TRANSPLANT INTERNATIONAL

Transplant International ISSN 0934-0874

INVITED COMMENTARY

A bridge over troubled waters

Massimo Boffini,[1] Davide Ricci,[1] Vito Marco Ranieri[2] and Mauro Rinaldi[1]

1 Cardiac Surgery Division, Surgical Sciences Department, ASOU Città della Salute e della Scienza, University of Turin, Turin, Italy
2 Intensive Care Medicine, Surgical Sciences Department, ASOU Città della Salute e della Scienza, University of Turin, Turin, Italy

Correspondence
Massimo Boffini MD, Assistant Professor, Cardiac Surgery Division, Surgical Sciences Department, ASOU Città della Salute e della Scienza, University of Turin, Corso Bramante 88/90, 10126 Turin, Italy.
Tel.: 0039 011 6335511;
fax: 0039 011 6336130;
e-mail: massimo.boffini@unito.it

Conflicts of interest
The authors have declared no conflicts of interest.

Received: 3 December 2014
Accepted: 5 December 2014

doi:10.1111/tri.12505

Lung transplantation (LTx) remains the only therapeutic strategy for the treatment of end-stage respiratory failure in selected patients [1,2]. However, clinical scenario of LTx is rapidly changing. Two aspects still characterize LTx in comparison with the transplant of other solid organs. First, only a limited number of lung grafts is considered suitable for transplant within the donors' pool. Secondly, patients quickly deteriorating while on the waiting list cannot be bridged for long periods [3]. These limitations result in a long period and a high mortality rate on the waiting list. Different strategies have been proposed to overcome these problems. Among those, the *ex vivo* lung perfusion (EVLP) appears the most promising one. Several lung transplant centers have been implemented with an EVLP program worldwide. EVLP is applied to evaluate and eventually recondition marginal or even initially rejected grafts, allowing an increase of transplanted grafts with clinical results as good as those obtained with the use of "standard" lungs [4,5].

Despite the effect of such strategies, the mismatch between the request and the offer still remains and the donor/recipient matching plays a crucial role to achieve the optimal risk/benefit ratio after transplant. Rapidly deteriorating patients waiting for lung transplant can be supported with mechanical ventilation and/or extracorporeal lung support (by means of extracorporeal circulatory membrane oxygenation or CO_2 removal devices) only for a limited period of time, and LTx remains the definitive therapy. Therefore, critically ill patients suffering from severe hypercapnic or hypoxic respiratory insufficiency represent a real challenge in LTx.

Ethical and clinical concerns arise when lungs are transplanted in supported patients because of the higher risk of transplant failure directly related to the critical status of the recipient. On the other hand, emergency LTx represents the only survival chance for these patients. In addition, emergency transplantation can reduce the number of grafts employed for standard cases loosing the survival benefit of elective procedure.

In the paper entitled "Extracorporeal CO2-removal as bridge to lung transplantation in life-threatening hypercapnia", Schellongowski P. *et al.* [6] describe optimal results

both in terms of transplant rate and of survival with the use of CO2-removal devices as a bridge to LTx in patients with severe hypercapnia.

Excellent clinical outcomes of transplant performed on supported patients are due to several reasons. The first one is the availability of more reliable technologies such as polymethylpentene oxygenators, heparin-coated circuits, double-lumen cannulas, pumpless technologies, and new-generation centrifugal pumps. Technological improvements allow a wider and an earlier application of extracorporeal support, reducing the need of mechanical ventilation that is considered a significant detrimental risk factor. As these technologies are applicable only for short periods of time, organ procurement organizations should be able to offer a suitable graft in a reasonable period of time. This aspect is clearly evident in the Italian experience. Few years ago, we reported our initial results with CO2 removal devices in patients awaiting lung transplantation [7]. The efficacy of these devices in the short term was clearly demonstrated; however, transplant rate was only 25%. At that time, a proper protocol of prioritization was not active in Italy and the chance for supported patients to be transplanted was the same as for elective patients. In November 2010, a national protocol of lung transplant priority has been activated in Italy. The preliminary analysis of this program has shown a 79% transplant rate (after a mean period of urgent waiting list of nearly 10 days) with acceptable medium-term results (30-day, 6-month, and 1-year survival rates of 81.8, 76.2, and 71.4%, respectively) [8]. Bridge to lung transplant strategy is therefore feasible, but it relies on the availability of a graft in a relative short period of time. Another critical point is the accurate selection of the candidate in terms of transplant suitability. Although not fully demonstrated, a common feeling is that morbidity and mortality of LTx are much more recipient related than donor related. A more aggressive strategy of support, in an early phase of the disease, can be helpful to preserve multi-organ function and to reduce the risk of multi-organ failure. This allows to keep the of risk/benefit ratio of transplant in the favor of benefit.

The experience reported by Schellongowski P. *et al.* is absolutely valuable, and it demonstrates a significant progress in the treatment of end-stage respiratory failure. For this reason, the authors must be congratulated for providing such good results.

Funding

The authors declared no funding.

References

1. Yusen RD, Edwards LB, Kucheryavaya AY, *et al.* The registry of the International Society for Heart and Lung Transplantation: thirty-first adult lung and heart-lung transplant report–2014; focus theme: retransplantation; International Society for Heart and Lung Transplantation. *J Heart Lung Transplant* 2014; **33**: 1009.
2. Boffini M, Ranieri VM, Rinaldi M. Lung transplantation: is it still an experimental procedure? *Curr Opin Crit Care* 2010; **16**: 53.
3. Del Sorbo L, Boffini M, Rinaldi M, Ranieri VM. Bridging to lung transplantation by extracorporeal support. *Minerva Anestesiol* 2012; **78**: 243.
4. Boffini M, Ricci D, Barbero C, *et al.* Ex vivo lung perfusion increases the pool of lung grafts: analysis of its potential and real impact on a lung transplant program. *Transplant Proc* 2013; **45**: 2624.
5. Boffini M, Ricci D, Bonato R, *et al.* Incidence and severity of primary graft dysfunction after lung transplantation using rejected grafts reconditioned with ex vivo lung perfusion. *Eur J Cardiothorac Surg* 2014; **46**: 789.
6. Schellongowski P., *et al.* Extracorporeal CO2-removal as bridge to lung transplantation in life-threatening hypercapnia. *Transpl Int* 2014; **28**: 297.
7. Ricci D, Boffini M, Del Sorbo L, *et al.* The use of CO2 removal devices in patients awaiting lung transplantation: an initial experience. *Transplant Proc* 2010; **42**: 1255.
8. Boffini M, Venuta F, Rea F, *et al.* Urgent lung transplant programme in Italy: analysis of the first 14 months. *Interact Cardiovasc Thorac Surg* 2014; **19**: 795.