Extradural analgesia has served obstetric patients for many years, but not without complications, as Dr Harding’s list of references shows. Deliberate puncture of the dura mater represents a further significant breach of the patient’s defences. In our enthusiasm to improve patient comfort and well being it is as well to remember the dictum “First of all do no harm”.

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Near-infrared spectroscopy in adults

Sir,—We refer to the article by Germon and colleagues [1], which described the effects of extracerebral ischaemia on measurement of regional cerebral oxygenation (rSO$_2$) by near-infrared (NIR) spectroscopy (Innos 3100 cerebral oximeter).

On application of a tourniquet around the scalp, the authors showed an initial rapid reduction in rSO$_2$ to 13%, plateauing by 3 min, which returned to no more than initial values on release of the tourniquet. As arterial collateral from the skull may take 2–3 min to fully engorge the scalp after inflation of a tourniquet around the skull, their results may be explained fully by a large increase in extracranial chromophore attenuating the light signal both into and out of the skull. To determine how long it takes for hypoxia to develop in skeletal muscle during tourniquet ischaemia, we applied tourniquets to the upper arm in six healthy male subjects and applied the oximeter to the forearm muscles. The reduction in oxygenation was greater than 50% and did not plateau until 5–6 min. Furthermore, hyperaemia occurred on release of the tourniquet with oxygenation increasing to 25% above initial levels (fig. 1). This contrasts markedly with the results of Germon and colleagues over the frontalis muscle. We believe the authors have misinterpreted their results by attributing them to changes in extracranial oxygenation rather than a highly unusual change in chromophore content caused by tourniquet engorgement.

In the second study the frontalis muscle was exercised for 1 min. Exercise induced hyperaemia and increased chromophore contents may again explain their findings. Finally, the authors did show a good correlation between rSO$_2$ and induced hypoxia measured by pulse oximetry, despite the application of a scalp tourniquet. This at least demonstrates that even in these highly artificial circumstances this instrument can still detect cerebral hypoxia.

Carotid endarterectomy is an ideal model to study the accuracy of cerebral oximetry. Selective injection of indocyanine green into the internal and external carotid arteries demonstrated that sensors with a 30–40-mm separation, between light source and the superficial and deep detectors, respectively, exclude extracranial attenuation while allowing maximum intracerebral penetration [2]. We have reported excellent correlations between rSO$_2$ and jugular bulb venous oxygen saturation, middle cerebral artery blood flow and general hypoxia [3, 4]. The extracerebral circulation is extensively collateralized and on unilateral occlusion of the external carotid artery there is normally little change in rSO$_2$ values. However, with severe internal carotid disease, the extracranial circulation forms important collaterals to the brain.

Figure 1 Mean (SEM) changes in oxygenation in forearm skeletal muscle ischaemia using a Somanetics Innos 3100 oximeter (n = 6). T = Tourniquet.
Correspondence

Sir,—We are grateful to Mr Picton and colleagues for stimulating further debate on the principles and applications of near-infrared (NIR) cerebral spectroscopy. They have questioned the methodology of our study and have drawn attention to some of their own experimental and clinical work.

We have no doubt that the application of the scalp tourniquet as we have described results in rapid, prolonged and stable ischaemia of the extracranial tissues. Pulsatile red cell flux measured by laser Doppler flowmetry and oxygenation. We agree with Picton and colleagues that carotid endarterectomy is an interesting model in which to study cerebral oxygenation. In one of the first studies performed using the Invos catheter, Williams and Picton [4] showed a significant prolongation in the time to recovery of cerebrocortical oxygen saturation after carotid endarterectomy in three patients undergoing carotid endarterectomy using the updated optical configuration (with light receivers 3 cm and 4 cm from the light source) [5]. In one patient, following clamping of the internal carotid artery, there was a reduction in rSO2 on the operated side with a reduction in MCA flow velocity on that side. This is anecdotal support for our finding that the new configuration is sensitive to oxygenation changes in cerebral tissue. However, all the other events described affect extra- in addition to intracranial oxygenation and therefore this study provided no evidence that changes in intra- and extracerebral oxygenation can be separated. In neither study was there statistical evidence to support the claim that there are, "excellent correlations between absolute measures of regional cerebral blood flow, and rSO2, and jugular bulb venous oxygen saturation, middle cerebral artery blood flow and general hypoxia". Perhaps more importantly, we are not aware of any work which relates changes in rSO2 to intraparenchymal changes in oxygenation.

We believe that NIR spectroscopy has huge potential as a clinical monitoring technique but agree with a recent editorial that the introduction of new technology into clinical practice should be based on solid evidence of efficacy rather than intuitive belief [7].

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3. Williams IM, Picton AJ, Farrell A, Mee GD, Mortimer AJ, McCollum CN. Light-reflective cerebral oximetry and jugular bulb venous oxygen saturation: clinical monitoring technique but agree with a recent editorial that the introduction of new technology into clinical practice should be based on solid evidence of efficacy rather than intuitive belief [7].
