Lung recruitment manoeuvres should be considered when assessing suitability for lung donation

Steve J Philpot, David V Pilcher, Shena M Graham and Gregory I Snell

To the Editor: We would like to present two cases of successful lung donation from organ donors who were initially unlikely to be considered suitable for lung donation because of poor oxygenation, but whose assessment improved after a successful lung recruitment manoeuvre.

In Case 1, a 65-year-old morbidly obese man was declared brain dead 3 days after a grade 5 subarachnoid haemorrhage. His family raised the possibility of organ donation. At that time, he was in a mandatory mechanical ventilation mode with an inspiratory pressure of 8 cmH_2O and a positive end-expiratory pressure (PEEP) of 15 cmH_2O. His PaO_2/FiO_2 (P/F) ratio was 239 mmHg. His lungs on x-ray were clear of focal consolidation or collapse. In light of his morbid obesity, atelectasis was considered likely to be contributing to his impaired gas exchange, and a staircase lung recruitment manoeuvre was performed.[1] The recruitment manoeuvre was well tolerated. Immediately following this, his P/F ratio was 401 mmHg. Lung donation proceeded, and the recipient was ventilated postoperatively for 35 hours. The recipient's P/F ratio at 11 hours was 373 mmHg. There was a left basal infiltrate on chest x-ray, consistent with primary graft dysfunction grade 1. The recipient is alive and well at 1 year.

In Case 2, a 59-year-old obese man was admitted to the intensive care unit after an out-of-hospital asystolic cardiac arrest with a hypoxic–ischaemic time of 45 minutes. In light of a history of recent air travel, a computed tomography pulmonary angiogram was performed, which showed no filling defects but did report bilateral moderate to large regions of atelectasis. This was not evident on his supine mobile chest x-ray. His Glasgow Coma Scale score remained 3 without sedation, his pupils were fixed and dilated, but he was not apnoeic. He developed status myoclonus, and somatosensory evoked potentials performed on Day 2 of his admission were bilaterally absent. A decision was made to withdraw cardiorespiratory support on the grounds of futility of ongoing treatment. Consent for organ donation after cardiac death was obtained from the patient's next of kin. In a spontaneous breathing mode, with pressure support of 15 cmH_2O and a PEEP of 20 cmH_2O, his P/F ratio was 190 mmHg. In light of the severe atelectasis demonstrated on his computed tomography pulmonary angiogram, a staircase recruitment manoeuvre was performed. The recruitment manoeuvre was well tolerated, and his P/F ratio improved to 394 mmHg. Lung donation proceeded, and the recipient was ventilated postoperatively for 20 hours. The recipient's P/F ratio at 13 hours was 297 mmHg, with a clear chest x-ray, consistent with primary graft dysfunction grade 1. The recipient is alive and well at 1 year.

There is a need to consider lung retrieval in all potential organ donors. However, this consideration must also take into account the wellbeing of the recipient. Criteria have been developed to assess lung suitability in the potential donor, which include an assessment of the PaO_2 after 30 minutes of breathing an FiO_2 of 1.0 mmHg. A P/F ratio > 250 mmHg is required before lung donation is considered; however, these criteria are empirical, and not based on a large body of evidence.[2,3] Furthermore, there are international differences in the criteria for defining suitability.[4]

Atelectasis is common in intubated and mechanically ventilated patients, and causes a mismatch of ventilation and perfusion, resulting in a reduction in the P/F ratio.[5,6] Hypoxia secondary to atelectasis should not be a contraindication to lung donation, as the lungs may be structurally and functionally normal. Furthermore, atelectasis is not always readily apparent on chest x-ray, as in our second case, and must therefore be considered in a hypoxic patient with no evident cause on plain chest imaging. As we have shown, the P/F ratio can change significantly after a lung recruitment manoeuvre in potential organ donors, suggesting atelectasis as a cause for the low prerecruitment P/F ratio.

