Perioperative myocardial ischaemia in patients undergoing transurethral surgery: a pilot study comparing general with spinal anaesthesia

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Summary

We have studied the incidence and duration of perioperative myocardial ischaemia using ambulatory ECG monitoring in 100 patients undergoing transurethral surgery, who were allocated randomly to receive either general or spinal anaesthesia. The overall incidence of myocardial ischaemia increased from 18% to 26% between the preoperative and postoperative periods. Patients with ischaemic heart disease had a significantly greater incidence of myocardial ischaemia after operation than patients without known ischaemic heart disease ($P < 0.05$). There was an increase in both the incidence and duration of myocardial ischaemia after operation with both anaesthetic techniques, but no significant difference between the two. (Br. J. Anaesth. 1995; 74: 368-372)

Key words
Heart, ischaemia, Surgery, urological, Anaesthesia, general, Anaesthetic techniques, subarachnoid.

Perioperative myocardial ischaemia has been shown to be associated with increased postoperative cardiac morbidity and mortality [1-3]. Most studies investigating the incidence of perioperative myocardial ischaemia in patients undergoing non-cardiac surgery have concentrated on patients with either known ischaemic heart disease or cardiac risk factors. However, knowledge of the prevalence of myocardial ischaemia in a particular surgical group would be of value in assessing perioperative risk.

Transurethral surgery is performed on a relatively elderly surgical population, and is associated with considerable morbidity. For example, myocardial mortality after transurethral resection of the prostate (TURP) is between 0.5 and 1%, increasing to more than 2% in patients over 80 yr [4-6]. Transurethral surgery may be performed under general or spinal anaesthesia, and it has been suggested that regional anaesthesia may offer some protection against postoperative myocardial infarction in patients with previous myocardial infarction [7]. This may result from the effects of the anaesthetic technique on the development of postoperative myocardial ischaemia. However, there has been little work directly comparing the influence of general with spinal anaesthesia [8].

In this pilot study we have investigated perioperative myocardial ischaemia in patients undergoing transurethral surgery, with the specific aims of: (1) determining the incidence and duration of perioperative myocardial ischaemia and its relationship with preoperative clinical factors; and (2) comparing the effects of spinal with general anaesthesia on the incidence of myocardial ischaemia after operation.

Patients and methods

Any patient undergoing transurethral resection of either a bladder tumour or the prostate was considered for the study, which was approved by the local Ethics Committee. Written informed consent was obtained from all patients. Exclusion criteria were: patients who had any contraindications to either spinal anaesthesia or to the general anaesthetic technique to be used; patients in whom ST segment analysis would be unreliable (left ventricular hypertrophy who also had a “strain” pattern on the ECG, bundle branch block, concurrent digoxin therapy, pacemaker in situ). After consent, patients were allocated randomly to receive either spinal or general anaesthesia. In addition, patients were allocated to three preoperative risk groups based on preoperative history and examination. IHD group: patients with known ischaemic heart disease (IHD) (previous myocardial infarction, angina or a past history of heart failure); RF group: patients with strong risk factors for IHD in the absence of known IHD (treated hypertension, diabetes, peripheral vascular disease or an abnormal preoperative ECG); NoRF group: patients with neither IHD nor risk factors.

Ambulatory ECG monitoring

ST segment monitoring of the ECG leads $V_2$ and $V_5$ was performed continuously for up to 24 h before operation and for a similar period after operation. Myocardial ischaemia was detected using the Compas computerized ambulatory ECG surveillance system, a microprocessor-based solid state system programmed with algorithms for accurate analysis of the ECG [9]. The monitor was applied to the patient on the evening before surgery and continued until
the patient entered the anaesthetic room. ST segment monitoring was recommenced after operation in the recovery room and continued until the next day. Significant myocardial ischaemia was defined as ST segment depression of 2 mm or more below, or elevation of 3 mm or more above baseline, 60 ms after the J point, persisting for 1 min or more. All ambulatory ECG recordings were analysed after the patient had completed the study. The presence and duration of myocardial ischaemia was noted for each patient before and after operation.

ANAESTHESIA

All patients were prescribed their usual medication on the morning of operation. Additional premedication was not controlled and was at the discretion of the attending anaesthetist.

