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## Does splitting the lung block into two single lung grafts equate to doubling the societal benefit from bilateral lung donors? Comparisons between two single versus one bilateral lung transplant

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**Abstract** Multi-organ thoracic transplantation, although beneficial to one recipient, has an opportunity cost of denied transplants to others. This paper compares population based outcomes of splitting lung blocks for two single lung transplants compared to doing one bilateral lung transplant, and suggests that the benefit of splitting lung blocks may not necessarily be double that of using each block for one recipient.

**Key words** Lung transplantation · Organ allocation

### Introduction

When both donor lungs are suitable for transplant, the lungs may either be used as a bilateral single lung transplant (BSLT) for one recipient or split and used for two single lung transplants (SLT) in two recipients. Allocating usable organs to different recipients maximises the number of patients benefiting from a donor. In contrast, transplantation of two or more organs into one recipient, whilst benefiting a single recipient, reduces the number of recipients benefiting from a single donor. We compare the outcome of donor lung blocks split for two SLT with those used for one BSLT.

time of registration, time of transplant, and at designated follow-up points. Lung donors from whom both lungs were used for transplant in the UK between April 1995 and December 1998 as reported to the UK Cardiothoracic Transplant Audit form the population for this analysis. Lungs used for en bloc heart-lung transplantation are excluded. Legislation ensures that all transplants are reported, thus avoiding selection bias in recruitment. The data presented represent an almost complete national cohort of consecutive donors for this period (less than 2% data unavailable). Lung donors from whom only one lung was used are not considered. Graft survival (event death or retransplantation) has been estimated using the Kaplan-Meier method and freedom from first rejection or infection with the actuarial method.

### Materials and methods

All eight lung transplant units in the UK contribute data to a national study, the UK Cardiothoracic Transplant Audit, which collects data on all patients registered on the national waiting list, at

### Results

Both lungs were used for lung transplants in 405 donors during the study period. Of these, 186 were used for heart-lung transplantation and thus excluded, leaving 219 for analysis. Of these 219 lung blocks, 148 were used for bilateral (or double) lung transplantation and 71 split for 142 single lung transplants. Donor cause of death and donor age distribution were similar for both groups. The principal indications for transplant were

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cystic fibrosis (61), fibrosing lung disease (67) and emphysema (90), which constituted 75% of transplants. Forty-one percent of BSLT were for cystic fibrosis, while 27% were for emphysema and 8% for fibrosing lung disease, while for the SLT group, 36% were for emphysema, 39% fibrosing lung disease and 7% retransplants. The remaining transplants were for a variety of indications. The 1-year graft survival for single lungs was 65% (70% CI 60–69) compared to 71% (70% CI 67–75) for bilateral grafts. Of the single lung pairs, at 1 year, both grafts were functioning from 44% of blocks; both grafts had failed in 14%, and in 42% one of the two lungs had failed. There was no demonstrable association between failure of one lung and that of its pair. By 1 year, the freedom from first rejection was 19% (70% CI 13–25), and from first infection 8% (70% CI 4–11), for SLT compared to 35% (70% CI 28–41) and 17% (70% CI 12–22), respectively, for the BSLT group. Of patients surviving to 1 year, 57% of SLT were in New York Heart Association Class I compared to 64% for the BSLT. Based on the above data, splitting of lung blocks results in an extra 1.8 survivors per donor block, 1.1 survivors free from rejection, and 1.6 symptom-free survivors at 1 year, but fewer (0.82) free from infection, compared to transplantation into one recipient.

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### Discussion

SLT is often put forward as a more economic approach to organ utilisation because two recipients benefit rather than one. While these data present an oversimplified assessment of the SLT versus BSLT debate (and are

thus limited), they do suggest that although more recipients may benefit from splitting lung blocks, this does not necessarily confer the recipient population with double the benefit compared to doing a single BSLT.

Currently only 33% of UK lung-only donor blocks are split for SLT, increasing this to 66% would increase the number of patients receiving lung transplants by 25%. While single lung transplantation might seem the optimum choice from the point of view of maximising the use of donor organs, single lung transplantation is not suitable for all diagnostic groups. Exclusive use of bilateral transplants in the UK would, however, reduce the number of lung transplants by 25%. While these data may suggest better graft outcome when both lungs are transplanted into one recipient, societal and economic considerations prevent the use of BSLT for all recipients, organ scarcity makes it difficult to justify phasing out SLT for modest improvements in individual outcome, particularly when the benefits of transplantation are comparatively limited [1, 2]. As choice of transplant is partly linked to diagnosis, preference for either procedure (which varies amongst transplant centres) means some patients may be more likely to receive a transplant depending on their diagnostic group (e.g. a preference for SLT would place cystic fibrosis patients at a disadvantage). Multi-organ thoracic transplantation leads to an inevitable trade-off between greater benefit for one individual and modest benefit to others. The extent to which reduced benefit for an individual should be traded for greater benefit for a population is debatable. Further investigation into the ethical and economic implications of decision-making in lung allocation processes is required.

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