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# Extended donor lungs: eleven years experience in a consecutive series☆

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**Abstract**

**Objective**: The aim of this study was to delineate the profile of extended donor lungs in comparison to ideal donor lungs and to analyse their outcome. Particular attention was given to donor lungs with a low $PaO_2$ (<250 mmHg) before harvesting or with multiple extended criteria. **Methods**: Between 1993 and 2003, 148 patients (79 women, 69 men, mean age 39.9 years) underwent lung transplantation. Indications were cystic fibrosis in 35.8%, emphysema in 26.4%, pulmonary fibrosis in 12.2%, pulmonary hypertension in 9.5%, and others in 16.1%. Donor data and recipients medical files were reviewed. Criteria for donor lungs were considered extended if one or more of the following criteria were met: age >55 years, smoking >20 pack-years, $PaO_2$ before harvesting <300 mmHg, pathologic chest X-ray, and purulent secretion at bronchoscopy. A comparison between recipients from ideal and from extended donor lungs was performed with respect to the median duration of mechanical ventilation, the median length of stay at the intensive care unit, postoperative complications, the 30-day and the 1-year survival, and the 6-month follow-up spirometry. **Results**: Sixty-three (42.6%) donor lungs were considered extended and 20 (31.7%) met more than one criteria. Outcome comparison between recipients from ideal (I) and extended (II) donor lungs did not statistically differ in postoperative complications (18.8% (I) vs. 26.9% (II), $P=0.32$), mean duration of mechanical ventilation (d) ($4.4\pm2.7$ (I) vs. $2.6\pm2.1$ (II), $P=0.2$), mean length of stay at the ICU (d) ($11.5\pm8.8$ (I) vs. $9.2\pm6.9$ (II), $P=0.4$), 6-month pulmonary function (FEV1 $=83\pm23$% of the predicted value (I) vs. $82\pm18$% (II), $P=0.81$), 30-day survival (90.6% (I) vs. 93.7% (II), $P=0.56$), 1-year survival (83.5% (I) vs. 81% (II), $P=0.83$). Thirty-day survival was also comparable even in recipients from donor lungs with $PaO_2<250$ mmHg ($n=8$) (90.6% (I) vs. 87.5%, $P=0.57$). The number of extended criteria had no impact on the outcome. The combination of $PaO_2<300$ mmHg with purulent secretion at bronchoscopy seemed to influence the early outcome of recipients from extended donor lungs negatively. **Conclusions**: Our results suggest that the use of selected extended donor lungs does not compromise the outcome after transplantation. $PaO_2$ <250 mmHg before harvesting of the lungs is not an absolute contra-indication for transplantation.


*Keywords:* Lung transplantation; Extended donor lungs; Outcome

## 1. Introduction

Lung transplantation is an established treatment for selected patients with end-stage lung or pulmonary vascular disease [1,2]. Like for all solid-organ transplants, the demand for donor lungs clearly exceeds the supply and the mortality while waiting for transplantation remains high. The donor lungs can become injured by the mechanism of death, smoking, fluid resuscitation, neurogenic pulmonary edema, aspiration pneumonia, or nosocomial pneumonia. One approach to increase the number of donor lungs is to attempt to improve the condition of donor initially considered unacceptable by aggressive medical management [1–4]. Additionally to overcome the limitation of donor lungs, liberalization of donor selection criteria has been considered to expand the available donor pool [5,6]. Previous reports from some experienced transplantation centers worldwide suggest that the use of non-ideal or extended (or marginal) donor lungs can expand the donor pool without compromising results from transplantation [2,3,5,7,8]. However, an increased early mortality rate in transplanted patients was observed in some series after use of extended donor lungs [3]. The aim of this retrospective study was to delineate the profile of extended donor lungs and to analyse the outcome after their use in our

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transplantation center. Particular attention was given to donor lungs with a low $PaO_2$ (<250 mmHg) before harvesting or with multiple extended criteria.

Since lung transplantation has evolved during the last years, consecutively to changes in donor lungs treatment and in intraoperative and postoperative recipient management, two periods of time were considered in the analysis of the outcome, from 1993 to 1998 and from 1999 to 2003.