In the general anaesthetic group (GA), anaesthesia was induced with fentanyl 1 μg kg⁻¹ and etomidate 0.3 mg kg⁻¹. Tracheal intubation and intermittent positive pressure ventilation were facilitated by vecuronium 0.1 mg kg⁻¹, and anaesthesia was maintained with 1–2% enflurane and 66% nitrous oxide in oxygen. Additional bolus doses of fentanyl were given during the procedure, as clinically appropriate. If hypotension occurred during operation this was treated by adjustment of the inspired enflurane concentration and i.v. 0.9% saline. At the end of surgery, neuromuscular block was antagonised with neostigmine 2.5 mg and glycopyrronium 0.5 mg.

Patients in the spinal anaesthetic group (SA) were initially given 250 ml of 0.9% saline followed by a further 250 ml over the 10 min following induction of anaesthesia. Spinal anaesthesia was performed using 2.75 ml of 0.5% “heavy” bupivacaine through a 25-gauge spinal needle at the L2–3 or L3–4 interspace. Adequacy of block to a level of T10 was ensured using loss of sensation to cold. Any intraoperative hypotension was treated initially with 0.9% saline 500 ml i.v. Small bolus doses of i.v. ephedrine were used if the response to saline was not adequate.

After operation all patients received i.m. morphine as required for analgesia, and were prescribed oxygen for 24 h.

STATISTICAL METHODS

The incidence of myocardial ischaemia was compared between the three preoperative risk groups and between the two anaesthetic techniques using the chi-square test. The duration of myocardial ischaemia before and after operation was compared between the anaesthetic techniques using the Mann–Whitney U test. Change in ischaemic burden after operation was compared using the chi-square test. Change in ischaemic burden after operation was compared between the anaesthetic techniques using the chi-square test. The duration of myocardial ischaemia was noted for each patient before and after operation.

Results

A total of 106 patients were recruited and, of these, six patients were later withdrawn; three patients because of monitor failure, two patients because they found wearing the monitors too burdensome, and one patient because of protocol violation. Thus 100 male patients with a mean age of 71 (range 45–90) yr completed the study. Eighty-nine patients underwent transurethral resection of the prostate (TURP) and 11 patients underwent transurethral resection of a bladder tumour (TURT). Fifty-two patients were allocated randomly to receive GA and 48 to receive SA. Anaesthesia was unsuccessful in two patients in the SA group, both of whom were converted to GA.

Thirty patients had known IHD. Of these, 25 patients suffered from angina, 19 had a past history of myocardial infarction, and three had a past history of cardiac failure. The mean age of this patient group was 73 (56–90) yr. Fifteen of these patients had GA and 15 SA (one failed).

Twenty-nine patients had strong risk factors for IHD in the absence of known IHD (RF group). Of these, 23 patients had treated hypertension, 10 patients had peripheral vascular disease, five patients had diabetes mellitus and eight patients had an abnormal preoperative ECG (none of which was diagnostic of a previous myocardial infarction). The mean age of these patients was 71 (57–89) yr. Eighteen of these patients had GA and 11 SA.

The remaining 41 patients (NoRF group) had a mean age of 69 (45–87) yr and had neither known IHD nor strong risk factors: 19 of these patients underwent GA and 22 SA (one failed).

AMBULATORY ST SEGMENT MONITORING

Before operation patients were monitored for a mean of 18.1 (range 8–24) h and after operation for 19.1 (8 to 24) h. Two patients had very large amounts of silent myocardial ischaemia, resulting in the memory within the monitors becoming full. As a consequence these patients were only monitored for 8 h both before and after operation. In addition, monitoring was discontinued 8 h after operation in a patient who had developed intractable heart failure who died 4 h later. All other patients were monitored for at least 12 h both before and after operation.

INCIDENCE OF MYOCARDIAL ISCHAEMIA

A total of 30 patients had myocardial ischaemia at some time during the perioperative period. The overall incidence of myocardial ischaemia before operation was 18% (table 1). This consisted of seven (23%) of the patients with IHD, seven (24%) with strong risk factors, and four (10%) with no known risk factors. After operation the overall incidence of myocardial ischaemia increased to 26%. In patients with IHD the number of patients with myocardial ischaemia increased to 12 (40%), in patients with risk factors the number of patients with myocardial ischaemia increased to 12 (40%), in patients with risk factors the number of patients with myocardial ischaemia remained similar at seven (24%) and in patients with no risk factors the number of patients increased to seven (17%). While there was no difference in the incidence of myocardial ischaemia between the groups before operation, the incidence of myocardial ischaemia after operation was greater in patients with IHD compared with the other patients ($P < 0.05$). Of the patients without known IHD, patients with peripheral vascular disease or an abnormal preoperative ECG had the highest incidence of perioperative myocardial ischaemia.
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burden between preoperative and postoperative

derived for both the preoperative and postoperative

A total of 30 patients had myocardial ischaemia at

perioperative myocardial ischaemia.

