LOCAL ANALGESIA PREVENTS THE CORTISOL AND GLYCAEMIC RESPONSES TO CATARACT SURGERY

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SUMMARY
We studied the metabolic and hormonal responses to cataract surgery in 18 elderly patients, allocated randomly to receive either general anaesthesia or local analgesia by means of a retrobulbar block. Local analgesia prevented the increases in circulating cortisol and glucose concentrations found in those patients who received general anaesthesia. The results show that complete afferent sensory block of the operative site inhibited endocrine and metabolic responses to ophthalmic surgery.

KEY WORDS

The effects of different anaesthetic techniques on the endocrine and metabolic response to surgery have been investigated in detail [1]. In particular, the ability of local analgesia to prevent the stress response to pelvic surgery and lower limb surgery has been studied extensively. Engquist and colleagues [2] have shown the necessity for complete afferent neuronal block, both somatic and autonomic, if the pituitary hormonal response to pelvic surgery is to be attenuated.

Ophthalmic surgery, conducted under local analgesia, offers the opportunity of investigating further the effects of total sensory block on the endocrine and metabolic changes associated with surgery. In the present study, we have compared the stress response to cataract surgery in elderly patients, undertaken with either general anaesthesia or local analgesia. Preliminary results have been reported elsewhere [3].

PATIENTS AND METHODS
We studied 18 elderly patients admitted for cataract surgery. They were otherwise healthy and not receiving any therapy known to interfere with the hormonal and metabolic response to surgery. They were allocated randomly to receive either general anaesthesia (GA) or local analgesia (LA). The nature of the study was explained to the patients and informed consent obtained. The study was approved by the Hospital Ethics Committee.

No premedication was given. On arrival of the patient in the anaesthetic room, a central venous cannula was inserted percutaneously via an antecubital fossa vein for collection of blood samples. After a 10-min rest, a control blood sample was collected.

In the GA group, anaesthesia was induced with thiopentone, the trachea was intubated after administration of vecuronium and the lungs were ventilated with 66% nitrous oxide in oxygen supplemented with 0.6–1.0% enflurane. On completion of surgery, residual neuromuscular block was antagonized with glycopyrronium 0.5 mg and neostigmine 2.5 mg. In the LA group, neural block was undertaken with a mixture of equal volumes of 2% lignocaine and 0.75% bupivacaine. Three millilitre was injected as a retrobulbar block and 2 ml placed at the side of the eye to block the facial innervation of the orbicularis muscle.

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In addition to the control blood sample, venous blood was collected after induction of either GA or LA, at the time of nuclear extraction, on completion of surgery, and 30 and 60 min after completion of surgery. The samples were centrifuged immediately and the supernatant stored at \(-20 \, ^\circ C\) before analysis. Plasma glucose and lactate concentrations were determined enzymatically by methods described previously [4]. Plasma non-esterified fatty acid concentrations were measured by an enzymatic method using acyl-CoA synthetase linked to chromogen production [5]. This method is specific for fatty acids with carbon chain lengths from 6 to 18. Plasma concentration of cortisol was determined by a sensitive and specific radioimmunoassay [6].

The data are presented as mean values (SEM). Statistical analysis was undertaken using one-way analysis of variance, two-way analysis of variance and Fisher's exact test, as appropriate.

**RESULTS**

There was no significant difference between the groups except for the duration of surgery, which was longer in the LA group (30 min compared with 25 min; \(P < 0.05\)) (table I). The overall theatre time, however, was similar in both groups (49 min LA group; 47 min GA group).

**Plasma cortisol (fig. 1)**

In the GA group, cortisol concentrations increased progressively throughout the study from a control value of 348 nmol litre\(^{-1}\) to 747 nmol litre\(^{-1}\) 60 min after completion of surgery. In contrast, in the LA group plasma cortisol concentration did not change during surgery from the control value of 320 nmol litre\(^{-1}\), and then decreased slowly to 223 nmol litre\(^{-1}\) 60 min after surgery (\(P < 0.05\)). There was a significant difference between the groups during surgery (\(P < 0.01\)) and after surgery (\(P < 0.001\)).

**TABLE I. Details of patients studied (mean values (SEM)).**

<table>
<thead>
<tr>
<th></th>
<th>LA group ((n = 9))</th>
<th>GA group ((n = 9))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yr)</td>
<td>73.5 (2.8)</td>
<td>67.9 (5.2)</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>76.1 (2.9)</td>
<td>70.1 (5.4)</td>
</tr>
<tr>
<td>Sex</td>
<td>6M:3F</td>
<td>2M:7F</td>
</tr>
<tr>
<td>Induction time (min)</td>
<td>13 (2.7)</td>
<td>12 (1.9)</td>
</tr>
<tr>
<td>Duration of surgery (min)</td>
<td>30 (2.5) *</td>
<td>25 (1.4)</td>
</tr>
<tr>
<td>Start of induction to leaving theatre (min)</td>
<td>49 (2.9)</td>
<td>47 (2.1)</td>
</tr>
</tbody>
</table>

**TABLE II. Mean (SEM) plasma concentrations of glucose, lactate and non-esterified fatty acid (NEFA).** \(*P < 0.05 = \text{Significant difference from control} ; \text{ns} = \text{not significant}\)**