## 2. Material and methods

From November 1992 to November 2003, a consecutive series of 148 patients, including 79 women and 69 men, with a mean age of 39.9 years (range 12–66 years) underwent lung transplantation at the University Hospital Zurich. A total of 148 donors were used in this series. A retrospective analysis of the computerized database was considered to review data for this study. Indications for transplantation were cystic fibrosis in 53 patients (35.8%), emphysema in 39 patients (26.4%), pulmonary fibrosis in 18 patients (12.2%), pulmonary hypertension in 14 patients (9.5%), and others like histiocytosis, bronchiectasis, or lymphangio-leiomyomatosis in 24 patients (16.1%). Donors were divided in two groups: ideal or extended. Donor lungs were considered extended if any one of the following criteria were met: age >55 years, smoking history >20 pack-years, pathologic chest X-ray, $PaO_2$ before harvesting of <300 mmHg on 100% oxygen with 5 cm $H_2O$ positive end-expiratory pressure, or purulent secretion at bronchoscopy. Donor arterial $PO_2$ was based on the final measurement before harvesting and after donor resuscitation and management. All the donors were managed to maintain euvolemia and to avoid excessive fluid administration. Donors received 1 g of intravenous methylprednisolone (Solumedrol®) and 2.2 g amoxycillin with clavulanic acid (Augmentin®) after initial contact with the donor hospital. Harvesting of the lungs followed standard procedures with an antegrade flush through the main pulmonary artery with the Euro-Collins solution till 1998 and then with a low potassium dextran solution (Perfadex®) after administration of prostaglandin E2 (Prostin®). A retrograde perfusion was also done on the back table.

A subgroup analysis was performed comparing recipients from ideal donor lungs with recipients from extended donor lungs which met just one or more than one criteria, or with $PaO_2$ before harvesting <250 mmHg.

The analysed end-points consisted of the 30-day mortality, the 1-year mortality, the 6-month follow-up spirometry (forced expiratory volume in 1 s, FEV1), the median duration of mechanical ventilation, the median length of stay at the intensive care unit (ICU), and postoperative complications.

Statistical analysis was performed with SPSS computer soft-ware. The Student's *t*-test for unpaired observation was used where appropriate. Survival data were estimated by use of the Kaplan–Meier life table analysis and compared with the log rank test. Statistical significance was accepted at $P<0.05$.

## 3. Results

From the 148 patients included in the study, 63 (42.6%) donor lungs were considered extended and 85 (57.4%) were ideal donor lungs. The use of extended donor lungs increased with time from 1999 up to 70% in 2003 (Fig. 1). The indications for transplantation in the recipients of the ideal donor group were cystic fibrosis in 31 patients (36.5%), emphysema in 23 patients (27.1%), pulmonary fibrosis in 10 patients (11.8%), pulmonary hypertension in six patients (7.1%), and others in 15 patients (17.5%). Twenty of the 63 recipients from extended donor lungs (31.7%) met more than one criteria. The incidence of the different criteria defining extended donor lungs was 12/63 (19%) for donor age >55 years, 20/63 (32%) for smoking >20 pack-years, 15/63 (24%) for $PaO_2$ before harvesting <300 mmHg, 29/63 (46%) for pathologic chest X-ray, and 14/63 (22%) for purulent secretion at bronchoscopy. Pathologic signs on chest X-ray were often multiple and included infiltration in 15 patients, pleural effusion and signs of contusion in six patients each, atelectasis in five patients, and pneumothorax in one patient.

Comparison of ideal donors and extended donors with respect to donor cause of death, total donor lung ischemic time, and donor intubation time showed no statistically significant differences. However, donors were significantly older in the extended donor group than in the ideal donor group and donor gender was also significantly different with a larger proportion of men in the ideal donor group than in the extended donor group (Table 1). The type of procedure (unilateral vs. bilateral) and the use of extracorporeal circulation was comparable in the two groups (Table 1). The incidence of postoperative complications, the recipient duration of mechanical ventilation (d) as well as the length of stay at the ICU (d) was also not significantly different (Table 1). Postoperative complications included haematothorax in nine patients, multiloculated pleural effusion in seven patients, pneumonia in six patients, severe arrhythmia in four patients, herniation of the lung in three patients, residual pneumothorax and wound dehiscence in two patients each. Haematothorax, multiloculated effusion was treated thoracoscopically and recovery was uneventful. In our series, eight patients (5.4%) were on intermittent positive pressure ventilation (IPPV) when the transplantation