A high FiO_2 in mechanically ventilated patients, as is administered when assessing PaO_2 in the potential lung donor, causes absorption atelectasis.[7] This can be prevented to some extent by the use of PEEP, and can be reversed with a lung recruitment manoeuvre. Guidelines used in other countries advocate for the use of higher levels of PEEP and/or lung recruitment manoeuvres in potential donors with a low P/F ratio, and even periodic lung recruitment in patients irrespective of P/F ratio.[4] Although Australian guidelines acknowledge the possibility of atelectasis contributing to a depressed P/F ratio, as well as the possibility of reversal of such by the use of PEEP and lung recruitment manoeuvres, they do not recommend their use routinely.[8] It is possible, therefore, that we are excluding lung donors because of poor oxygenation secondary to reversible atelectasis. Further, the very process of assessing oxygenation using a high FiO_2 may be contributing to this atelectasis.[3,7]

It has been shown that ventilator strategies employed in potential organ donors can significantly affect the likelihood of lung retrieval.[9-11] Although improved donation rates in these trials may have been due to a reduction in lung injury due to lung protective ventilation strategies, it is also possible that improved donation rates stemmed from reduced rates of atelectasis resulting from higher mean airway pressures in the treatment arms.

The two patients presented here were initially unlikely to be considered suitable for lung donation because of hypoxia secondary to atelectasis. However, both successfully donated their lungs after staircase recruitment manoeuvres resulted in a significant increase in P/F ratios. We suggest that potential organ donors not fulfilling the criteria for lung donation because of an inadequate P/F ratio should be reassessed after lung recruitment, even when atelectasis is not evident on chest x-ray.

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Competencies, learning opportunities, teaching and assessments for training in general intensive care

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To the Editor: We note with interest the recently drafted College of Intensive Care Medicine of Australia and New Zealand (CICM) document entitled *Competencies, learning opportunities, teaching and assessments for training in general intensive care*,[1] particularly the recognition it affords fibreoptic intubation (FOI) training. The document states the potential need for training and skills assessment in fibreoptic laryngoscopy and bronchoscope-aided intubation. While the acknowledgement that FOI skills are important for the practising intensivist is laudable, this does raise several issues regarding the acquisition and maintenance of these skills.

The local attitudes of anaesthetists regarding FOI skills are unequivocal; the vast majority rate it as an important skill for an anaesthetic specialist.[2] However, comparable data for local intensive care unit doctors have not been published. In May 2009, after gaining ethics approval, we conducted a web-based survey of skills and attitudes to FOI among trainees and Fellows of the Joint Faculty of Intensive Care Medicine (questionnaire can be viewed at http://www.surveymonkey.com/s.aspx?sm=psIXwpjFie7E7MBYKzSXmg_3d_3d; original results available on request). Despite endorsement by the educational committee of the College, the response rate to the survey was only 27.0% (479 respondents); the majority of respondents (90.0%) were working in Australia and New Zealand. Pertinent results are shown in Table 1.

Table 1. Proportion of respondents agreeing, by survey question

Theme of survey question	Proportion agreeing
FOI desirable, important or vital for ICU specialist	97.0%
FOI competency should be component of JFICM training	67.4%
Would attend FOI training if it was made available	83.4%
Could confidently perform unsupervised FOI at the end of ICU training	26.7%
Could confidently perform unsupervised FOI at the time of survey	38.3%
No FOIs performed during ICU training	60.3%
⩽ 5 FOIs performed during clinical anaesthesia training	62.9%
⩽ 10 FOIs in total performed during entire medical career	62.7%
No supervised FOI before performing first unsupervised FOI	35.2%
No FOI performed in the 12 months before survey	48.3%
FOI training available in respondent's hospital	9.0%
Bedside teaching was principal method of FOI training	72.7%

FOI = fibreoptic intubation. ICU = intensive care unit.
JFICM = Joint Faculty of Intensive Care Medicine.

