Intraoperative variations in blood pressure and heart rate are known to occur,
but the haemodynamic changes were much more pronounced in our patient during tumour manipulation and excision compared with pheochromocytoma. We also suggest that total thyroidectomy and radical neck dissection for cancer is likely to be prolonged and the surgery should be staggered for minimizing haemodynamic changes and the use of an EMG reinforced endotracheal tube for intraoperative recurrent laryngeal nerve monitoring may be helpful.

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Declaration of interest
None declared.

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Elevated serum concentrations of erythropoietin after xenon anaesthesia in cardiac surgery: secondary analysis of a randomized controlled trial

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Editor—Recently, the World Anti-Doping Agency officially added xenon to its list of banned substances, brought on by reports indicating that some athletes used xenon, beginning at Olympic Games at Athens in 2004 until Sochi in 2014.

Accumulating evidence indicates that xenon has various beneficial biological effects on the human body. In particular, its capability to improve myocardial contractility and to activate hypoxia-inducible factor-1α (HIF-1α), resulting in an increase of circulating erythropoietin concentrations, renders xenon an attractive option to enhance the performance of elite athletes. Researchers and clinicians started a discussion about the clinical benefit in support of humans exposed to high demand for oxygen. In particular, patients after cardiac surgery frequently experience haemodilution, blood loss, and an inflammatory response that may result in myocardial function and organ dysfunction. Given the promising properties of xenon, we supposed it to represent an attractive option as an anaesthetic during cardiac surgery and evaluated its safety and feasibility. Apart from the favourable effects of xenon on blood flow, metabolism, and haemodynamics, little is known about its effects mediated at the molecular level. Ma and colleagues and Goetzennich and colleagues supposed the preconditioning effects to be mediated by an activation of HIF-1α and its downstream effectors. While the measurement of HIF-1α is restricted to tissue samples, no study has investigated the effect of xenon on the downstream targets of HIF-1α, including erythropoietin, which provides various anti-inflammatory and protective effects.

Using a database and serum samples from a recent randomized controlled trial that demonstrated the safety and feasibility of xenon anaesthesia in patients undergoing coronary artery bypass grafting surgery, we performed a secondary analysis and evaluated the effect of xenon anaesthesia on circulating concentrations of erythropoietin. In brief, 30 patients undergoing elective coronary artery bypass grafting surgery were enrolled in this prospective, randomized, controlled trial and allocated to receive either balanced xenon or sevoflurane anaesthesia. Blood samples were collected before surgery, at admission to the intensive care unit, and 24 h thereafter for the measurement of erythropoietin concentrations by the automatic IMMULITE®/IMMULITE 1000 Epo procedure (Siemens, Llanberis, UK).

The measured erythropoietin concentrations after xenon anaesthesia demonstrated a significant increase on the first postoperative day [8.7 (SD 4.3) vs 12.9 (SD 7.4); P=0.017; Fig. 1A]. Given that androgens, including testosterone, are known to...
stimulate the production of erythropoietin, we investigated the circulating serum concentrations of testosterone at different time points, but did not observe significant differences (Fig. 1A). To probe for an effect of erythropoietin on serum concentrations of haemoglobin, we compared haemoglobin between patients from both groups. Although no difference was observed with respect to administered packages of red blood cells or blood loss, the measured haemoglobin concentrations trended towards higher values in the xenon group (Fig. 1C). However, we have to concede that the observed association between the increase of erythropoietin and haemoglobin remains speculative, and causes might be multifactorial. The present results may be judged within the limits of a preliminary analysis and considered as purely hypothesis generating.

Apart from its effect on haemoglobin concentrations, an impressive body of evidence indicates that erythropoietin has cytoprotective properties and pleiotropic effects on the brain, kidney, and cardiovascular system. Erythropoietin modulates a broad array of cellular processes, such as progenitor stem cell development, cellular integrity, and angiogenesis, and it inhibits the apoptotic mechanisms of injury. We conclude that these findings are of particular interest in patients exposed to myocardial ischaemia–reperfusion and may stimulate new approaches for therapeutic use of xenon in the vulnerable patient.

Acknowledgements

Assistance with this work: we are indebted to the patients who participated in the trial.

