Original Article

Comparison of Epidural Morphine Soaked Gel Foam and Continuous Intravenous Morphine Using PCA in the Management of Postoperative Pain Following Lumbar Spinal Fixation Surgery

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ARTICLE INFO

ABSTRACT

Background: Pain management can be a major challenge after spinal surgery. The use of parenteral opioids has been the mainstay of analgesia for patients undergoing posterior lumbar spinal surgery. The route of opioid administration can be epidural, intrathecal, intramuscular (IM), or intravenous (IV), or opioid administration can be in the form of a continuous infusion or as patient-controlled analgesia (PCA) with or without background infusions. Intravenous or IM administration of opioids is associated with dose-dependent side effects such as respiratory depression, nausea and vomiting, sedation, and gastrointestinal ileus. Aim of the study: To compare the analgesic effect of epidural morphine soaked Gelfoam with that of continuous intravenous morphine using PCA following lumbar spinal fixation surgery. Patients and Methods: A prospective non-randomized controlled trial of 100 cases of spinal fixation surgery of at least one motion segment of the lumbar spine was involved. Patients were divided into 2 groups. Group one included 50 patients who underwent placement of gel foam soaked with 1 ML of 0.1% morphine. Group two, included 50 patients as well, with intravenous patient controlled analgesia set. Results: Our patient population included 33 females and 67 males. The mean age at time of operation was 48.2 in group 1 (the youngest was 30 and the oldest was 56) and 47.1 in group 2 (the youngest was 28 and the oldest was 59). There was no procedure related morbidity or mortality in the series. 62 cases included fusion of one motion segment, 38 cases included fusion of 2 motion segments. We had statistically comparable results for pain control in both groups. There has not been statistically significant difference in the pain control between both groups in the first 48 hours. No correlation has been found between the levels operated upon or the number of levels operated and the pain control or the failure in both groups. No correlation was found between the sex and the ages of the patients and the pain control or failures. Conclusion: We conclude that the use of morphine soaked Gelfoam placed epidurally following spinal surgery is an effective analgesic method. The results are compared to intravenous continuous infusion of morphine with fewer side effects, and lower cost.

INTRODUCTION

Pain management can be a major challenge after spinal surgery. The alleviation of postoperative pain is primarily provided for humanitarian reasons, but also to reduce no ciception-induced responses, which may adversely influence organ functioning and contribute to morbidity. Pain may obviously be considered as another neurophysiological response to surgery but with its own secondary effects on biological functions. Pain amplifies the metabolic response, autonomic reflexes, ileus, and nausea and delays mobilization and feeding. Effective treatment of postoperative pain, therefore, results in modification of the biological response to surgery, but the extent of modification is dependent on the choice of analgesic technique. The use of parenteral opioids has been the mainstay of analgesia for patients undergoing posterior lumbar spinal surgery. The route of opioid administration can be epidural, intrathecal, intramuscular (IM), or intravenous (IV), or opioid administration can be in the form of a continuous infusion or as patient-controlled analgesia (PCA) with or without background infusions. Intravenous or IM administration of opioids is associated with dose-dependent side effects such as
respiratory depression, nausea and vomiting, sedation, and gastrointestinal ileus.  

Epidural opioids were first described in 1982 after spinal surgery. The analgesic onset of epidural opioids is usually noted within 15 to 60 minutes, and the effect of a single injection lasts for 16 to 24 hours.\(^4,5,6\)

The use of epidural catheters placed intraoperatively had been tried. But the rare and serious complications such as epidural hematomas and infections limited the use of such technique.\(^7,8\)

Wu et al used microfibrillar collagen hemostatic sponge as a novel carrier for morphine to prolong the duration of pain control. They proved that the fibrin clot that forms delays the dilution of medication by keeping morphine within the clot. They compared this technique with the intravenous opioids using the PCA and the bullous intramuscular meperidine and proved that it is as effective.\(^9\)

Gelfoam\(^\text{®}\) is an absorbable gelatin sponge used frequently as a hemostatic agent during surgical procedures. It has also been used as a drug delivery agent in some cardiological procedures.\(^10\)

In our study we hypothesized that Gelfoam\(^\text{®}\) would do the same role as the microfibrillar collagen sponge in delivering morphine epidurally and supply a fair analgesic effect postoperatively following spine surgery.

**PATIENTS AND METHODS**

A prospective non-randomized controlled trial of 100 cases of spinal fixation surgery of at least one motion segment of the lumbar spine was involved.