<table>
<thead>
<tr>
<th>Sample</th>
<th>Glucose (nmol litre(^{-1}))</th>
<th>Lactate (nmol litre(^{-1}))</th>
<th>NEFA (nmol litre(^{-1}))</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control</td>
<td>After induction</td>
<td>Nuclear extraction</td>
</tr>
<tr>
<td>Glucose</td>
<td>4.7 (0.2)</td>
<td>4.9 (0.2)</td>
<td>5.1 (0.2)</td>
</tr>
<tr>
<td>GA</td>
<td>4.4 (0.1)</td>
<td>4.5 (0.1)</td>
<td>4.4 (0.2)</td>
</tr>
<tr>
<td>LA</td>
<td>1.22 (0.08)</td>
<td>1.29 (0.15)</td>
<td>1.29 (0.17)</td>
</tr>
<tr>
<td>Lactate</td>
<td>1.33 (0.05)</td>
<td>1.23 (0.05)</td>
<td>1.10 (0.04)*</td>
</tr>
<tr>
<td>NEFA</td>
<td>0.91 (0.09)</td>
<td>1.01 (0.12)</td>
<td>1.00 (0.11)</td>
</tr>
<tr>
<td>GA</td>
<td>0.90 (0.07)</td>
<td>1.02 (0.10)</td>
<td>1.05 (0.10)</td>
</tr>
<tr>
<td>LA</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**FIG. 1.** Mean (SEM) plasma concentration of cortisol in the GA group (open bars) and LA group (hatched bars). Sample 1 = before induction of anaesthesia; 2 = after induction of anaesthesia; 3 = nuclear extraction; 4 = end of surgery; 5-30 min after completion of surgery; 6-60 min after completion of surgery.
Circulating metabolites (table II)

Plasma concentration of glucose increased in the GA group from 4.7 to 5.2 mmol litre\(^{-1}\) on completion of surgery, but this change was not significant. In the LA group, plasma concentration of glucose did not alter more than 0.2 mmol litre\(^{-1}\) from the control value of 4.4 mmol litre\(^{-1}\) throughout the study. There was a significant difference in plasma concentration of glucose between the groups at nuclear extraction, at the end of surgery and 30 min after completion of surgery (\(P < 0.05\)).

In the GA group, plasma concentration of lactate did not alter significantly during surgery from the control value of 1.22 mmol litre\(^{-1}\), but declined significantly to 0.99 mmol litre\(^{-1}\) 60 min after completion of surgery (\(P < 0.05\)). In contrast, in the LA group plasma concentration of lactate decreased slowly during the study and this resulted in a significant difference between the groups at the end of surgery and 60 min after completion of surgery (\(P < 0.05\)).

Plasma NEFA concentrations did not change significantly in each group during the study.

DISCUSSION

The results show clearly that cataract surgery under general anaesthesia evokes an endocrine and metabolic response, and that this response can be prevented completely by local analgesia. In the GA group, the plasma cortisol values increased more than two-fold, but the changes in circulating metabolites were relatively small.

The retrobulbar block used to provide LA necessitates the injection of a local analgesic solution around the ciliary ganglion in the apex of the orbit. The ciliary ganglion is a peripheral parasympathetic ganglion of the oculomotor nerve and also contains sympathetic and somatic afferent fibres [7]. The parasympathetic root contains both sensory and motor fibres, the latter supplying the ciliary muscle and sphincter pupillae. The sympathetic fibres arise from the superior cervical ganglion, traverse the ciliary ganglion without synapsing, and supply the dilator pupillae and blood vessels of the eyeball. The somatic afferent component of the ganglion consists of sensory fibres from the eyeball in the short ciliary nerves (ophthalmic branch of the trigeminal nerve). These fibres also traverse the ganglion without synapsing and continue in the nasociliary nerve. Thus a correctly placed retrobulbar block provides not only somatic afferent, but also autonomic, block of the eyeball. Our results are important confirmatory evidence of the effectiveness of complete deafferentation of the operative site in preventing catabolic hormone secretion during surgery.

The main cause for the glycaemic response to surgery is activation of the sympathoadrenal system [8]. It can be inferred, therefore, that the comparatively small glycaemic response to surgery of 0.5 mmol litre\(^{-1}\) in the GA group reflected only a modest increase in circulating plasma concentrations of catecholamine. This contention is supported by the lack of a significant increase in plasma concentration of lactate in the GA group, as it has been postulated that the lactic acidaemia of surgery is an indirect indicator of increased sympathetic activity [9]. Both plasma glucose and lactate concentrations decreased significantly in the LA group, suggesting reduced catecholamine secretion.

The effects of age on the metabolic and endocrine response to surgery have received little attention. Blichert-Toft and colleagues [10] compared the response to inguinal herniorrhaphy in men aged 20–30 yr and 70–75 yr and observed only small differences. Similarly, age was found not to be a significant variable in determining the hormonal and metabolic changes associated with cholecystectomy [11]. We consider it likely, therefore, that the metabolic response to cataract surgery under GA was minor because of the nature of the surgery rather than the age of the patients.

There was no difference between the groups in the total time spent in the operating theatre, although the duration of surgery was longer in the LA group (table I). Thus, perhaps surprisingly, LA offered no advantage over GA in theatre utilization. It was our impression, however, that patients who received LA felt symptomatically better in the immediate postoperative period. This opinion is similar to the observations of Rassan and Thomas [12], who noted the excellent recovery of patients undergoing cataract surgery with LA and patients’ preference for this form of anaesthesia.

In conclusion, we have shown that the hormonal and metabolic response to cataract surgery was abolished by LA. Further studies are required to determine if regional analgesia confers any long
term benefit in terms of morbidity and mortality. At present, LA offers metabolic stability in a group of patients who often have severe endocrine and metabolic diseases.

REFERENCES