Declaration of interest

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Fig 1 Perioperative serum concentrations of erythropoietin (A), testosterone (B), and haemoglobin (C). (A) There was a significant increase (*) of serum erythropoietin concentrations after xenon anaesthesia from the preoperative value to the first postoperative day (24 h later), whereas no significant change was observed in the sevoflurane group. Serum concentrations of erythropoietin showed a trend towards difference between both groups on the first postoperative day (P=0.051). (B) No significant change or difference between groups was observed with respect to the measured testosterone concentrations. (C) Circulating concentrations of haemoglobin trended to be higher in the xenon group throughout the postoperative course. All data were analysed by two-way ANOVA or Student’s unpaired t-test where appropriate (Prism-6, Graphpad Software Inc., La Jolla, CA, USA; SPSS-21, IBM Corporation, Armonk, NY, USA) to compare differences at distinct time points.
Editor—Percutaneous tracheotomy is a commonly performed procedure in patients requiring prolonged mechanical ventilation. Although it is a procedure with few complications, these may be serious, so it would be useful to optimize safety with ultrasound-guided techniques. It is known that ultrasound increases the safety of procedures such as central venous catheterization or thoracocentesis.

This prospective observational study was performed on 16 donated fresh cadavers at the Department of Anatomy, University of Barcelona. A total of 16 percutaneous tracheotomies were performed; these were randomized to two groups, namely ultrasound guided (UG) and Seldinger technique (ST), in eight cadavers in each group. Material from the Ciaglia Blue Dolphin® (Cook España S.A, Barcelona, Spain) was reused. An orotracheal intubation was performed. In the UG group, a portable Mindray DP-50® (Mindray Medical España S.L, Madrid, Spain) ultrasound machine with 5–10 MHz linear transducer was used. With the neck in hyperextension, transverse plane ultrasonography was performed to identify the tracheal midline. After the dilation of the trachea was done, members of the Department of Anatomy performed the anatomical neck dissection. In the ST group, palpation of the anterior part of the neck was done to identify the puncture point, and the same dilation technique and anatomical dissection as in the UG group were performed. We defined a sternomental distance (Savva test) lower than 13.5 cm (positive predictive value 82%) and a Cormack and Lehane Classification grade 3 and 4 as the predictors of difficult airway management.


The primary outcome was a successful wire insertion in the tracheal midline, defined as between 11 and 1 o’clock at the first attempt. The secondary outcome was dilation of the trachea between the first and second or the second and third tracheal rings. Another outcome was an evaluation of the possible complications, namely vascular injury, thyroid gland injury (isthmus or lobes), posterior tracheal wall puncture, oesophageal canalization, or subcutaneous tissue canalization. The results are shown in Table 1.

Kleine-Brueggeney and colleagues performed a study in which nine punctures were performed on cadavers with the use of a guidewire, with a successful puncture at the first attempt in eight cadavers. The only one that was not achieved had difficult airway criteria. The conclusion was that ultrasound-guided puncture facilitates successful puncture of the trachea, as in our study; we had a first-attempt success rate of 87.5% in the UG group and 62.5% in ST group.

Kleine-Brueggeney and colleagues11 also concluded that the use of ultrasound in transverse and longitudinal planes cannot prevent soft tissue puncture. Using tomography, they detected thyroid isthmus puncture in eight of nine cadavers. In our study, the tracheotomy was done with neck hyperextension; the puncture site was changed twice because of the position of the thyroid isthmus, and thyroid isthmus puncture occurred in only one of the 16 tracheotomies performed, and it was in the ST group.

We conclude that ultrasound has potential to facilitate puncture and correct guide insertion during percutaneous tracheotomy even in subjects with difficult airway criteria. It can provide information on possible anatomical variations, increasing the safety of the procedure.

Usefulness of ultrasound in percutaneous tracheotomy


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Table 1 Results and complications [expressed as n (%)]. CTM, cricothyroid membrane puncture; first–third, puncture between first and third tracheal rings; OES, oesophageal canalization; ST, Seldinger technique group; SUB, subcutaneous tissue damage; >third, puncture lower than third tracheal ring; THYR, thyroid injury (isthmus or lobes); UG, ultrasound-guided group; VAS, vascular injury; WALL, posterior wall trachea damage

<table>
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<th></th>
<th>First attempt</th>
<th>Midline</th>
<th>First-third</th>
<th>&gt;Third</th>
<th>CTM</th>
<th>VAS</th>
<th>THYR</th>
<th>WALL</th>
<th>OES</th>
<th>SUB</th>
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<td>8 (100%)</td>
<td>6 (75%)</td>
<td>2 (25%)</td>
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<td>1 (12.5%)</td>
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</tr>
<tr>
<td>ST</td>
<td>5 (62.5%)</td>
<td>8 (100%)</td>
<td>7 (87.5%)</td>
<td>0</td>
<td>1 (12.5%)</td>
<td>0</td>
<td>1 (12.5%)</td>
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