EXTRADURAL BUPIVACAINE AND METHADONE FOR EXTRACORPOREAL SHOCK-WAVE LITHOTRIPSY†

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Fragmentation of urinary calculi by means of extracorporeal shock wave lithotripsy (ESWL) is accompanied by severe deep pain in the kidney region and superficial pain in the involved skin area. In order to provide adequate pain relief while maintaining stability of the cardiovascular system, which is affected easily during ESWL by immersion in warm water, various general and regional anaesthetic regimens have been described [1-6]. Many patients require analgesic therapy following ESWL, because of abdominal discomfort and colicky pain from the passage of stone fragments.

The successful treatment of ureteric colic in addition to the benefit of supplementation of extradural anaesthesia by extradural opioids has been reported previously [7, 8]. Compared with morphine, extradural methadone was found to be as effective for postoperative analgesia, but with fewer urinary complications [9].

In the present study, the efficacy of low dose extradural bupivacaine analgesia with and without extradural methadone was compared. The quality of post-ESWL analgesia by continuous infusion of extradural methadone with a patient-controlled pump was evaluated also.

SUMMARY

Combined extradural bupivacaine and methadone analgesia was investigated in 144 patients who underwent extracorporeal shock wave lithotripsy (ESWL). Patients were assigned randomly to one of three groups: group I—extradural 0.5% bupivacaine hydrochloride 0.75 mg kg⁻¹; group II—extradural 0.1% methadone hydrochloride 4 mg after the bupivacaine; group III—as group II, plus a continuous extradural infusion of methadone 0.3 mg h⁻¹ after operation. In all patients, only partial motor deficit occurred. During ESWL, patients who received extradural bupivacaine and methadone had significantly less pain compared with those who had bupivacaine alone (P < 0.025). Extradural anaesthesia and immersion in the warm water bath were accompanied by only mild fluctuations in arterial pressure. After ESWL, significantly more patients with continuous methadone infusion were pain free (P < 0.05) and they required less systemic analgesics. The anaesthesia during and after the ESWL procedure may be carried out safely and effectively by the administration of small doses of bupivacaine combined with methadone followed by infusion of the opioid.

PATIENTS AND METHODS

One hundred and forty-four patients undergoing ESWL were studied after informed consent was obtained. The patients received no premedication and were allocated randomly as follows: group I—extradural bupivacaine; group II = extradural bupivacaine and methadone; group III = extradural bupivacaine and methadone anaesthesia and continuous patient-controlled extradural methadone analgesia administered by a syringe pump.
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after ESWL. For the purpose of analysis of results, groups II and III were considered to constitute one unit during ESWL.

The extradural needle was placed at the L2–3 or L1–2 space. For extradural anaesthesia a predetermined minimum dose of 0.5% bupivacaine 40 mg (8 ml) or 0.75 mg kg\(^{-1}\) (0.15 ml kg\(^{-1}\)) was administered through the needle. In the heaviest patients, the maximal dose administered did not exceed 70 mg (14 ml). In groups II and III, 0.1% methadone hydrochloride 4 mg was added shortly after the extradural catheter was introduced. In group III a bolus of extradural methadone 2 mg was added on completion of treatment and the catheter was connected to a portable, battery-operated syringe pump (Model M26, Graseby Medical, England) set to deliver methadone 0.3 mg h\(^{-1}\). These patients were instructed to press a button when in pain, to inject the available drug in boluses of 0.2 mg until analgesia improved. The total dose infused to each patient after surgery did not exceed 5 mg. Midazolam was administered i.v. during ESWL when indicated.

The degree of pain during the ESWL was assessed by the patient, according to the following scale: 1 = no pain; 2 = non-painful sensation of the generated shock waves; 3 = minor pain without need for additional drugs; 4 = pain requiring addition of 1.5% lignocaine 5 ml; 5 = severe pain (change to general anaesthesia).