The incidence of myocardial ischaemia increased

from 17% before to 27% after operation in the GA

patients compared with an increase from 20% to

26% in the SA patients (table 1) (ns). The two

patients in whom anaesthesia was converted from SA

to GA were not included, although neither had any

perioperative myocardial ischaemia.

DURATION OF MYOCARDIAL ISCHAEMIA

A total of 30 patients had myocardial ischaemia at

some time during the perioperative period. For each

patient who had myocardial ischaemia, an ischaemic

burden, defined as duration of ischaemia (in minutes)
divided by duration of monitoring (in hours), was
derived for both the preoperative and postoperative

periods (table 2). A significant change in ischaemic

burden between preoperative and postoperative

values was defined as a difference of at least 1 min

er per hour, which also represented a change in the

postoperative ischaemic burden of at least 10%

compared with before operation (our own definition).

There was an increase in ischaemic burden after

operation in 11 patients, six patients with IHD, three

with risk factors and two with no risk factors. Seven

of these patients had GA and four patients had SA.

There was a decrease in ischaemic burden after

operation in three patients, one with IHD, one with

risk factors and one with no risk factors. Of these

patients, one had GA and two had SA.

In the GA patients overall, there was an increased

ischaemic burden in 13.5% of patients and a

decreased burden in 1.9%, with 84.6% of patients

having either no perioperative myocardial ischaemia

or no significant change in ischaemic burden. In the

SA patients overall, there was an increased ischaemic

burden in 8.7% of patients and a decreased burden

in 4.3%, with 87.0% of patients having either no

perioperative myocardial ischaemia or no significant

change in ischaemic burden (table 3).

<table>
<thead>
<tr>
<th>Total</th>
<th>Preop.</th>
<th>Postop.</th>
<th>Either preop. or postop.</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ischaemic heart disease</td>
<td>100</td>
<td>18 (18%)</td>
<td>26 (26%)</td>
</tr>
<tr>
<td>Strong risk factors</td>
<td>30</td>
<td>7 (23%)</td>
<td>12 (40%)</td>
</tr>
<tr>
<td>Vascular disease</td>
<td>29</td>
<td>7 (24%)</td>
<td>7 (24%)</td>
</tr>
<tr>
<td>Diabetes</td>
<td>10</td>
<td>3 (30%)</td>
<td>4 (40%)</td>
</tr>
<tr>
<td>Abnormal ECG</td>
<td>5</td>
<td>2 (40%)</td>
<td>1 (20%)</td>
</tr>
<tr>
<td>No risk factors</td>
<td>8</td>
<td>3 (38%)</td>
<td>4 (50%)</td>
</tr>
<tr>
<td>General anaesthesia</td>
<td>46</td>
<td>9 (20%)</td>
<td>12 (26%)</td>
</tr>
<tr>
<td>Spinal anaesthesia</td>
<td>52</td>
<td>9 (17%)</td>
<td>14 (27%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Anaesthetic type</th>
<th>n</th>
<th>Increase</th>
<th>No change</th>
<th>Decrease</th>
</tr>
</thead>
<tbody>
<tr>
<td>General</td>
<td>52</td>
<td>7 (13.5%)</td>
<td>44 (84.6%)</td>
<td>1 (1.9%)</td>
</tr>
<tr>
<td>Spinal</td>
<td>46</td>
<td>4 (8.7%)</td>
<td>40 (87.0%)</td>
<td>2 (4.3%)</td>
</tr>
</tbody>
</table>
Four patients suffered significant perioperative morbidity, three of whom died. All three patients who died received general anaesthesia. Patient No. 13 suffered a myocardial infarction 4 days after operation and eventually died 25 days after surgery. This patient had no myocardial ischaemia before operation, but after operation had an ischaemic burden of 1.7 min h\(^{-1}\). Patient No. 28 suffered a cerebrovascular event after operation on the evening following surgery and died 25 days later. He did not show any myocardial ischaemia before or after operation. Patient No. 70 developed severe cardiac failure during operation and died 12 h after operation. He did not show any myocardial ischaemia before operation, but had 1.0 min h\(^{-1}\) of myocardial ischaemia after operation until monitoring was discontinued. Patient No. 93 developed atrial fibrillation soon after spinal analgesia was commenced. He was treated with i.v. digoxin, and his heart rate stabilized at about 90 beat \(\min^{-1}\). After operation his ECG showed sinus rhythm and his recovery was uncomplicated.

