

significantly also in Group GA 10 min after anaesthesia induction and remained increased until the end of our observation period. However, cortisol changes remained within the normal range in all groups.

We have tested the hypothesis that anxiousness and pain may be the main reasons for hormonal response to cataract operation. Regarding anxiousness we compared local anaesthesia alone or under sedation with propofol concerning their effect on cortisol, TSH and prolactin serum levels. No statistically significant hormonal changes were observed between the two groups. On the other hand we tested the hypothesis that pain is the main reason for endocrine response; therefore, we compared local anaesthesia vs. TIVA with propofol concerning their effect on hormonal changes. Local anaesthesia prevented the hormonal response to cataract surgery while TIVA did not completely suppress the stress response, and therefore increased cortisol, prolactin and TSH levels were observed. With respect to cortisol, the results of our study partly agree with the previous studies, because although a statistically significant increase in cortisol during TIVA was observed, cortisol fluctuated within its normal range [1,2]. Since no concomitant opioids have been used in the present study, it is in support of the hypothesis that propofol is likely to have antinociceptive action. In addition, cortisol and TSH increase was within the normal range, while prolactin peaked at the end of the operation, showing a very slight decrease 1 h post surgery. Clinical significance for the observed hormonal

response requires further investigation and confirmatory studies.

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Use of transoesophageal echocardiography in impending paradoxical embolism due to thrombus straddling a patent foramen ovale

10.1017/S0265021506001669

EDITOR:

Transoesophageal echocardiography (TOE) is now established as an important diagnostic tool in the operating theatre and the intensive care unit (ICU). The surgical management of pulmonary and intracardiac thromboembolism, particularly when com-

plicated by impending paradoxical embolism, presents the perioperative echocardiographer with the opportunity to influence surgical decision making and to potentially improve patient outcome [1]. We report a case demonstrating the use of TOE in both the diagnosis and the intraoperative management of a patient with major pulmonary thromboembolism and thrombus straddling a patent foramen ovale (PFO).

A 47-yr-old female presented to hospital complaining of acute dyspnoea and palpitations. She had been less mobile in the previous 2 weeks because of

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Accepted for publication 15 August 2006 EJA 4102
First published online 23 October 2006

an ankle injury. Her past medical history included a benign pituitary neoplasm and sub-fertility. She did not take any medication. Thoracic computed tomography (CT) showed bilateral pulmonary thromboemboli and suspected intracardiac thrombus. Anticoagulation was commenced and the patient was immediately transferred to the regional cardiothoracic surgery centre. On admission to the ICU, physical examination revealed pulse 120 beats min^{-1} , blood pressure 110/70 mmHg, oxygen saturation on room air 94%, respiratory rate 22 breaths min^{-1} and the presence of a lower abdominal mass. There was no evidence of lower limb venous thrombosis.

Transthoracic echocardiography (TTE) provided evidence of a mobile mass in the right atrium but adequate imaging of the left atrium was not obtained. TOE was subsequently performed, in close collaboration between the anaesthesia and cardiology teams, under general anaesthesia in the ICU. A large serpiginous mass, measuring 7 cm long and 1 cm wide, was identified originating in the right atrium and traversing the intra-atrial septum through a PFO into the left atrium. The right ventricle was dilated, global function was impaired, functional tricuspid regurgitation was present and there was evidence of pulmonary hypertension. No central pulmonary artery emboli were visible. The patient remained sedated and mechanically ventilated following TOE and underwent CT of the thorax, abdomen and pelvis. This confirmed extensive thrombus in the right and left pulmonary arteries, and also revealed a large uterine tumour with significant pelvic venous compression and thrombosis.

The patient proceeded to emergency surgery to prevent impending paradoxical systemic thromboembolism. Cardiopulmonary bypass (CPB) was established following which intracardiac thrombectomy, pulmonary thromboembolotomy and closure of PFO were performed. After separation from CPB, a comprehensive intraoperative TOE examination confirmed the absence of residual intracardiac thrombus and complete closure of the PFO. Inferior vena cava filter insertion and hysterectomy were also performed. Following an uneventful postoperative course, she was discharged from hospital on oral anticoagulation therapy.