Twenty-four hours after ESWL, all patients were examined by an independent anaesthetist who was unaware of the anaesthetic procedure, and the pain score was recorded. The need for analgesics was an additional indicator for pain after ESWL and scored as follows: I = no need for analgesic drugs; II = oral analgesic drugs (dypirone 1 g or pentazocine 30 mg); III = i.m. analgesic drugs (pentazocine 60 mg or pethidine 75 mg).

The number of patients in each group, categorized according to analgesic requirement and pain score, was evaluated for statistical significance by the chi-square test. When the phenomena studied occurred with low frequency, Fisher’s exact test was used. The differences in the time of onset of pain between the three groups were compared by analysis of variance.

RESULTS

Patient data are given in table I. There were no significant differences between the groups.

<table>
<thead>
<tr>
<th>Table I. Patient data (mean (SD))</th>
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<tr>
<td>Group I</td>
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<tr>
<td>No. of patients</td>
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<tr>
<td>Male</td>
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<td>Female</td>
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During ESWL

Extradural anaesthesia with bupivacaine alone (group I) or combined with methadone (group II and III) was associated with mild fluctuations in systolic arterial pressure. A mean maximal reduction of 4.7 (SEM 7)\% was observed in group I and of 5.5 (8)\% (range -20\% to +7.7\%) in group II and III. The phase of body immersion in the water bath was accompanied in most of the patients by a small increase in systolic arterial pressure (range -13.6\% to +23\%). In the course of the procedure hypotension, defined as a
systolic arterial pressure less than 90 mm Hg, occurred in seven patients and was corrected by ephedrine 5-10 mg i.v.

Atrial or ventricular premature beats occurred in 10 patients (3.5% of each type) during ESWL, and disappeared when the procedure was discontinued temporarily. Fifty percent of these patients had no previous history of arrhythmia.

Motor deficit was only partial in all patients, enabling unassisted transfer to and from the hydraulic cradle at the start and end of the procedure.

Midazolam 1.5-3 mg was added on 17 occasions (11.9%) when the patient was very tense and after the possibility of insufficient anaesthesia was ruled out. The sedation regulated the patient's breathing; normal ventilation is necessary to help keep the stone within the range of the shock waves.

Extradural anaesthesia provided satisfactory conditions (pain scores 1-3) for ESWL treatment in 98% of the patients in groups II and III and in 86.7% in group I (fig. 1). The patients with pain score 3 (15.6% in group I and 2% in groups II and III combined) had no spontaneous complaints during treatment, but upon questioning at the end of the procedure revealed that they had experienced some minor pain. Severe pain after the original extradural drug administration (scores 4 and 5) occurred in 13.3% of patients in group I and in 2% of groups II and III (P < 0.001). All these patients received 1.5% lignocaine 5 ml; in five of them good analgesia was obtained. In two other patients further improvement was achieved by the addition of midazolam. In one patient general anaesthesia had to be administered because of failed extradural blockade. The mean number of shock waves for lithotripsy was 1674 (461), and lasted for a mean period of 35 (18) min.

There was no difference in sensitivity to pain between the two sexes, no difference in distribution of patients according to their body weight between the pain score groups, and no significant change was observed in the pain score as a result of the number of ESWL shock waves administered.

Recovery period

In the first 24 h after ESWL, 60% of patients of group I, 72.6% of group II and 87.5% of group III did not experience pain (scores 1 and 2), and none required systemic analgesics. Those patients in group I who suffered pain reported its onset 5.5 (2.7) h after termination of treatment, while in group II the pain was noted after 7.9 (3.1) h (P < 0.05) and in group III after 7.3 (3.3) h. Severe abdominal or colicky pain occurred in 40% of patients in whom anaesthesia consisted of extradural bupivacaine alone. These complaints were noted only in 12.5% of the patients who were treated by continuous infusion of extradural methadone (P < 0.05). The total amount of methadone infused did not exceed 5 mg in any patient. In 42.2% of the patients in group I, oral or i.m. analgesics were required, compared with 8.3% in group III (P < 0.002). In the patients who received extradural methadone only during ESWL (group II), analgesia seemed to be better after the procedure compared with group I, but the difference not significant statistically. Oral or i.m. analgesic treatment was needed in 25.5% of the patients in group II, significantly more than in those who continued to receive extradural methadone pump analgesia (group III) (P < 0.025) (fig. 1).

