PREOPERATIVE INTERCOSTAL NERVE BLOCK: EFFECT ON THE ENDOCRINE METABOLIC RESPONSE TO SURGERY

C. E. PITHER, L. D. BRIDENBAUGH AND F. REYNOLDS

The endocrine metabolic response to surgery is triggered by various stimuli, including afferent neuronal activity from the site of tissue damage. This initiates a train of events with widespread hormonal and metabolic sequelae. Many factors affecting this response have been revealed by blocking afferent neural pathways and assessing the degree of attenuation of the response.

Most of the work in this field has utilized extradural analgesia. There are no data on the effects of intercostal blockade on the glucose and cortisol response to surgery and we have studied this in patients undergoing cholecystectomy.

METHODS AND RESULTS

Twenty patients (ASA categories I or II and free from endocrine or metabolic disorders) were studied. All were to have cholecystectomy performed by one of two surgical teams. Hospital Ethical Committee approval was gained and informed consent obtained from all patients.

Patients were allocated randomly to one of two groups, group A receiving the intercostal blocks, group B receiving the same anaesthetic technique without the blocks. Premedication comprised diazepam 10 mg by mouth 1 h before the procedure. Upon the patient's arrival in the anaesthetic room 16-gauge cannulae were inserted into both arms under local anaesthesia. Samples for baseline glucose and cortisol concentrations were taken and midazolam 2.5–5 mg administered i.v. ECG electrodes were applied and connected to a 24-h ambulatory recorder.

Patients receiving the intercostal blocks were turned prone and further midazolam 5–7 mg administered to produce a light sleep. The blocks were performed 7 cm from the midline bilaterally according to the technique described by Moore [1]. Seventy millilitre of 0.5% bupivacaine with adrenaline 250 μg. The control group had the same quantity of adrenaline infiltrated into the intercostal space. Both groups had general anaesthesia with endotracheal intubation and controlled ventilation. In the non-blocked group, the mean cortisol concentration increased from a control value of 182.5 nmol litre⁻¹ to a peak of 686.2 nmol litre⁻¹ at 5.5 h after incision. In the blocked group the baseline serum cortisol concentration was 283.8 nmol litre⁻¹ and it increased to a similar peak at 5.5 h. There were no significant differences between groups. The baseline plasma glucose concentration was also higher in the blocked group (4.45 mmol litre⁻¹ compared with 3.94 mmol litre⁻¹), but after a brief increase following the performance of the block decreased to only 14% above control values. The unblocked group exhibited a substantial increase following the start of the surgery which continued for the duration of the study period to end at a mean of 6.48 mmol litre⁻¹. These differences were significant (P < 0.001). It is concluded that bilateral intercostal blocks may inhibit the glucose response to surgery, but have no effect on the cortisol response.
INTERCOSTAL BLOCKS

position and anaesthesia was induced with thiopentone \(4 \text{ mg kg}^{-1}\). Intubation of the trachea was facilitated by suxamethonium \(1 \text{ mg kg}^{-1}\). In patients not receiving the intercostal blocks, anaesthesia was induced in a similar fashion and the same amount of adrenaline was infiltrated into the intercostal muscles following induction. In both groups ventilation was controlled, the intercostal group receiving no neuromuscular blocking drug unless surgical relaxation proved inadequate or unwanted patient movement occurred. In both groups anaesthesia was maintained by nitrous oxide in oxygen and \(0-2\%\) enfurane as required. Blood samples for measurement of cortisol and glucose were taken on arrival in the anaesthetic room and at the following times after incision: 1, 30, 90, 150, 210, 270, 390 min. Cortisol assay was performed using a radioimmunoassay technique.

Glucose was assayed enzymatically using a Technicon AA2 autoanalyser (glucose oxidase and 4 amino phenazone).

Compound sodium lactate solution was infused at a rate of \(5 \text{ ml kg}^{-1} \text{ h}^{-1}\) for the duration of the operation and for 4 h thereafter in both groups. Subsequently \(4\%\) dextrose in \(0.18\%\) saline was infused at \(100 \text{ ml h}^{-1}\).

