000 mls respectively, somebody even suggested to perfuse over 10,000 mls. In the first case of our operations, we perfused 1500 ml and 4000 ml for heart and lung respectively, after the procurement of heart and lung, we observed some pink residues in the middle and the lower parts of the two lungs, the perfusion was not satisfactory. It is also possible that it is related to the fact that the perfusion tube dropped out once during the operation and it caused the uncertainty of the perfusion volume. The second case of the operation was very good, the perfusion was good and the heart and the lungs perfusion solutions were clear, no pink residues was fund on the lungs.
3. Regarding the control of the perfusion pressure, since the pulmonary circulation system has the characteristic of low-pressure and high-volume, most reports requires that the perfusion should be performed at low pressure, not higher than 20 mmHg, which means not higher then the donors' pulmonary arteries pressures. Otherwise, it may course lung damages. However,

some other people believe the perfusion should be performed at high pressure and with big volume (50 ~ 60mmHg, 60ml/kg), the purpose of it is to get rid of the thrombosis in the capillaries and heterogeneous reaction originals. Due to the lack of our capacity, we did not accurately monitor the perfusion pressure in the operation.

4. Effective reduction of pressure in heart chamber: in addition to cutting the inferior vena cava, the left atrial appendage should also be cut open.
5. Regarding the protective ice mud, we believe that the crushed ice should be prohibited, because it can severely damage the donors lungs; the usage of ice mud is extremely big, several tens of thousands of milliliters should be prepared, due to the lack of experience of our first case of operation, we did not have enough prepared, and the operation was delayed for several minutes.
6. Regarding the stop of bleeding, we emphasize that electrocautery should be not used, instead, use the routine stitching closures, because the use of electrocautery to stop bleeding is not reliable and may cause increase of local temperature.
7. Regarding the separation of the tissues surrounding the trachea, we suggest to preserve as much as possible, we used fingers to separate them bluntly.
8. Regarding the ventilation, the inhaled oxygen content should not be more than 40% during the operation, because too much oxygen may increase the content of oxygen radicals in the lungs, and increase the damage of the lung re-perfusion. The lung was expanded according to the requirements before the cut off of the trachea here in the first case of the operation, it was discovered that part of the lung lobes collapsed, it is considered that it might be caused by not having enough tidal volume during the operation, and this situation might in consequence leads to the lack of enough perfusion for some localities, this situation needs further studies.

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