OUTCOME AFTER GENERAL ANAESTHESIA FOR REPAIR OF FRACTURED NECK OF FEMUR

A Randomized Trial of Spontaneous v. Controlled Ventilation

S. A. COLEMAN, W. J. BOYCE, P. H. COSH AND P. J. McKENZIE

There is clear evidence in the literature that anaesthetic technique affects outcome after surgery for fractured neck of femur. Subarachnoid anaesthesia is associated with a reduced mortality in the first 2–4 weeks after surgery [1, 2]; however, 2 months after the operation this early advantage had disappeared. After 1 year, mortality was independent of anaesthetic technique [2, 3].

The use of ketamine as sole anaesthetic agent has been shown to be associated with a decrease in the early postoperative mortality in comparison with a control group receiving conventional “relaxant” anaesthesia [4]. However, the reduction in mortality was again of short duration, and no advantage could be demonstrated with long-term follow up.

In the studies of McLaren, Stockwell and Reid [1] and Spreadbury [4], mortality in the groups who received a technique of general anaesthesia which included controlled ventilation and neuromuscular blockade was very high in the first 4 weeks after surgery, being more than 30% in both studies. Spreadbury [4] stated that “the mortality after ‘relaxant’ anaesthesia for these operations is unacceptable.”

The present study was intended to clarify this issue by comparing outcome up to 6 months after operation for fractured neck of femur in patients allocated randomly to receive general anaesthesia with either spontaneous or controlled ventilation.

SUMMARY

One hundred and fifty-two patients undergoing surgery for fractured neck of femur were randomly allocated to receive either general anaesthesia with spontaneous ventilation with nitrous oxide and halothane in oxygen or general anaesthesia with controlled ventilation with fentanyl, nitrous oxide and halothane in oxygen. Atracurium was used to provide muscle paralysis in 65% of the latter group, the remainder receiving no neuromuscular blocking agent other than suxamethonium for intubation. Patients were followed up for 6 months. Mortality and outcome were not significantly different between the groups. Overall mortality at 4 weeks was 5.2%, and at 6 months was 15.1%—figures which are considerably lower than in some other comparable studies. This study does not support the suggestion that general anaesthesia with controlled ventilation is associated with increased postoperative mortality.

A non-depolarizing neuromuscular blocking drug (atracurium) was used, in small dosage, only if considered necessary on clinical grounds.

The study was approved by the local Ethics committee who did not consider informed consent to be appropriate, and thus it was not sought.

PATIENTS AND METHODS

One hundred and sixty patients undergoing operative repair of intertrochanteric or trans-cervical fracture of the femur in the John Radcliffe Hospital, Oxford were allocated randomly (on the opening of an envelope just before the induction of anaesthesia) to receive general anaesthesia either breathing spontaneously (group 1) or with controlled ventilation (group 2).
Patients were not considered for inclusion if they were younger than 35 years of age or if the fracture was pathological. A further eight patients were excluded for the reasons shown in Table I. All patients received i.v. fluid in the preoperative period. None received formal premedication, but analgesia was given if required.

Anaesthesia was induced in all patients with etomidate 0.2–0.3 mg/kg body weight i.v. Suxamethonium 50–100 mg i.v. was given to facilitate tracheal intubation. Group 1 patients were allowed to breathe spontaneously via a Mapleson A breathing system. Lung ventilation in group 2 subjects was controlled using a Penlon Nuffield 200 ventilator attached to a Bain anaesthetic system supplied with a fresh gas flow of 100 ml/kg body weight. The anaesthetic gas mixture used throughout the study was 66\% nitrous oxide and 0.1–1.5\% halothane in oxygen. Balanced anaesthesia in group 2 was supplemented with small increments of fentanyl 25–100 μg given i.v. when indicated clinically. If, in addition, neuromuscular blockade was needed to allow adequate control of lung ventilation, atracurium 0.3 mg/kg body weight i.v. was administered. Residual neuromuscular blockade was antagonized at the end of operation when deemed necessary on the basis of the total drug dose given and the time elapsed since the last increment of atracurium.