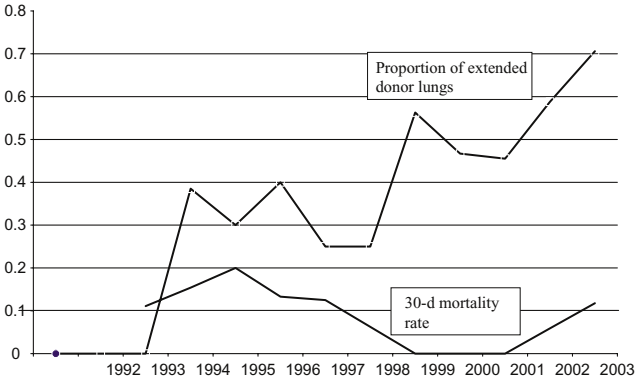


Fig. 1. Relation between the use of extended donor lungs and the 30-day mortality from 1992 to 2003.

Table 1
Comparison between the two groups of ideal and extended donor lungs according to the donor variables, the characteristics of the procedure, the morbidity, the duration of mechanical ventilation and the length of stay at the ICU

| | Ideal donor group ($n=85$) | Extended donor group ($n=63$) | $P$ value |
|---|---|---|---|
| *Donor parameters* | | | |
| Age (mean±SD) | 32.0±11.6 | 39.4±13.8 | 0.001 |
| Gender | | | |
| Male | 55 (64.7%) | 14 (22.2%) | 0.0001 |
| Female | 30 (35.3%) | 49 (77.8%) | |
| Cause of death | | | |
| Trauma | 43 (50.6%) | 33 (50.8%) | 0.087 |
| Nontraumatic | 42 (49.4%) | 30 (49.2%) | |
| Intubation time (h) | 40±34 | 42±35 | 0.73 |
| Ischemic time (h) | 4.56±1.14 | 4.75±1.52 | 0.57 |
| *Recipients parameters* | | | |
| Type of transplantation | | | |
| Unilateral | 17 (20%) | 9 (14.3%) | 0.39 |
| Bilateral | 68 (80%) | 54 (85.7%) | |
| Extracorporeal circulation | 12 (14.1%) | 12 (19.0%) | 0.50 |
| Postoperative complications | 16 (18.8%) | 17 (26.9%) | 0.32 |
| Duration of mechanical ventilation (d) | 4.4±2.7 | 2.6±2.1 | 0.20 |
| Stay at the ICU (d) | 11.5±8.8 | 9.2±6.9 | 0.40 |

was performed. In five of these patients, extended donor lungs were transplanted. One year after transplantation, five patients were alive, including two recipients from ideal donor lungs (66.6%) and three recipients from extended donor lungs (60%).

In the 63 patients who received extended donor lungs, 22 (34%) had cystic fibrosis, 16 (25.4%) suffered from emphysema, eight (12.7%) had a lung fibrosis and a pulmonary hypertension each, and nine (14.3%) another underlying disease. Extended donor lungs which met only one criterion were observed in 37.2% in patients with cystic fibrosis, 18.6% in patients with emphysema, 14% in patients with pulmonary fibrosis, 14% in patients with pulmonary hypertension, and 16.2% in patients with another disease in comparison to 30, 40, 10, 10, and 10% for extended donor lungs which met more than one criterion. Spirometry at 6 months was similar in both groups of recipients, with FEV1=83±23% of the predicted value in the recipients from ideal donor lungs and FEV1=82±18% of the predicted value in the recipients from extended donor lungs ($P=0.81$).

