Editorial

Donor lung inflation: are we doing it right?

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Lung recruitment is among the first things done during standard donor lung retrieval. Recruitment maneuvers at 25–30 cmH_2O are performed to help recruit atelectatic areas. Functional assessment is then performed by sending blood gases either from the arterial line or from individual pulmonary veins. After considering all available information such as compliance, recoil, blood gases and bronchoscopic findings a decision is made regarding acceptance of donor lungs. All these actions are performed prior to heparinization and aortic cross clamping.

The hemodynamic consequences of recruitment maneuvers during donor procurement also known as intraoperative Valsalva maneuver are well documented (1,2). Often times the hemodynamics are severely altered while inspecting and recruiting the left lung due to physical pressure on the heart. These can at times be difficult to recover from and can make the donor unstable and consequently even from a hemodynamic standpoint undesirable.

However, the changes to the lung parenchyma itself are unclear. Perhaps these maneuvers can potentiate lung edema in brain dead donors who already have a catecholamine surge, and cytokine release with a proinflammatory state (3).

In the present manuscript Niman *et al.* (4), have demonstrated that lung recruitment after cardiac arrest during donor lung procurement has a protective effect on both the donor lung as well as following transplant. The authors should be congratulated for their efforts to study an innovative method to mitigate donor lung damage during procurement and for the novel concept.

Their study demonstrated that lungs recruited prior to aortic cross clamping showed significant deterioration in graft function. On the contrary, those recruited after aortic cross clamping seemed to afford protection from reperfusion injury seen in the earlier group. The wet/dry ratio was higher in the blood circulated group (BCR) as opposed to the non BCR group. The P/F ratio was better when the lungs were procured after being inflated after cross clamping compared to the group with blood circulation. Thus, lack of blood circulation during lung recruitment maneuvers helps ameliorate the harmful effects of re-expansion pulmonary edema (RPE) seen in atelectatic donor lungs utilized for transplantation.

While conditions were similar among all the groups this reaffirms that lung injury perhaps occurred while the atelectatic lungs were inflated under blood perfused conditions within the donor (4).

It has to be reiterated that these were normal lungs to begin with. It will be interesting to see if such a study can be reproduced or undertaken in humans with brain dead donors and donation-after circulatory determination of death (DCDD) donors and then study the effect of donor lung recruitment with and without blood flow. Another point that needs to be looked into is whether we are inflating lungs at higher than needed pressure with chest open which can in itself be compounding the problem. Indeed, the ideal inflation pressure is currently unknown. Previous CT studies have shown an airway pressure requirement of 40 cmH_2O to eliminate all atelectasis. However, this was in adults under anesthesia with a closed chest, even less is known about the ideal pressure in a patient whose pleural space is open to atmosphere (5).

Their approach (4) is appealing but perhaps difficult to implement into current donor procurement algorithms in brain-dead donors since functional lung assessment is one

of the cornerstones of deciding whether to accept lungs for transplant. In the presence of minimal atelectasis, it is perhaps beneficial to forego routine lung recruitment maneuvers and wait till aortic cross clamping. Obviously, the question arises in those cases with bilateral lower lobe atelectasis seen more often as to how one should proceed based on the data from this study. If the lungs are not boggy or consolidated and the bronchoscopic findings are acceptable it might be worthwhile recruiting lungs after cross clamping. That however brings into question non-homogenous distribution of perfusate. This is a contentious subject without easy resolution.

It is pertinent to point out that donors do undergo organized lung recruitment prior to arrival in the operating room and it is unclear if this might have already started the cascade of events that are seen during clinical inspection.

DCDD donors would perhaps be an ideal opportunity to implement this novel procurement strategy. Briefly, during DCDD procurement the chest is opened (while the donor is reintubated), heart is vented to exsanguinate the donor and pulmoplegia is instituted, bronchoscopy is performed, and lungs are recruited in no-blood circulated condition as there is already circulatory arrest.

A similar concept has been studied by Lindstedt *et al.* (6). Performing ex vivo lung perfusion (EVLP) using an acellular solution they enabled atelectatic lung recruitment while pausing lung perfusion transiently. In the modified subset, lung weight was relatively unchanged, while in the conventional EVLP group, the lungs were heavier. They concluded that modified EVLP with ventilation without perfusion has the ability to help recruit atelectatic lungs without adverse effects (6). It remains to be seen if the same results can be reproduced with EVLP using the organ care system (OCS) which uses blood perfusate.

In conclusion, donor lung inflation performed after aortic cross clamping or following circulatory cessation has the ability to mitigate reperfusion pulmonary edema and thereby potentially improve graft function after transplantation. This can be a turning point if it can be successfully reproduced in clinical trials involving human donors. We once again congratulate the authors on their innovative concept.

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