Alfentanil analgesia/sedation for extracorporeal shock wave lithotripsy: A comparison with general and epidural anesthesia

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An alfentanil infusion was used to produce analgesia and sedation for patients undergoing extracorporeal shock wave lithotripsy with the Dornier HM-4™ lithotripter. This was compared to general and epidural anesthesia in a retrospective review of 197 consecutive patients. Total care time, anesthesia time, and recovery room time were shorter for the alfentanil analgesia/sedation group. The incidence of nausea and vomiting was similar in all three groups. Technical failure (requiring switching to general anesthesia) was not significantly different than when performed with epidural anesthesia. The technique was simple and reliable when performed by a large number of anesthesia practitioners (anesthesiologists, anesthesia residents and CRNAs).

Key words: Alfentanil, analgesia, extracorporeal shock wave lithotripsy, lithotripsy, sedation.

Introduction
Anesthesia for extracorporeal shock wave lithotripsy (ESWL) usually consists of general or epidural anesthesia. In addition, general anesthesia using high-frequency jet ventilation, intercostal blockade combined with infiltration of local anesthetic, infiltration alone, and intravenous sedation have all been described.

In the new Dornier HM-4™ model lithotripter, the water tank of the HM-3™ has been replaced by a plastic water-filled cushion that encloses the shock wave generator. The patient remains dry and lying over the water cushion in a frame so that the back and flank are exposed and in contact with the cushion. In providing anesthetic coverage for the first such commercial unit operational in the United States, the authors’ technique evolved from general or epidural anesthesia to alfentanil analgesia/sedation by continuous infusion. This article presents the authors’ experience using alfentanil analgesia/sedation for extracorporeal shock wave lithotripsy with the Dornier Model HM-4 lithotripter and compare it to general and epidural anesthesia on the same unit.

Methods
A retrospective chart review was performed on 197 consecutive ESWL cases done by our department from January to May 1988. This time period includes the previously described changes in anesthetic technique. There was no formal design as to the type of anesthesia administered; each of the anesthesia practitioners involved in the study selected an anesthetic plan based on usual procedure and patient factors. Patients were assigned to one of three groups, depending on the type of anesthesia they received while undergoing ESWL: general anesthesia (GA), epidural anesthesia (EDA), or alfentanil analgesia/sedation (AAS).

Data were collected from the chart to obtain total care time, surgical time, anesthesia time, and recovery room time.
Total care time was from the patient's entrance into the ESWL or cystoscopy suite to discharge from the facility. If epidural anesthesia was used, the total care time began at the beginning of placement of the epidural anesthetic.

Surgical time was from the beginning to the end of the procedure. If cystoscopy preceded ESWL, surgical time was from the beginning of cystoscopy to the end of ESWL.

Anesthesia time was from the patient's entrance into the ESWL or cystoscopy suite to entrance into the recovery room. If epidural anesthesia was used, anesthesia time began at the beginning of placement of the epidural anesthetic.

Recovery room time was from entry into the recovery room to discharge from the facility.

Criteria for discharge home included the ability to ambulate, void, tolerate oral fluids, lack of nausea or vomiting, and stable vital signs. For hospitalized patients who were to be sent back to their hospital rooms after treatment, discharge criteria included stable vital signs, resolution of conduction blockade (if applicable), and lack of nausea or vomiting. Incidence of discomfort, nausea or vomiting intraoperatively (for EDA and AAS groups), failure of the anesthetic requiring a change in technique, and nausea or vomiting postoperatively were also examined.

All patients were monitored with an electrocardiogram (ECG), automated blood pressure cuff, neuromuscular blockade monitor (if GA was used), pulse oximetry, capnography (through nasal prongs in EDA and AAS groups), and either a precordial or esophageal stethoscope. Supplemental oxygen was administered to all EDA and AAS patients.

Patients given GA were positioned in the ESWL unit, preoxygenated, and then anesthesia was induced with sodium thiopental. All patients in this group were intubated and were given nitrous oxide, oxygen, alfentanil by infusion pump (Bard Harvard Mini-Infusor 900™ for alfentanil), small doses of midazolam (0-4 mg) and/or droperidol (0-1.25 mg), and were paralyzed with intermediate acting nondepolarizing agents. Neuromuscular blocking drugs were reversed routinely. All patients were extubated in the operating room at the end of the procedure.

Patients given EDA received either lidocaine or 2-chloroprocaine, the majority with catheter technique, administered in a holding area with ECG and blood pressure monitoring. They were then transported to the ESWL or cystoscopy suite. At least a T6 sensory level was obtained.