All cases in the study had been diagnosed to have degenerative spinal disorder, spinal canal stenosis, or prolapsed disc disease. All cases were subjected to conservative treatment for an appropriate period before recommending surgical intervention. All cases had been consented to participate in the study and explanation of available analgesic methods had been done. Patient who refused to participate had been operated on and a different method of postoperative analgesia had been implemented.

Exclusion criteria were presence of unintended durotomy or history of hypersensitivity to morphine.

The patients selected the pain control method with no randomization as agreed with the anesthetic consultant.

Group one included 50 patients who underwent placement of gel foam soaked with 1 ML of 0.1% morphine. Group two, included 50 patients as well, with intravenous patient controlled analgesia set.

**Operative technique**

Group one: After finishing the fixation and decompression and placement of the bone graft, hemostasis was ensured. Meticulous examination of the dura to ensure there was no dural tears. This was followed by placement of a patch of absorbable gelatin sponge(Cutanplast, Milano, Italy) tailored to the size of exposed dura soaked with 0.1 ml of preservative free morphine giving the dose of 1mg, diluted in 3 ml of normal saline (Fig. 1). This was followed by placement of another layer of Gelfoam\(^\text{®}\) to prevent aspiration of the morphine in the drains. This is followed by placement of suction drain and closure of the wound in layers.

Group Two: The same steps as group one were done except that no morphine embedded absorbable gelatin sponge is placed. Initial dose of intravenous morphine is given to assure adequate plasma concentration (5-20 mg according to patient weight). On recovery from anesthesia, Initial dose of intravenous morphine is given to assure adequate plasma concentration. Then the PCA system is placed (Accufuser Plus, Woo Young Medical, Korea). (Fig. 2) The IV opioids dose calculated by the anaesthesia consultant (a solution of 5 mg/ml was prepared with a maximum allowed dose of 30-70 mg in 4 hours), and subsequent doses given according to patient weight, pain score and complications.
Both groups were be followed up using Visual Analogue Scale for pain with grade 0 no pain and grade 10 the most severe pain. Follow up will also include any complications of morphine, postoperative ambulation, and cost of analgesia. The need of any additive analgesic methods in the first 48 hours, as well as occurrence of complications requiring discontinuation of analgesic method was to be considered as failure of the technique.

We encouraged early ambulation; all cases were advised to walk in the first 12 hours.

All patients will have a post-operative x-ray in the first postoperative day to ensure proper screws placement. All uncomplicated cases will be discharged on the second postoperative day (48 hours after completion of surgery).

Data was statistically analyzed using Microsoft Excel for Mac 2011 Version 14.4.1. Demographic data were assessed using analysis of variance for continuous variables and Pearson chi-square test for nominal variables. Patient ratings were assessed using analysis of variance.

RESULTS

Our patient population included 33 females and 67 males. The mean age at time of operation was 48.2 in group 1 (the youngest was 30 and the oldest was 56) and 47.1 in group 2 (the youngest was 28 and the oldest was 59). There was no procedure related morbidity or mortality in the series.

<table>
<thead>
<tr>
<th>Levels Operated</th>
<th>Number of cases</th>
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<tbody>
<tr>
<td>L3-4</td>
<td>4</td>
</tr>
<tr>
<td>L4-5</td>
<td>30</td>
</tr>
<tr>
<td>L5-S1</td>
<td>28</td>
</tr>
<tr>
<td>L3-4&amp;L4-5</td>
<td>6</td>
</tr>
<tr>
<td>L4-5&amp;L5-S1</td>
<td>32</td>
</tr>
</tbody>
</table>

In our series, we defined failure as the occurrence of severe pain exceeding 4 on the VAS, or the presence of intolerable side effect of analgesia used requiring additional medications or stoppage of the technique.

The failure rate was 5 cases in Group 1 (10%), all of them were intolerable pain requiring addition of another analgesic agent. Other than those 5 patients, 2 cases of group 1 developed allergic reactions that improved on steroids.

Group 2 patients had failure in 5 cases (10%). Two of which developed respiratory depression and we had to stop the PCA. Both cases recovered after the PCA morphine was stopped. In 3 other cases PCA failed as analgesic method and another analgesic method was added. Four cases of group 2 developed tolerable side effects. Two of which developed hypotension and responded to IV fluid bolus, 2 cases developed itching and responded to steroid injection.