Discussion

In 1989, Raby and colleagues [1], investigating patients undergoing vascular surgery, first showed the presence of silent myocardial ischaemia before operation to be associated with increased postoperative cardiac morbidity. Similar findings have since been obtained in other surgical groups [3]. In 1990, Mangano and colleagues [2] extended this work into the postoperative period. Investigating patients with IHD or at high risk during non-cardiac surgery, they found that the incidence of myocardial ischaemia increased from 20% before to 41% after operation. They also showed that the presence of myocardial ischaemia after operation had an even stronger association with postoperative cardiac morbidity. Since then it has been shown that not only the incidence but also the duration of myocardial ischaemia increases after surgery [10, 11], and that silent myocardial ischaemia precedes most postoperative cardiac events [10].

We found that silent myocardial ischaemia was relatively common in patients undergoing transurethral surgery, and that in keeping with other studies, there was a trend towards an increase in both the incidence and duration of myocardial ischaemia after operation, despite the fact that all patients received supplementary oxygen after operation. Postoperative myocardial ischaemia has previously been shown to be temporally related to hypoxaemia, and we wished to reduce this possibility [12]. As in other studies [1, 13, 14], we have shown that the incidence of silent myocardial ischaemia, particularly after operation, was greater in patients with known IHD. However, patients without known IHD, with or without strong risk factors, still had a relatively high frequency of silent ischaemia and this may be a reflection of the incidence of asymptomatic cardiac disease in this relatively aged surgical group. Other studies in different surgical groups have also shown that many patients exhibit silent myocardial ischaemia in the absence of proven IHD [2, 13]. We also demonstrated a very large inter-patient variability in ischaemic burden. Several patients in our study had a very low ischaemic burden, representing only 1 or 2 min of ischaemia during a monitoring period, and the possibility of false positive results in these cases cannot be excluded. However, an in-house study validated the Compas ambulatory ECG system in patients undergoing exercise ECG testing, and we are confident that the strict criteria we have used to define myocardial ischaemia give a low incidence of false positive readings.

It would appear from other studies that although the presence of myocardial ischaemia is an important preoperative risk factor, it is an increase in the duration, or the development of silent myocardial ischaemia after operation, which is more significant in precipitating cardiac morbidity [2, 10]. Indeed, although our study was too small to assess any influence of perioperative myocardial ischaemia on cardiac outcome, it is interesting to look at the three patients who had perioperative cardiac events. Two of these patients died and both had myocardial ischaemia after but not before operation. A third patient developed atrial fibrillation during operation, but had no ischaemia before or after operation and his postoperative course was uneventful. This seems to underline the potential influence of postoperative myocardial ischaemia on outcome after surgery. It is therefore important to assess if the anaesthetic technique plays any role in the development of postoperative myocardial ischaemia.

Transurethral surgery may be performed under either general or regional anaesthesia. Some studies suggest that regional anaesthesia may offer some protection against postoperative infarction in patients with previous myocardial infarction [7], and may reduce the risk of cardiac failure in patients with a history of cardiac failure [15]. However, we are not aware of any previous study which has directly compared the incidence of myocardial ischaemia in patients allocated randomly to receive either general or regional anaesthesia. Indeed, only one previous study has investigated the incidence of myocardial ischaemia in patients undergoing transurethral surgery. Christensen and colleagues [11] investigated 14 patients with known angina undergoing minor surgery under spinal analgesia, 10 of whom underwent transurethral resection. They found a high incidence of myocardial ischaemia before operation which was increased in both incidence and duration after operation.

Our study was intended as a pilot study, and as a consequence the sample size is too small for any firm conclusions. However, we have confirmed that after transurethral surgery there is an increase in both the incidence and duration of silent myocardial ischaemia after operation and that this occurs whether the patients undergo general or spinal anaesthesia. After general anaesthesia the ischaemic burden increased in 13.5% and decreased in 1.9% of patients compared with an increase in 8.7% and a decrease in 4.3% of patients following spinal anaesthesia. This may be a true difference, but for a
study to have a power of 0.8 for detecting such a difference, with a significance level of 0.05, more than 1100 patients would be needed. This would require a multicentre study.

Studies investigating postoperative myocardial ischaemia in patients undergoing non-cardiac surgery have been performed for both general [2, 3] and regional anaesthesia [10, 11, 16]. A consistent finding in all of these studies is an increase in silent myocardial ischaemia after operation. It would seem well proved therefore, that regardless of the anaesthetic technique, there is an increase in silent myocardial ischaemia after surgery. It remains to be determined, however, if the scale of the increase is affected preferentially by one technique.

References