Patients given AAS received a small dose of midazolam (0.5-2.5 mg) and droperidol (0.5 to 1.25 mg) intravenously, as well as alfentanil, as soon as they entered the surgical suite and while being positioned for the procedure. Midazolam was given as an anxiolytic and droperidol as an antiemetic. Alfentanil was administered by infusion pump. Patients received a bolus dose (5 to 7.5 μg/kg) repeated 1 to 3 times in the 5 to 10 minutes of positioning. This was followed by a continuous infusion (0.5 to 1.0 μg/kg/min). The end point for alfentanil titration varied from practitioner to practitioner, but it was generally a sedated but easily arousable patient who usually closed his or her eyes spontaneously.

In addition, patients in the AAS group wore respiratory triggering bands around their chests which were integrated with the ESWL unit. All patients maintained spontaneous ventilation and had well-delineated capnographic tracings.

A factorial analysis of variance using the t-test with Bonferroni correction was done on the time data with anesthetic technique (GA, EDA, or AAS) as the first factor, procedure (ESWL or ESWL and cystoscopy) as the second factor, and disposition (home or hospital) as the final factor. This design was chosen to separate the influence of procedure and disposition from anesthetic technique. All times are reported in minutes as mean values ± standard deviation. A chi-square analysis was done on the complication data. For all statistical comparisons, P values less than 0.05 were considered significant.

Results
A total of 197 consecutive charts were reviewed. Patient characteristics are shown in Table I. The number of patients who received either ESWL alone or combined ESWL and cystoscopy, and who were discharged to either the hospital or their homes is shown in Table II. Average alfentanil dose for each of the three anesthetic groups is shown in Table III. Time data is shown in Table IV.

The average total care time for the AAS group (167 ± 51 minutes) was significantly shorter than

<table>
<thead>
<tr>
<th>Table I: Patient characteristics</th>
</tr>
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<tbody>
<tr>
<td>General anesthesia (GA)</td>
</tr>
<tr>
<td>Median age</td>
</tr>
<tr>
<td>Number of ASA III or IV patients</td>
</tr>
<tr>
<td>Total number of patients</td>
</tr>
</tbody>
</table>
Table II
Number of patients by technique, procedure, and disposition to home or hospital

<table>
<thead>
<tr>
<th>Technique</th>
<th>GA (Number = 52)</th>
<th>ESWL</th>
<th>Hospital</th>
<th>ESWL and CYSTO</th>
<th>Home</th>
<th>Hospital</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Anesthesia (GA)</td>
<td></td>
<td>22</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>0</td>
</tr>
<tr>
<td>Epidural Anesthesia (EDA)</td>
<td></td>
<td>31</td>
<td>10</td>
<td>24</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>Alfentanil/Analgesia Sedation (AAS)</td>
<td>(Number = 63)</td>
<td>28</td>
<td>16</td>
<td>13</td>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>

Table III
Alfentanil doses for each anesthetic technique in mL, concentration equals 500 µg/mL

<table>
<thead>
<tr>
<th>Technique</th>
<th>GA (General anesthesia)</th>
<th>EDA (Epidural anesthesia)</th>
<th>AAS (Alfentanil/analgesia sedation)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average dose</td>
<td>5.0</td>
<td>1.6</td>
<td>4.9</td>
</tr>
<tr>
<td>Range</td>
<td>0.9-11.3</td>
<td>0-9.3</td>
<td>1.6-11.1</td>
</tr>
</tbody>
</table>

ESWL—Extracorporeal shock wave lithotripsy
CYSTO—Cystoscopy

that for the EDA or GA groups (213 ± 40 minutes and 220 ± 51 minutes) respectively. There was no significant difference between the EDA and GA groups in total care time. This held true irrespective of procedure (ESWL alone or ESWL with cystoscopy), or disposition (discharge home or to hospital). There were no significant interactions among any of the factors analyzed.

The average anesthesia time for the AAS group (85 ± 24 minutes) was significantly shorter than that for the GA group (98 ± 28 minutes), which in turn was significantly shorter than that for the GA group (119 ± 39 minutes). Recovery room time was similar whether a patient had ESWL alone or ESWL with cystoscopy (94 ± 33 and 99 ± 40 minutes). However, it was shorter for those patients discharged to a hospital bed than for those discharged to home (84 ± 34 versus 102 ± 35 minutes).

A list of complications is presented in Table V. Nausea or vomiting occurred either intraoperatively or in the recovery room in 10% of patients in the AAS group, while 17% of the GA group and 7% of the EDA group were so affected. These differences were insignificant.