After a mean follow-up of 3.3 years, the survival analysis at 30 days and at 1 year after transplantation showed an overall survival of 91.9% at 30 days and 82.4% at 1 year for the 148 patients. No statistical significant difference was observed between the two groups. Thirty-day survival was 90.6% in recipients from ideal donor lungs as compared to 93.7% in recipients from extended donor lungs ($P=0.56$). Furthermore, the survival at 1 year was also comparable (83.5% in the group ideal donor vs. 81% in the group extended donor lungs, $P=0.83$). Comparison of 30-day and 1-year survival between the periods 1993–1998 and 1999–2003 in all patients, in recipients from ideal and from extended donor lungs showed no statistical significant difference. Additionally, the outcome of recipients from extended donors was comparable to this of recipients from ideal donors for each

Table 2
Thirty-day and 1-year survival in recipients from ideal donor lungs, from extended donor lung according to the period of time

| | All patients | Ideal donors | Extended donors |
|---|---|---|---|
| *30-day survival* | | | |
| 1993–2003 | 91.9% (136/148) | 90.6% (77/85) | 93.7% (59/63) |
| 1993–1998 | 87.5% (63/72) | 85.4% (41/48) | 91.7% (22/24) |
| 1999–2003 | 96.1% (73/76) | 97.3% (36/37) | 94.9% (37/39) |
| *1-year survival* | | | |
| 1993–2003 | 82.4% (122/148) | 83.5% (71/85) | 81% (51/63) |
| 1993–1998 | 77.8% (56/72) | 79.2% (38/48) | 75% (18/24) |
| 1999–2003 | 86.8% (66/76) | 89.2% (33/37) | 84.7% (33/39) |

Fisher's exact test

| | $P$ |
|---|---|
| *Period 1993–1998 vs. period 1999–2003* | |
| 30-day all patients | 0.07 |
| 30-day ideal donors | 0.13 |
| 30-day extended donors | 0.63 |
| 1-year all patients | 0.20 |
| 1-year ideal donors | 0.25 |
| 1-year extended donors | 0.51 |
| *Group ideal donors vs. group extended donors* | |
| 30-day period 1993–1998 | 0.71 |
| 30-day period 1999–2003 | 1 |
| 1-year period 1993–1998 | 0.77 |
| 1-year period 1999–2003 | 0.74 |

period of time (Table 2). The analysis of the survival according to the number of criteria met to define extended donor lungs revealed no significant difference between the group with only one criterion and the group with multiple criteria (93 and 95% at 30 days and 79.1 and 85% at 1 year) ($P=1$). The survival analysis according to the underlying cause of the disease and according to the type of donor lung is given in Tables 3 and 4. The mortality was higher in patients with pulmonary hypertension at 30 days and at 1 year after transplantation but no increase of the 30-day mortality was seen in the recipients from extended donor lungs independently of the underlying disease. Although the proportion of extended donor lungs increased with time, no increase of the 30-day mortality was observed (Fig. 1).

The analysis of the criteria defining extended donor lungs in the 12 recipients who receive such lungs and who died at 30 days or at 1 year showed age >50 years in one patient, smoking >20 pack-years in four patients, $PaO_2$ <300 mmHg in four patients, pathologic chest X-ray in five patients, and purulent secretion in three patients. If we correlate these results with the incidence of the extended criteria in the 63

Table 3
Mortality at 30 days according to the underlying disease and to the type of donor lungs

| Disease ($n$) | 30-day mortality | | |
|---|---|---|---|
| | Ideal | Extended | Total |
| Cystic fibrosis (53) | 2/31 (6.4%) | 2/22 (9.1%) | 4/53 (7.5%) |
| Emphysema (39) | 1/23 (4.3%) | 1/16 (6.2%) | 2/39 (5.1%) |
| Pulmonary fibrosis (18) | 2/10 (20%) | 0/8 | 2/18 (11.1%) |
| Pulmonary hypertension (14) | 3/6 (50%) | 1/8 (12.5%) | 4/14 (28.6%) |
| Other (24) | 0/15 | 0/9 | 0/24 |