A non-depolarizing myoneural blocking drug was given to 50 (64.9\%) of the patients in group 2 and antagonism of neuromuscular blockade with neostigmine (and atropine) was required in nine (18\%).

Supplementary oxygen was administered continuously to both groups, for 6 h from the moment of discontinuation of the anaesthetic gases, via a Hudson’s type facemask at a flow rate of 4 litre min\(^{-1}\).

In one patient halothane was contraindicated and enflurane was substituted.

All anaesthetics were administered by members of the Nuffield Department of Anaesthetics, Oxford, and anaesthetists were asked to record an assessment of the cardiovascular, ventilatory, neurological and general fitness of the patient before operation using the following scoring system:

1 = Normal or minor defects;
2 = significant disorders of moderate severity;
3 = Severe or multiple disorders.

In the “general” assessment, 1 was equivalent to ASA I–II, 2 to ASA III, and 3 to ASA IV or V.

In addition, age, time lapse from admission to operation, past medical history, medication, operative procedure, anaesthetic drugs and doses, preoperative and intraoperative fluid balance, and presence or absence of untoward events during anaesthesia were recorded.

Six months after operation all surviving patients were visited and completed an interviewer-administered questionnaire, giving details of their progress since leaving hospital. Similar information was obtained from the General Practitioners for those patients who had died.

Characteristics and outcomes in the two groups were assessed using contingency testing (either χ\(^2\) or Fisher’s Exact Probability test, as appropriate). The mortality in the two groups was compared using the Standard Error of the Difference between Proportions. Levels of probability of 0.05 or less were considered to be statistically significant.

RESULTS

The distributions of age, sex, pre-operative condition and interval between admission to hospital and operation are displayed in table II. The average age of the patients in this study was 79 years; 78\% were female. The average time between admission and operation was 1.5 days. None of these values differed significantly between the two groups. There was no significant difference in the distribution of the preoperative conditions of patients in the two groups.
Table II. Details of patients studied

<table>
<thead>
<tr>
<th>Group</th>
<th>Age (yr) (mean ± SEM)</th>
<th>Sex (M/F)</th>
<th>Fitness</th>
<th>Mean time admission to operation (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (SV)</td>
<td>80.5 ± 1.35</td>
<td>12/63</td>
<td>Grade 1</td>
<td>1.5 ± 0.17</td>
</tr>
<tr>
<td>2 (IPPV)</td>
<td>77.7 ± 1.16</td>
<td>22/55</td>
<td>Grade 2</td>
<td>1.4 ± 0.13</td>
</tr>
</tbody>
</table>

Table III lists the outcome or location of patients at 6 months. One hundred and twenty-two patients were originally admitted from their own homes. Six months later, 88 of these had returned home, 20 had been rehoused, usually in some form of institution, and 14 had died.

The number of deaths that occurred in each group at 2, 4 and 12 weeks after operation are shown in table IV and are identical. Twenty-six weeks after surgery there had been nine deaths in group 1 and 14 deaths in group 2. This difference was not statistically significant, being only 1.06 standard error.

The mean length of stay (± SEM) in the acute hospital was 20.4 days (± 3.3) for group 1 and 19 days (± 1.4) for group 2. In summary, there were no statistically significant differences in short- or long-term outcome between the groups, although there was a proponderence of deaths occurring in the IPPV group amongst patients admitted from institutions.

Table III. Outcome or location of patients at 6 months

<table>
<thead>
<tr>
<th>Admitted from home</th>
<th>Group 1 (SV)</th>
<th>Group 2 (IPPV)</th>
<th>χ²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Died</td>
<td>7</td>
<td>7</td>
<td>ns</td>
</tr>
<tr>
<td>Returned home</td>
<td>39</td>
<td>49</td>
<td>ns</td>
</tr>
<tr>
<td>Relocated</td>
<td>13</td>
<td>7</td>
<td>ns</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Admitted from institution</th>
<th>Group 1 (SV)</th>
<th>Group 2 (IPPV)</th>
<th>χ²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Died</td>
<td>2</td>
<td>7</td>
<td>ns</td>
</tr>
<tr>
<td>Returned to institution</td>
<td>14</td>
<td>7</td>
<td>ns</td>
</tr>
</tbody>
</table>