Although the skills were rated highly, the majority of respondents had not performed FOI during their ICU training and felt ill-equipped to carry out the procedure unsupervised. Furthermore, when presented with a hypothetical difficult airway scenario, most respondents (76.8%) opted for "awake FOI by other specialist" as the most appropriate method of airway management. Astonishingly, over a third had performed their first FOI without having any prior procedural supervision.

The questionnaire results, although thought-provoking, have some obvious weaknesses. Their interpretation is limited by the low response rate, and their relevance to current practice may be compromised by the time elapsed since they were collected. However, the consistent theme of inadequate skills in FOI among respondents across multiple questions enhances the internal validity of the questionnaire. We would suggest that the results are a very useful resource to help address several issues regarding the development of FOI teaching for CICM trainees.

First, how many FOIs will a trainee need to perform before they can be judged to be proficient? Although there will be individual variability, previous studies suggest that a benchmark of successful intubation within 60 seconds and a low failure rate can be achieved after six FOIs or, more realistically, after 10–18 FOIs.[3-5] Some authors have suggested as many as 30 prior successful FOIs before tackling difficult airways.[6] In contrast, most of our respondents (62.7%), including those with prior anaesthetic experience, performed 10 or fewer throughout their whole career.

Second, how will proficiency by assessed? Although the CICM document implies that skills learning and assessment will be workshop-based, there is concern that simulation/workshop skills do not immediately translate to the patient setting.[7] Therefore, assessment should ideally occur in the workplace (eg, Direct Observation of Procedural Skills[8]) using a validated assessment tool such as the global rating scale for FOI[9] or cumulative sum analysis.[10] While the latter has been used to evaluate other anaesthetic skills (direct laryngoscopic intubation and epidural insertion), to our knowledge it has not been used for FOI assessment.

Third, how will skills be taught? Over the 30 years since the reports on FOI training by Ovassapian and colleagues,[3] many educational tools have been developed, from didactic teaching or workshops to "choose-the-hole" models to more recent virtual-reality multimedia tools.[11] However, effective learning occurs best when these teaching tools are coupled with supervised bedside teaching,[12,13] the most common teaching method reported in our survey. Therefore, plans to introduce FOI training should formally address the bedside component of teaching, ensuring the appropriate context for learning.[14]

Fourth, how will prior skills be maintained? That almost half our survey respondents had not performed FOI in the previous 12 months highlights this issue strongly. Although we are unaware of evidence-based guidelines for maintaining FOI skills, it seems reasonable to suggest that if novices can acquire them after 10 procedures, then a fewer number would be required each year for maintenance in a non-novice (possibly 2–5 per year).

Fifth, who is going to do the supervising, teaching and assessing? In our survey, 38.3% reported proficient or specialised skills in FOI. This would suggest that there is a sizeable pool of FOI-competent CICM Fellows and trainees from which suitable trainers and assessors could be selected.

Finally, the survey results demonstrate an increase in the proportion of respondents confident with unsupervised FOI at the time of the survey, compared with that at completion of ICU training. If this indeed represents a process of ongoing consultant learning, "competence" in FOI may be a reasonable goal for CICM training, allowing progression towards "proficiency" during one's early consultant career.

In summary, the addition of formal FOI training to the CICM curriculum is a forward step. However, ensuring an appropriate combination of workshop training and bedside supervision, along with adequate provision for maintaining and improving skills, will be important. Feedback from past trainees (and current Fellows), as seen in our survey, may help guide the future planning of these endeavours.

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Correction

Incorrect caption to figure: In "Inadvertent sodium loading in critically ill patients — plus some pedantry" in the June 2012 issue of the Journal (*Crit Care Resusc* 2012: 14; 163-4), the caption to Figure 1 on page 163 should read: "*Displayed to the conference that was reported in* Eur J Intensive Care Med *1975; 1: 93-7, and later featured in* Int Anesthesiol Clin *1979; 17: 299.* ❑