Table 4
Mortality at 1 year according to the underlying disease and to the type of donor lungs

| Disease (*n*) | 1 year mortality | | |
|---|---|---|---|
| | Ideal | Extended | Total |
| Cystic fibrosis (53) | 3/31 (9.7%) | 5/22 (22.7%) | 8/53 (15.1%) |
| Emphysema (39) | 2/23 (8.7%) | 5/16 (31.2%) | 7/39 (17.9%) |
| Pulmonary fibrosis (18) | 3/10 (30%) | 0/8 | 3/18 (16.7%) |
| Pulmonary hypertension (14) | 4/6 (66.7%) | 2/8 (25%) | 6/14 (42.9%) |
| Other (24) | 2/15 (13.3%) | 0/9 | 2/24 (8.3%) |

recipients with extended donor lungs, the probability for each criterion to be associated with a bad outcome at 30 days or at 1 year was 4/15 (26.7%) for $PaO_2 < 300$ mmHg, 3/14 (21.4%) for purulent secretion, 4/20 (20%) for smoking $>20$ pack-years, 5/29 (17.2%) for pathologic X-ray, and 1/12 (8.3%) for age $>55$ years. All the patients who died at 30 days had one or more of the criteria $PaO_2 < 300$ mmHg, pathologic chest X-ray, or purulent secretion. In these patients, the criteria age $>55$ years and smoking $>20$ pack-years were never met.

From the 15 patients who received extended donor lungs with a $PaO_2$ before harvesting $<300$ mmHg, special attention was given to the eight recipients from donor lungs with $PaO_2 < 250$ mmHg. The mean value of $PaO_2$ was 208 mmHg (range 168–237 mmHg). The recipients of these eight extended donor lungs included two patients with cystic fibrosis, three patients with emphysema, one patient with pulmonary fibrosis, one patient with pulmonary hypertension, and one patient with histiocytosis. The 30-day survival was 87.5%. The patient with pulmonary hypertension died 2 days after transplantation from an acute organ failure with right heart insufficiency and failure following an important reperfusion injury. The 1-year survival was 75% (6/8). A second patient died 2 months after transplantation from perforation of a duodenal diverticle. The survival at 30 days and at 1 year in this special subgroup of patients was not significantly different from that in the recipients from ideal donor lungs and recipients from extended donor lungs.

## 4. Discussion

The lack of donor lungs is still a relevant problem. Selection criteria for suitable donors were defined at the early days of lung transplantation but they have not been evaluated in scientific trials [9–12]. In our study, we have confirmed that satisfactory outcome of lung transplantation can be achieved with the use of extended donor lungs. Indeed, the use of extended donor lungs enabled us to increase the number of lung transplants performed at our institution, specially in the last 5 years without compromising early- and mid-term outcome.

Furthermore, there was no difference between recipients from ideal donor lungs compared with extended donor lungs in terms of duration of intubation, length of stay at the ICU, 6-month pulmonary function, and postoperative complications. Our rate of perioperative complications was comparable in the two groups of recipients and corresponded to the findings of other reports (15–25%) [3,5].

Several lung transplant centers have also observed successful transplantation with the use of extended donors [2,3,5,7,8]. Aside a liberalization of donor selection criteria to expand the available donor pool, another strategy to increase the number of donor lungs includes attempts to improve the condition of donors initially considered unacceptable [1,2,13–15]. In our study, donor lungs were considered extended in 42.6% after aggressive management before harvesting. This corresponds to the results of other centers in which up to 55% of recipients received extended donor lungs [1,5,8]. Our approach to maximizing organ utilization included early discussion with the intensivists at the donor hospital, management of fluid balance, bronchoscopic toilet of airways to remove secretion and reduce atelectasis, antibiotics, initiation or increase of positive end-expiratory pressure in an attempt to improve the gas exchange. We also gave steroids routinely, since it has been demonstrated that high-dose steroids after brain death can improve oxygenation and can increase lung donor utilization [15]. In our experience, we could observe no difference between the ideal donors and the extended donors in terms of cause of death and ischemic time. Indeed, it has been suggested that brain injury may lead to upregulation of proinflammatory cytokines with increase of the ischemia-reperfusion injury [11]. Waller and coworkers demonstrated that using donor lungs from patients who died of trauma did not in itself compromise early graft outcome, provided that appropriate management strategies were used, including antibiotic treatment [16]. Our study corroborated this and showed no difference between the outcome of recipients from donors who died of trauma and those who died of nontraumatic causes. According to the graft ischemic time, several studies showed that ischemic time alone did not increase 30-day or 1-year mortality [11,17]. However, the combination of a cold ischemic time of $>6$ h with older donor age seemed to increase the mid-term mortality [17]. However, although the extended donors were significantly older in our study, no difference was seen in the analysis of survival between the two groups.

