To provide further insight into this topic, we would like to share our unpublished observations regarding a series of 15 patients with head injury, matched for age and severity of injury to the study population but never exposed to brain temperatures lower than 35°C. Although the cerebral pressure reactivity index (PRx) was demonstrated to be linearly related to brain temperature in the temperature range of 37–39°C in patients treated with moderate hypothermia (R=0.53; n=17, P=0.03), in this second group of patients, we did not observe any significant relationship between brain temperature and PRx (n=15, P=0.83). It must be noted that average PbCO₂ was similar in the two groups [PbCO₂ mean difference=2 mm Hg (0.21 kPa); P=0.36]. Similarly, PbO₂ in patients treated with moderate hypothermia [PbO₂=17 (10) mm Hg; 2.3 (1.4) kPa] was comparable with PbO₂ in patients not exposed to hypothermia [PbO₂=20 (11) mm Hg; 2.6 (1.5) kPa, P=0.45]. However, although average PRx significantly correlated with PbO₂ in patients exposed to moderate hypothermia (R=0.66; n=17, P=0.004), in the same temperature range there was no significant relationship between PRx and PbO₂ in the group of patients who were not actively cooled (n=15, P=0.78). We also investigated the relationship between PRx and brain temperature within all individual patients. In patients exposed to hypothermia, PRx and brain temperature are positively correlated in 16 (67%) of 24 cases [median R=0.85; IQR (0.80–0.88)], whereas in controls a positive correlation between PRx and brain temperature was observed only in four (26%) out of 15 patients [median R=0.00; IQR (−0.88 to −0.87); P<0.01]. In summary, temperature-dependent hyperaemic derangement of cerebrovascular reactivity seems to be a phenomenon specifically related to therapeutic hypothermia for refractory intracranial hypertension. However, it must also be emphasized that none of our patients was exposed to temperatures exceeding 40°C. Therefore, our findings do not contradict Cremer’s experimental observations.

In conclusion, the exposure to moderate hypothermia seems to play an independent role in determining the vulnerability of cerebral vessels to rewarming in brain-injured patients.

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Regional anaesthesia in patients treated with aspirin and clopidogrel

Editor—I read the recent review on coronary artery stents and non-cardiac surgery with interest. Howard-Alpe and colleagues refer to the difficult clinical situation in which an anaesthetist wishes to perform a central neuroaxial block on a patient treated with antiplatelet therapy. The authors suggest preoperative platelet transfusion ‘if regional neuroaxial blockade is thought to be essential’ for emergency surgery. I wish to highlight three practical difficulties in transfusing platelets in order to allow a central neuroaxial block to be performed.

First, how many pools of platelets should be transfused? The authors cite French guidelines from 2003, which refer to platelet count. However, it is likely that patients on antiplatelet therapy will have a platelet count of >100 000 μl⁻¹ and the platelet count tells us little about platelet function. A recent healthy volunteer study suggests that at least two to three pools of platelets may be required to normalize platelet function after clopidogrel and aspirin administration.

Secondly, how can platelet function be monitored after platelet transfusion to decide that a block may be safely performed? None of the platelet function tests described in the review will exclude the possibility of the very rare complication of haematoma after an epidural or spinal block. The platelet count may be normal despite abnormal platelet function, as demonstrated in pre-eclampsia. A case report of spinal anaesthesia in a patient taking clopidogrel and aspirin describes the use of platelet aggregometry to monitor the effect of platelet transfusion. However, as Howard-Alpe and colleagues state, this technique is laboratory-based and therefore may be unavailable to the clinician.

Finally, is the risk of platelet transfusion before central neuroaxial block offset by the perceived benefits of the block to the patient? Platelet transfusion is not without risk, including administration errors, and bacterial contamination of platelets.

Until anaesthetists have further data to support the safety (or otherwise) of epidural and spinal anaesthesia in patients taking both clopidogrel and aspirin, it is likely that those patients in whom regional neuroaxial blockade is thought to be essential will be confined to a small group, such as those awaiting lung transplantation.

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Editor—I would like to thank Dr Self for his interesting and informative letter. In our review article, we highlighted the difficulties and risks associated with...
performed neuroaxial blockade in patients taking dual antiplatelet therapy with aspirin and clopidogrel. We presented the dilemmas that arise in the care of a patient on dual antiplatelet therapy, who needs emergency surgery where neuroaxial blockade is felt to be essential. The question of how many pools of platelets need to be transfused to perform neuroaxial blockade safely was an issue we discussed. We quoted the French guidelines of 2003, stating that in the absence of platelet dysfunction, for spinal anaesthesia a platelet count of 50,000 μL⁻¹ should be achieved and for epidural anaesthesia, 80,000 μL⁻¹. Obviously, in the case of aspirin and clopidogrel therapy, there is platelet dysfunction in the absence of thrombocytopenia. However, at the time we wrote our article, the amount of platelet transfusion needed to safely reverse the combined effects of clopidogrel and aspirin therapy was not known. Consequently, we welcome Dr Self’s reference to the recently published healthy volunteers study suggesting at least two to three pools of platelets are needed to normalize platelet function after clopidogrel and aspirin therapy, and would advise any clinician to follow this recommendation in the absence of alternative guidelines.