Cases of thrombus entrapment in a PFO are rare but may have devastating consequences. A PFO straddling thrombus may embolize into the right atrium causing pulmonary embolism or into the left atrium causing paradoxical systemic embolism. Erkut and colleagues [2] reviewed 46 reported cases and suggest that this unusual occurrence is increasingly being recognized because of the widespread use of TOE. The clinical presentation is variable: 45.6% of cases presented with clinical features of pulmonary embolism without evidence

of paradoxical embolism (like our patient), 28.2% presented with both pulmonary and paradoxical embolism and 12.7% presented with paradoxical embolism only. Chartier and colleagues [3], in their case series of patients with floating right heart thrombi, emphasize the importance of echocardiography as the key diagnostic investigation: both transthoracic and transoesophageal modalities may be used in conjunction to confirm the diagnosis. The likelihood of unsatisfactory imaging of the left atrium using TTE underlines the superiority of TOE in these cases. Aboyans and colleagues [4] reported an overall early mortality of 21% in their review of known cases. Immediate treatment is warranted but the optimal management is controversial: therapeutic options include anticoagulation, thrombolysis or surgical management. Fragmentation of the right or left atrial components of the thrombus followed by pulmonary or systemic embolization is a theoretical risk of thrombolytic therapy. Medical therapy has also been associated with recurrent complications. Therefore, intracardiac thrombectomy and closure of the PFO has been recommended for the treatment of thrombus entrapment. Intraoperative TOE can accurately identify thrombus in the PFO [5], confirm its successful removal and assess closure of the defect [6].

We conclude that TOE is useful in the preoperative diagnosis of pulmonary and intracardiac thrombi in the ICU and essential to assist intraoperative decision making in the surgical management of these patients in the operating theatre.

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Colour coding, drug administration error and the systems approach to safety

10.1017/S0265021506001670

EDITOR:

We were interested to read Haslam and colleagues' recent paper on the risks of introducing the international colour-coding system for syringe labels in anaesthesia [1]. The authors demonstrate that introducing the new international colour-coding scheme, to a hospital that previously used the Medilabel system, can increase the rate of near-miss incidents or latent drug errors, primarily owing to the fact that the international scheme uses some of the same colours as the Medilabel system, but for different classes of drug. This is an unsurprising result and underscores the importance of the use of multiple safeguards in any complex work environment, consistent with the systems approach to safety – particularly when obvious potential risks present themselves, such as when changing colour-coding schemes. In a recent systematic review of the entire body of literature related to intravenous drug administration error in anaesthesia, our group identified 11 distinct strategies for the prevention of drug error in addition to colour coding by class of drug [2]. Furthermore, colour coding alone was rated as being able to prevent only 20% of the 80 incidents we used to validate our 12 safety strategies. What this result tells us is not that colour coding *per se* is ineffective, but that it should be used as part of a wider system of multiple safeguards within a fully developed culture of safety. No single safeguard can be expected to prevent all error types, just as no amount of human vigilance can. In addition, all safety technologies carry some potential for adverse outcomes, including even bar coding, which has recently been endorsed by the US Food and Drug Administration [3]. An effective culture of safety should anticipate potential safety risks where possible, attempt to minimize them where appropriate and react quickly to

remove or ameliorate them when incidents do occur. For safety to be maintained and indeed improved, this process must be continuous, as inevitable changes in supplies, upgrades in equipment and revisions of procedures can all have important safety implications.

In terms of colour-coded drug labels, a short-term increase in the risk of drug error during the introduction of a consistent colour-coding scheme seems likely to lead to less iatrogenic harm in the long term than the continued use of up to three inconsistent colour-coding schemes in the same country and, indeed, sometimes simultaneously within the same hospitals [4]. Furthermore, Haslam and colleagues claim that it has not been proven that colour-coded labels can reduce errors, citing a Fasting and Gisvold paper in support [5]. However, this study is known to be underpowered [6]. In addition, it has been argued that it would have been statistically appropriate to use a one-sided test of significance in analysing the results, in which case the combination of education and colour coding does yield a significant reduction in error rate ($P = 0.037$) [6]. Colour coding is a potent psychological cue that is used widely and effectively in numerous other complex and potentially hazardous organizations [7]. It would be a surprising result indeed if it were discovered that healthcare is a sufficiently peculiar or special discipline that these basic safety principles did not apply.

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Accepted for publication 15 August 2006 EJA 4113
First published online 23 October 2006

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