The majority (46%) of our extended donors were defined as such because of a pathologic chest X-ray. This was also the case in the other published series [1,3,7,8]. However, the relevance of the radiologic findings given by the transplantation coordinator is often to take with caution and to be interpreted with the bronchoscopic findings, the gas analysis and the macroscopic aspect and the palpation of the lungs before harvesting. In this respect, the experience of the retrieval surgeon is very important, specially in the case of lung contusion to decide if the whole lung or just a lobe can be transplanted.

The majority of the patients transplanted at our institution suffered from cystic fibrosis and not from emphysema. This is probably due to the fact that our centre is one of the leading centres in Europe in which lung volume reduction surgery (LVRS) is performed. At the beginning of our transplantation program, we have usually performed unilateral transplantations in patients with emphysema. As soon as LVRS became an established therapy in selected patients with terminal emphysema, the number of emphysematous patients who underwent transplantation decreased [18].

The distribution of the underlying diseases in the recipients from extended donor lungs did not differ from the distribution in the whole series of 148 transplanted patients. This similar repartition rules out the possible bias by which extended donor lungs might have been reserved for patients with a prognostic more favorable underlying disease like cystic fibrosis or emphysema. This is an important remark because the Washington University group suggested in their publication in 1995 to use primarily extended donor lungs in recipients with emphysema [8]. We have demonstrated the possibility to use these lungs in selected patients with other underlying diseases without compromising the results. However, for patients with pulmonary hypertension, we never used donor lungs, which had any form of a chest trauma or any risk of other dysfunction. The only exception was made for donors who rapidly developed neurogenic edema.

We were specifically concerned about whether any of the extended donor criteria may predispose to a worse outcome. Our study is the first report showing that the use of extended donor lungs with a $PaO_2$ <250 mmHg in selected cases is not necessary associated with an unfavorable outcome. If the measure of $PaO_2$ remained low despite aggressive clinical management in a donor with secretion and pathologic chest X-ray, we generally did not use the donor lungs. On the other hand, if the value of $PaO_2$ showed a tendency to improve or at least to stabilize after bronchoscopy or fluid balance management, we generally used the donor lungs even if the value before harvesting remained <250 mmHg in selected cases, according to the judgment and experience of the surgeon, but also according to the underlying disease of the recipient. Specially in case of neurogenic edema, we observed rapid recovery in all patients after transplantation.

The analysis of the criteria defining extended donor lungs in the 12 recipients who receive such lungs and who died at 30 days or at 1 year showed that donors with an association of $PaO_2$ <300 mmHg and purulent secretions should be used with extreme caution, since these extended criteria might influence the early outcome negatively. Extended donor age and smoking history do not seem to affect early outcome but may play a role in the mid-outcome. In our study, the early mortality rate at 30 days was 6.3% in the recipients from extended donor lungs and no difference was found between the group with one criterion and the group with more than one criterion. This rate was comparable to the mortality rate in the ideal donor lungs group and also similar to the results of previous reports [7,8]. However, in his series with 128 transplants, Pierre observed a 30-day mortality significantly higher in the recipients of the extended donors (17.5 vs. 6.2% in the recipients from ideal donors). A possible explanation was a prolonged intubation time of the donors in the group extended donor lungs with a greater risk for pneumonia and fluid overload which was not the case in our series [3,5,19].