The data were analysed using the GLIM program. After testing for normality, data were compared by regression analysis and \(F\) tests.

The two groups did not differ significantly in respect of age, size, duration of surgery, or blood loss. Attention was paid to the following aspects of the study design.

**Haematocrit.** The haematocrit of the cortisol samples was measured. The variation between samples was not more than \(5\%\).

**Duration of starvation.** The patients were always first on the operating list to ensure uniformity of fasting.

**Adequacy of blockade.** The extent of the block was assessed on wakening by loss of cutaneous sensation to pinprick. One patient who had severe pain on recovery from anaesthesia and an inadequate block was excluded from the study.

**Cardiovascular variables.** The intercostal group exhibited very stable cardiovascular systems with little change in heart rate or arterial pressure. The unblocked group had higher heart rates and arterial pressures at comparative sampling times. They thus required higher concentrations of enfurane to maintain anaesthesia.

The baseline plasma cortisol concentration was initially higher in the intercostal group. Following the onset of the surgery there was a rapid increase in both groups to a plateau after \(3\) h. There were no significant differences between the two groups, but there was a significant change from the baseline value (fig. 1A).

The baseline plasma glucose concentration was initially higher in the intercostal group. In this group there was an increase with performance of the blocks, but after a peak \(1\) h after the block, the concentration decreased to a plateau at a mean value \(14\%\) above the control value. In the unblocked group a similar change occurred, but it was delayed until the onset of surgery, and the value continued to increase for the duration of sampling to a level \(64\%\) above the control value.

\[\text{Fig. 1. Changes in plasma cortisol (A) and glucose (B) concentrations. The duration of surgery is indicated by the horizontal arrow. Closed squares represent intercostal block group, open squares control group. Mean \pm SEM.}\]
There was a significant difference between the two groups \( (P < 0.001) \) (fig. 1B).

**COMMENT**

The results of this study show that blockade of the intercostal nerves before operation produces a diminution in the glucose response to cholecystectomy, but does not affect the cortisol response. Whilst it may be said that the groups were poorly controlled, in that the control group had neither a sham block procedure nor similar plasma bupivacaine concentrations, it was not thought ethically justifiable to perform these manoeuvres.

Under general anaesthesia the plasma glucose and cortisol concentrations increase soon after the commencement of surgery and remain abnormally increased for several hours. The changes in both these variables can be modified substantially by extradural analgesia following lower abdominal surgery [2], while only the glucose response is influenced by a similar block following upper abdominal surgery [3]. It is thus not surprising that this study has failed to show any alteration in cortisol response.

However, we have shown that intercostal block modified the glucose response, but only after a significant increase just before incision. This is most likely to be a result of the stimulus of performing the block. The injected adrenaline may have caused an increase in glucose concentration, but this was also administered to the control group in whom a change was not seen until the start of surgery.

Patients who have had uncomplicated abdominal surgery with intercostal blocks may be virtually pain free on recovery from anaesthesia, thus the major nociceptive component of the stimulus is abolished by somatic block of the intercostal nerves. For the glucose response to be modified, however, some blockade of the sympathetic nervous system must be postulated. Intercostal blocks have been shown, by dye and radiographic studies [4], to extend medially as far as the sympathetic chain, especially with the large volumes used in this study. Thus it is possible that we have induced a block similar in extent and nature to thoracic extradural block which would explain the similarity to the results of Bromage [3] and the ablated cardiovascular responses we noted.

Control concentrations of both glucose and cortisol were higher in the intercostal group. It may be that this is a chance occurrence, but a possible explanation is the increased anxiety of the patients anticipating the block. Psychological stress has been shown to affect some hormonal concentrations [5].

The large dose of bupivacaine injected produced high plasma concentrations, but no side effects were noted. This is consistent with the wide experience of one of the authors (L.D.B.) in injecting similar doses in the intercostal space without untoward sequelae. It is possible that these high concentrations could have been responsible for some of the changes seen, but available evidence suggests this is unlikely. Birch and colleagues [6] found no effect of i.v. lignocaine on cortisol or glucose responses and we found no correlation between the increase in plasma bupivacaine concentrations and the decrease in plasma glucose concentrations.

**REFERENCES**