With regard to Dr Self’s second point, we would agree that no platelet function test excludes the rare possibility of haematoma after spinal or epidural anaesthesia. Haematoma is a rare complication of neuroaxial blockade that has also been reported in patients not taking either anticoagulant or antiplatelet therapy. In our article, we referred to two separate case reports of haematomas after spinal and combined spinal and epidural anaesthesia; in both cases, the clopidogrel was stopped 7 days before the procedure. As with many aspects of medicine nothing is guaranteed, and patients must be made aware of the possible complications of anaesthesia at consent. Dr Self drew attention to the case report we quoted where platelet aggregometry was used to guide the correction of platelet function with platelet transfusion before neuroaxial blockade in the patient undergoing emergency surgery while awaiting lung transplantation. We believe that in the increasingly litigious world in which we practice medicine, the security of a normal result on platelet function testing, or correction of an abnormal result with platelet transfusion, will enable the anaesthetist to feel and prove they did all possible to avoid the devastating complication of epidural haematoma. We agree that the platelet count may well be normal, despite abnormal platelet function as can be the case in pre-eclampsia and, as we highlighted, in the patient taking antiplatelet therapy. It is precisely for this reason that we advise if you suspect abnormal platelet function, you should perform platelet function testing and correct the platelet function as guided by the test result or, if testing is unavailable, transfuse platelets before you proceed.

Finally, we also agree that platelet transfusion is not without risks to the patient and increasingly platelets are an expensive and scarce resource. Not only, as stated by Dr Self, are there risks of administrative errors, transfusion reactions, and infective contamination, but also in this patient subgroup, the risk of thrombosis associated with platelet transfusion is high. Subsequently, we do not advise neuroaxial blockade in the emergency scenario in patients on dual antiplatelet therapy with aspirin and clopidogrel unless there is an essential indication for the block such as end-stage respiratory disease. In the elective scenario, guidelines state that clopidogrel should be stopped for 7 days before neuroaxial blockade and aspirin can be safely continued. This strategy does not completely rule out the possibility of epidural haematoma, but reduces the risk significantly. We believe that communication between members of the clinical team and the patient involved with a full explanation of the risks and benefits of different perioperative strategies is vital as in all situations.

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Editor’s comment: This subject was addressed further in the review article in September’s British Journal of Anaesthesia on antiplatelet drugs and anaesthesia. In relation to regional anaesthesia and antiplatelet drugs, the authors addressed the perceived opinion that regional is safer than general anaesthesia in elective, at risk patients and stated ‘We conclude that the risk/benefit ratio of preoperative withdrawal of antiplatelet drugs in order to perform a regional or neuraxial blockade is not justified’.

4 Davies JR, Fernando R, Hallworth SP. Hemostatic function in healthy pregnant and preeclamptic women: an assessment using the platelet function analyzer (PFA-100®) and thromboelastograph®. Anesth Analg 2007; 104: 416–20
7 Litz RJ, Gottschlich B, Stehr SN. Spinal epidural haematoma after spinal anaesthesia in a patient treated with clopidogrel and enoxaparin. Anesthesiology 2004; 101: 1467–70
Diagnosing and quantifying incomplete expiration in patients with lung disease

Editor—Incomplete expiration is common in smokers and patients with chronic obstructive pulmonary disease (COPD). This can increase FRC and auto-PEEP. The increased intrathoracic pressure may compromise venous return or, if great, could cause a pneumothorax. We report a simple new method for detecting this, which appears quick and reliable, and can quantify the increase in lung volume.

During mechanical ventilation of an anaesthetized subject, we set the APL valve to zero and then discontinued ventilation for approximately 10 s, allowing complete expiration to occur. Complete expiration was verified by confirming that the expiratory flow rate shown on the flow–volume loop was zero. The ventilator was restarted using the previously set rate and volume and the flow–volume loop was observed (Fig. 1). With the GE s/5 spirometer (D-lite), which displays successive individual inspired and expired volumes, the differences between inspired and expired tidal volumes were added for the next three respiratory cycles. We have called this the volume of incomplete expiration, since it represents the volume retained by the respiratory system when the previous pattern of mechanical ventilation is resumed.

A female aged 71 yr with a history of 40 pack years of smoking and symptoms and signs of severe COPD underwent a total abdominal hysterectomy. The volume of incomplete expiration was 380 ml. This feature was reproducible, with other measures of incomplete expiration, resulting in volumes of 310, 400, and 290 ml (mean 345 ml) during the anaesthetic (Fig. 2).

A further patient with a long history of smoking, although no formal diagnosis of COPD showed incomplete expiration with a mean total volume of incomplete expiration of 215 ml (200–250 ml) over four trials.

As a control patient, a man of 62 yr with no respiratory disease and a non-smoker undergoing a hemi-colectomy had a mean volume of incomplete respiration of 10 ml (−50 to 50 ml) over four trials.

Similarly a man of 65 yr also a non-smoker with no respiratory disease undergoing an open right radical nephrectomy had a mean volume difference of 40 ml (10–100 ml) over four trials.

This technique was used in various patients and seems to be useful in both confirming and quantifying incomplete expiration. There appears to be a difference between observed values of our four patients, which correlates with the severity of clinically observed airways disease.

We cannot find previous reports of this manoeuvre, of discontinuing ventilation and measuring subsequent volume changes when mechanical ventilation is recommenced. This could be particularly useful as most other methods of detecting incomplete expiration rely on pressure measurement, as opposed to volume, and do not quantify the degree of incomplete expiration.

Detecting incomplete expiration is clinically useful. Various strategies can reduce incomplete expiration, such as reducing the I:E ratio or the tidal volume. Perhaps, the