Sir,—We note with satisfaction that Drs Enderby and Bushman in their letter approve of the method we used in the evaluation of the performance of our circuit (Beatty et al., 1982). We presume, therefore, that they will be interested in the results of the application of the same method in the assessment of the circuit they reported in 1977 and in a comparison of those results with similar results published in respect of a more familiar circuit (Kay et al., 1983).

Table I shows the additional work of breathing imposed on inspiration and expiration for our own closed circuit and a circuit made from standard anaesthetic components using the description by Bushman and colleagues (1977). Additionally, the expiratory work as a percentage of total extra work is shown and the rate of working in mJ min⁻¹. For comparison, the results obtained for the Magill circuit are shown. All the results were obtained using sinusoidal simulation of breathing at a simulated breathing rate of 12 b.p.m. and a tidal volume of 500 ml. Fresh gas flow rates for the Magill circuit were 6 and 8 litre min⁻¹. It can be seen from the table that the extra work of breathing imposed by the Bushman circuit is over twice that imposed by our circuit and some three times larger than that imposed by the Magill circuit, which has been considered suitable for the spontaneously breathing patient. The rate of working for the Bushman circuit is again three times that of the Magill circuit. In all categories, save that of extra inspiratory work, our own circuit produced, on testing, figures comparable to those with the Magill circuit and was the only circuit that we have so far tested that meets the criteria of Cooper (1961) that the expiratory to total extra work ratio be less than 50%.

In addition to the simulated flow studies, we have conducted volunteer studies using both circuits. Broadly speaking, for our own circuit, the figures for extra inspiratory and expiratory work, and other variables, showed similar results for simulations of comparable tidal volumes. However, volunteers using the Bushman circuit complained about the high resistance to breathing. These complaints were associated with increased oxygen uptakes, estimated from the demand volume of oxygen consumed. One volunteer could not continue to breathe with the circuit for more than a few minutes and showed an oxygen uptake of 910 ml min⁻¹, approximately four times his basal value. No corresponding effects were encountered with our own circuit.

It was on the basis of the sort of figures quoted and the experience of the volunteers that we decided that the Bushman–Enderby design of circuit was unsuitable for a closed circuit which was to be used as a gas exchange measuring instrument. Further analysis showed that the key component in achieving acceptable performance was the design and action of the bellows. We feel that the improvement in design and efficiency of the circuit that we reported constitutes a significant advance, and a development of objective methods of comparison of circuit performance. We regret that Dr Enderby and Bushman have not supported their assertions with regard to the efficacy of their own design with any sort of objective measurements.

The objective and scientific design of circuits holds out the possibility of a more precise delivery to the patient of increasingly expensive volatile agents, in addition to increasing safety for the spontaneously breathing as well as the mechanically ventilated patient.

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REFERENCES


AN EFFICIENT TECHNIQUE FOR PERFORMING EXTRADURAL BLOCKADE

Sir,—We read with great interest the article "Anaesthesia for Caesarean Section: A Medical Audit of Junior Anaesthetic Staff Practice" by Morgan and colleagues (1983). We do not agree that extradural block is a "more difficult technique" and takes five times as long as general anaesthesia from induction to the delivery of the infant.

We collected data on 110 elective Caesarean sections carried out under single bolus dose extradural block. All blocks were performed utilizing a 20-gauge Epi-Sure needle. Bupivacaine 0.5% was administered by a resident who had 2 years training in anaesthesia. The results are presented in table I (opposite). We do so few elective Caesarean sections under general anaesthesia that we could not collect any data for this group during the same period.

Recognizing the dangers of general anaesthesia in the parturient, we have virtually eliminated its use for obstetrics in our institution and, in the past 10 yr, of 6095 Caesarean sections, 94.4% were conducted under extradural analgesia. General

<table>
<thead>
<tr>
<th>Breathing system</th>
<th>Extra work of breathing (mJ)</th>
<th>Expiratory rate (mJ min⁻¹)</th>
<th>Total work (mJ)</th>
<th>Total work ratio (%)</th>
<th>Rate of work (mJ min⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magill</td>
<td>79*</td>
<td>5</td>
<td>86</td>
<td>89</td>
<td>1032</td>
</tr>
<tr>
<td></td>
<td>124*</td>
<td>5</td>
<td>129</td>
<td>94</td>
<td>1548</td>
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<tr>
<td>Beatty</td>
<td>42</td>
<td>7</td>
<td>113</td>
<td>37</td>
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<td>Bushman</td>
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<td>103</td>
<td>266</td>
<td>61</td>
<td>3192</td>
</tr>
</tbody>
</table>

*Fresh gas flow 6 litre min⁻¹; **fresh gas flow 8 litre min⁻¹