The outcome of lung transplanted patients has changed during the last years. Our results confirmed this, showing a trend to improvement of survival from 87.5 to 96.1% at 30 days and from 78.8 to 86.8% at 1 year after transplantation between the periods 1993–1998 and 1999–2003. This change in survival was observed in both groups of recipients from ideal as well as from extended lung donors but was not statistical significant. Several factors have contributed to this improvement, including a more aggressive treatment of the donor lungs before harvesting, but also the development of a more appropriate management intraoperative and at the intensive care unit. The role of the preservation solution is difficult to define. Although extensive laboratory experience and some clinical studies suggest that low potassium dextran lung preservation solution (Perfadex) is superior to Euro-Collins solution, further studies are required to investigate the impact of Perfadex in the mid- and long-term outcome of lung transplantation. In a retrospective study, Dark et al. did not find any difference in the mean ventilation time, the mean intensive therapy unit stay, the mortality rate caused by primary organ failure between Perfadex and Euro-Collins solution [20]. Furthermore, in our experience, the outcome of the recipients from extended donor lungs was comparable to the outcome of the recipients from ideal donor lungs before using the Perfadex preservation solution during the period 1993–1998, which can probably rule out a significant effect of Perfadex in the outcome.

In conclusion, our results demonstrate that the liberal use of selected extended donor lungs does not compromise the outcome after transplantation as long as the function impairment is considered to be reversible within the first days after transplantation, based on the overall clinical judgment (e.g. minor thoracic trauma, secretion, neurogenic edema). Furthermore, $PaO_2$ <250 mmHg before harvesting of the lungs is not an absolute contra-indication for transplantation. However, large experience is required in the management of donor lungs before harvesting and their selection results from an interactive process between the transplant surgeon and the managing team of the donor. The different parameters and findings have to be interpreted in a dynamic way, in a context and not as single observations, particularly with respect to chest X-ray and bronchoscopic findings.

Our positive experience with extended donor lungs emphasizes that the criteria generally admitted to define an ideal donor lung are guidelines only.

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## Appendix A. Conference discussion

***Dr P. Filosso*** (*Torino, Italy*): We have the same results, but with a lower number of lung transplantations performed at our Institution, in Torino, Italy. I have two short questions for you.

First: in our experience, we observe a high percentage of acute rejection in patients receiving lung from a marginal donor.

Second: what is your policy in antibiotic treatment of recipients receiving lungs with purulent secretions?

***Dr Lardinois***: First question: All the patients of our series received induction therapy and an immunsuppression regimen based on steroids, cyclosporine, and azathioprine or MMF. With this regimen, the rate of acute rejection is very low. I am not able to give you the exact data, but we do not see more acute rejections in recipients from extended donor lungs than in recipients from ideal donor lungs.

Second question: All the patients who undergo lung transplantation at our institution receive broad spectrum antibiotics initiated according to the underlying disease and on the basis of the organisms isolated from the different specimens before transplantation. The treatment can be changed or adapted according to the additional information given by the analyse of the bronchial secretion from donor lungs assessed during the transplantation. Furthermore, the management of the donor lungs is very important, particularly in case of purulent secretion. The systematic administration of broad spectrum antibiotics combined with bronchoscopic toilet of airways to remove secretion and reduce atelectasis is routinely performed. Antibiotic therapy will be prolonged during weeks after transplantation.

***Dr B. Koul*** (*Lund, Sweden*): My question is that in both the groups, extended and nonextended groups, you had about 80% patients receiving the double lungs, bilateral lung transplants, although the number of emphysema was 30% in both the groups. Do you think by giving an extended donor lung that bilateral transplant has to do with the bad results?

***Dr Lardinois***: At our institution, single-lung transplantations have been performed at the beginning of our transplantation program. However, the functional results are better after bilateral transplantation. Additionally, published data suggest a lesser incidence of bronchiolitis obliterans after bilateral procedure. Since 1998, we usually perform bilateral lung transplantation, also because the majority of our recipients are CF patients who require bilateral transplantation. Single-lung transplantation is an exception procedure in patients with emphysema for example when the other lung was damaged or contused. To answer your question, we have not observed any significant difference in the outcome of the recipients from extended donor lungs between the two periods 1993–1998 and 1999–2003 and also between recipients from extended and from ideal donor lungs after bilateral procedure.

***Dr E. Yildirim*** (*Ankara, Turkey*): As you have shown in one of your slides, the duration of mechanical ventilation is short in the extended donor group. I think it's expected to be the opposite. Would you comment on it.

***Dr Lardinois***: Our results demonstrate that with a good strategy in selecting the extended donor lungs and with an aggressive management of the donor lungs, it is possible to use such lungs without compromising the early postoperative phase, particularly the duration of intubation on the intensive care unit.