The pain scores are shown for Group 1 (Fig. 3), and Group (Fig. 4)

![VAS for Group 1 Patients](image)

**Fig. 3:** Visual Analogue Scale for patients in Group 1. Those who exceeded grade 4 have been considered as a failure in management and received another method of analgesia (N=5)
We had statistically comparable results for pain control in both groups. There has not been statistically significant difference in the pain control between both groups in the first 48 hours.

There has not been statistically significant correlation between the levels operated upon or the number of levels operated and the pain control or the failure in both groups. There has not been statistically significant correlation between the sex and the ages of the patients and the pain control or failures.

As a developing country the cost is usually an issue. We compared the cost of the two techniques. The PCA group was more expensive than the morphine soaked gel foam (600 Egyptian pounds per case (US $85.80) in the PCA group as compared to 100 Egyptian pounds per case (US $14.30) in the morphine soaked Gelfoam® group).

**DISCUSSION**

The authors decided to use Gelfoam® as a carrier to allow slow release of opioids as an epidural postoperative analgesic method. Gelfoam® has hemostatic properties. While its mode of action is not fully understood, its effect appears to be more physical than the result of altering the blood clotting mechanism.11

Gelfoam® is a gelatin-based sponge that is FDA-approved and has been used by surgeons and dentists for decades. When not used in excessive amounts, Gelfoam® is absorbed completely, with little tissue reaction. This absorption is dependent on several factors, including the amount used, degree of saturation with blood or other fluids, and the site of use. When placed in soft tissues, Gelfoam® is usually absorbed completely in from 4 to 6 weeks, without inducing excessive scar tissue.12,13

The features of slow release of drugs using the Gelfoam® have been tried in several researches with success. It has been tried in the pericardium of the heart with no inflammatory response, nor scarring in the heart in cases of myocardial infarction.10

A study published on 2011 used the microfibrillar collagen hemostatic sponge applied to the epidural space as a carrier of morphine to increase the effective analgesic time and proved to be as effective as the PCA in the first three days.9

We decided in our study to use Gelfoam® as a carrier. Gelfoam® is more readily available and cheaper than the microfibrillar sponge, an issue important in developing countries with difficult economic situations. Gelfoam® gets absorbed totally within 4-6 weeks as compared to 8-10 weeks for the microfibrillar hemostatic sponges. We believe that this may lower the incidence of adhesions. In their study they allowed patients to use other analgesic methods in the postoperative period. We preferred to use epidural opioids alone as compared to intravenous opioids to eliminate other factors that may affect the results.

There have been concerns about Gelfoam® causing compression of the caudaequina following laminectomy.11 We have always applied the Gelfoam® over the central dura and not over the nerve root. None of our cases developed postoperative symptoms related to Gelfoam® placement.
The well-known complications of epidural opioids are dose dependent and there has been prescription doses of 2-4 mg by some authors. Side effects occurred with these doses have been noticed. It included pruritus, nausea, vomiting, respiratory depression, hypotension, and sphincter dysfunction. Similar pain relief has been achieved by lower doses of epidural morphine. With a lower effective dose, epidural morphine administration produces fewer side effects than intravenous morphine. That was the reason the authors preferred using the 1 mg epidural dose to lower the side effects. It has proved to be effective as a sole postoperative analgesic method with fewer side effects.

Epidural opioids are thought to act directly on the pain producer. The effective dose of epidural morphine is lower than that of intravenous morphine because the drug acts directly on the neurotransmission pathway. It decreases the central absorption of opioids and its effect on the respiratory system.

A similar pain relief has been achieved with epidural catheter placement with repeated morphine injection; however, it had higher side effects than the current study. The incidence of local superficial infection after routine epidural catheter placement is as high as 12%. We also believe that the catheter care needs a more expert care in the postoperative period as compared to the morphine soaked Gelfoam that needs no special wound care in the postoperative period.

An extended release morphine form has been available for single epidural injection with effective pain relief for 48 hours. This form however is not yet available nor is it registered in the Egyptian market. Also a higher dose of opioids are needed to achieve pain relief (15 mg), which may carry the risk of higher risk of side effects.

In developing countries like Egypt, the cost of the procedure is usually crucial. The technique of morphine soaked Gelfoam® is far cheaper than the IV continuous morphine in PCA method. The reduction of the cost to one sixth of PCA with practically as effective pain relief is a great advantage.

CONCLUSION

We conclude that the use of morphine soaked Gelfoam® placed epidurally following spinal surgery is an effective analgesic method. The results are compared to intravenous continuous infusion of morphine with fewer side effects, and lower cost.

REFERENCES