The incidence of technical failure (resulting in a change of technique) for AAS was 3% and that for EDA was 9%. This difference was statistically not significant. In one of the two AAS cases, the patient, although feeling no discomfort, was too restless for the procedure to continue and required conversion to general anesthesia. In the other, the patient became apneic and unresponsive due to a relative inadvertent overdose of narcotic and was essentially under general anesthesia. The EDA group, failure included four cases of inability to place the catheter and three of incomplete anesthesia. No

Table IV
Anesthetic techniques compared for total care, anesthesia, surgery, and recovery room times (minutes ± standard deviation)

<table>
<thead>
<tr>
<th>Technique</th>
<th>GA</th>
<th>EDA</th>
<th>AAS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total care time</td>
<td>220±51</td>
<td>213±40</td>
<td>167±51¹</td>
</tr>
<tr>
<td>Anesthesia time</td>
<td>98±28²</td>
<td>122±29</td>
<td>85±24¹</td>
</tr>
<tr>
<td>Surgical time</td>
<td>66±29</td>
<td>77±29</td>
<td>63±20</td>
</tr>
<tr>
<td>Recovery room time</td>
<td>119±39</td>
<td>91±33³</td>
<td>82±26¹</td>
</tr>
</tbody>
</table>

Times are mean values in minutes ± standard deviation. Significance assumes at P = 0.05.

1. Significantly shorter than GA and EDA.
2. Significantly shorter than EDA.
3. Significantly shorter than GA.
Table V
Incidence of complications in various anesthesia groups

<table>
<thead>
<tr>
<th></th>
<th>General anesthesia (GA)</th>
<th>Epidural anesthesia (EDA)</th>
<th>Alfenanil analgesia/sedation (AAS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of patients</td>
<td>52</td>
<td>82</td>
<td>63</td>
</tr>
<tr>
<td>Nausea or vomiting</td>
<td>9</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Partial airway obstruction</td>
<td>4</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Discomfort</td>
<td>*</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Naloxone used</td>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Convert to GA</td>
<td>*</td>
<td>7</td>
<td>2</td>
</tr>
</tbody>
</table>

*Not applicable

One half of nausea and vomiting episodes in the EDA group were intraoperative, the rest were postoperative, whereas all were postoperative in the AAS group. Discomfort refers to discomfort insufficient to require a change in technique. Airway obstruction was always postoperative in the GA group. EDA conversions to GA included four cases of inability to place a catheter and three cases of incomplete anesthesia. AAS conversions to GA included one case of apnea and one overly restless patient. There were no significant differences in the incidences of nausea/vomiting or conversion to GA.

**Discussion**

The AAS technique appears suited to the ESWL procedure. It is simple, flexible, reliable, and reproducible. It is also well accepted by patients, physicians and staff.

The Dornier HM-3 (water tank model) is the lithotripter generally used in the United States. The Dornier HM-4 (tankless) lithotripter with a standard generator and elipsoid (18-24 kV) was used in this study. There are important differences (i.e., improvements) between the two models. In the HM-4, patient access is much improved, and airway maintenance should the need arise, is quite easy. Observation of respiration and patient communication are unhampered and, thus, aid in titration of drugs. The use of respiratory bands and capnography, both of which produce a real-time tracing on ECG monitors, further aid in respiratory evaluation. There is also elimination of the effects of water immersion on respiratory function.

Graff and associates used a modified HM-3 lithotripter equipped with a new shock wave generator and standard elipsoid and found that a benzodiazepine/narcotic combination alone resulted in treatment that was judged “free of pain or with easily tolerable pain” in 88% to 93% of the patients. However, an increased number of shock waves was necessary for stone disintegration by approximately 700 impulses, and the percentage of secondary treatments for incomplete disintegration was increased. In addition, patients with major stone burdens, ureteroscopies, extreme anxiety, or secondary treatments were eliminated from the study.

Lithotripters using piezoelectric shock wave generation do not require anesthesia at all in the majority of cases, but may have a lower success rate compared to the Dornier HM-3 lithotripter. Recently, intravenous analgesia/sedation using fentanyl or alfentanil have been compared for ESWL. Although the type of machine was not specified, the authors found that intravenous analgesia proved satisfactory, and that alfentanil appeared to produce less respiratory depression than fentanyl.

Although this is a retrospective study, the authors feel that the results obtained are valid. No factors which would influence the outcome were altered other than the anesthetic technique itself.

In summary, this study used alfentanil analgesia/sedation by infusion pump as the primary anesthetic for ESWL. Compared to general and epidural anesthesia, the total time, anesthesia time, and recovery room time were shorter with this technique. Technique failure was similar to that with epidural anesthesia, and the complication rate was no greater than with the general or epidural technique.

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AUTHORS

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