No serious side effects were encountered. Nausea and vomiting appeared in 31.1%, 43.1% and 37.5% of patients in groups I, II and III, respectively. One-third of those who had nausea vomited also. Two males in group III (4.2%) suffered urinary retention. In one of these, benign hypertrophy of the prostate was found.

DISCUSSION

The physiological changes resulting from the combination of extradural anaesthesia and body immersion in warm water may be associated with haemodynamic instability [1,4]. The addition of methadone improved significantly the quality of anaesthesia for ESWL, contributed to a longer duration of the analgesic block, and enabled injection of the local anaesthetic in smaller doses than recommended usually. Hence, haemodynamic stability was obtained and motor weakness minimized during and after the procedure. A similar finding was observed when a mixture of fentanyl and a full dose of bupivacaine was given for extradural blockade [8]. The authors noted that the analgesia obtained was more prolonged, motor blockade was reduced and fewer episodes of acute hypotension occurred than after bupivacaine alone. In the present study, the partial motor blockade may be related to an uneven effect of the low mass of injected anaesthetic drug on the large motor fibres in the spinal cord. The ability
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of the patients to move themselves almost unassisted to and from the hydraulic cradle was very helpful for the medical staff.

The pain experienced following ESWL results from both tissue injury elicited by the shock waves in the renal area, and elimination of the fragmented stones. The first type of pain is of moderate intensity, insidious and poorly localized, while the second is severe, colicky in nature and is relieved usually only by parenteral opioids. The value of extradural opioids in obstinate cases of ureteric colic pain has been demonstrated already [7]. The present study emphasizes also the efficacy of opioid administration for renal calculi following lithotripsy.

Extradural analgesia combined with injection of a single bolus of methadone, or with continuous methadone infusion, increased both the incidence and duration of the post-ESWL pain relief. The continuous plus “on-demand” patient administration of small doses of extradural opioids is known to provide constant analgesia and effectively fulfils the changing individual requirements with a lower frequency of side effects [10, 11].

The choice of methadone was based on its high lipid solubility, which accounts for a rapid onset of action (approximately 15 min) [9] and rapid elimination from the spinal structures [12]. The use of small volumes minimizes the danger of late respiratory depression as a result of rostral spread. The low rate of urinary retention associated with extradural methadone [9, 13] is an important advantage in patients with urological problems. Usually, extradural opioids produced a higher rate of micturition disturbances, especially when combined with extradural anaesthesia [8, 9]. In the present study, the combination of extradural bupivacaine and methadone administered to urological patients resulted in a low rate of urinary complications. This may be explained by a urodynamic effect after spinal injection of methadone, which has been observed in dogs. It causes an increase in the bladder detrusor tone and, as a result, a low compliant bladder which will accommodate only small volumes of urine [14, 15]; accordingly, an enhancement of the volume-evoked micturition response may have occurred.

Nausea and vomiting, which occurred at a similar frequency in all three groups, might have been related to irritation of the peritoneum and other abdominal viscera by the shock waves, and not to the injected opioid. Anti-emetic drugs alleviated these symptoms.

In conclusion, in patients about to undergo ESWL, the combination of an opioid and reduced amounts of a local anaesthetic drug provides good analgesia during the procedure. In addition, stable haemodynamic conditions are to be expected while the patient is immersed in the warm water. The use of a lipophilic opioid like methadone, with rapid onset of action, may be advantageous. For relief of pain after ESWL, the patient-controlled infusion of extradural methadone may provide analgesia.

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REFERENCES