Table IV. Cumulative mortality

<table>
<thead>
<tr>
<th>Time after operation (weeks)</th>
<th>Group 1 SV (n = 75)</th>
<th>Group 2 IPPV (n = 77)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-2</td>
<td>3 (4%)</td>
<td>3 (3.9%)</td>
</tr>
<tr>
<td>0-4</td>
<td>4 (5.3%)</td>
<td>4 (5.2%)</td>
</tr>
<tr>
<td>0-12</td>
<td>9 (12%)</td>
<td>9 (11.7%)</td>
</tr>
<tr>
<td>0-26</td>
<td>9 (12%)</td>
<td>14 (18.2%)</td>
</tr>
</tbody>
</table>

DISCUSSION

With the techniques applied in this study there were no detectable differences in outcome between the two anaesthetic groups. In addition, it is notable that the mortality figures were lower than in some other comparable studies in which anaesthetic technique has been stipulated; in particular, the overall mortality in the first 4 weeks after surgery was 5.2%, in comparison with figures of 31% [1], 32% [4] and 18% [2]. The last of these studies used spontaneous ventilation, whereas the other two studies used controlled ventilation with use of non-depolarizing myoneural blocking drugs.

The result of the present study indicates that a technique utilizing controlled ventilation is safe for patients with fractured neck of femur either...
when non-depolarizing neuromuscular blockers are avoided or when atracurium is used in low dosage. Atracurium was chosen as being unlikely to produce residual paralysis in the postoperative period in the elderly [5].

Valentin and colleagues [3] compared spinal and general anaesthesia in relation to the surgical repair of fractured neck of femur and also found mortality results similar to those of the present study in their spinal anaesthesia group, and slightly higher early mortality at 4 weeks, of 7.5%, in their general anaesthetic group (controlled ventilation with neurolept or enfuran supplementation). Late mortality was very similar to that in the present study in both groups.

There are several possible explanations for the relatively low mortality observed in the present study. In particular, Oxfordshire's elderly population has better than average health and socioeconomic status (the Standardized Mortality Rate for all causes is about 90% of the National average).

McLaren, Stockwell and Reid [1] used pancuronium 0.1 mg kg⁻¹ to achieve muscle paralysis and patients in the study of Spreadbury [4] received (with one exception) "standard doses" of tubocurarine, alcuronium or pancuronium.

It is possible, as suggested by McLaren, Stockwell and Reid [1] that, in patients receiving the "long-acting" neuromuscular blockers, there may have been some residual effect in the postoperative period, which might have increased the likelihood of stasis and subsequent deep venous thrombosis. The ability to cough may also have been impaired. In patients with fractured neck of femur, the incidence of deep venous thrombosis is reduced if spinal anaesthesia is used in comparison with general anaesthesia [6]. However, Laaksonen and colleagues [7] failed to find any difference in incidence of deep venous thrombosis between patients having general anaesthesia with spontaneous or controlled ventilation.

Two other features of the anaesthetic methods of the present study might possibly have contributed to the relatively good outcome. In the first place anaesthesia was induced in both groups without etomidate. Because of its cardiovascular stability, this drug may be especially valuable in an elderly population with a significant prevalence of cardiovascular disease and where dehydration is common.

Second, supplementary oxygen was administered continuously to all patients from the end of anaesthesia for at least 6 h. Patients with fractured neck of femur are already relatively hypoxaemic when presenting for surgery [8-10]. Profound decreases in arterial Po₂ may occur if patients are allowed to breathe room air over the first h after general anaesthesia and the lowest values of Po₂ occur between 4 and 8 min after nitrous oxide is discontinued [11]—a period when patients are frequently in transit to the recovery area and seldom receive supplementary oxygen.

Patients in the present study had either dynamic hip screw insertion or primary hip prosthesis. The insertion of prosthesis and cement may be associated with hypotension and hypoxaemia, the latter of which may be unrecognized [12].

It would appear that careful general anaesthesia with avoidance of long acting drugs and with continuous supplementary oxygen in the immediate postoperative period results in a relatively good outcome after surgery for fractured neck of femur, regardless of whether controlled or spontaneous ventilation is used.

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REFERENCES

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