Vitreoretinal surgery: pre-emptive analgesia

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Abstract

***Aim*—Vitrectomies are performed either under general anesthesia (GA), local anesthesia (LA), or a combination of both. Postoperative pain is expected to be less in patients with LA because of prolonged action of the local anaesthetic. Pre-emptive analgesia is based on the idea that analgesia initiated before a nociceptive event will be more effective than analgesia commenced afterwards. The authors compared postoperative analgesia in patients with GA combined with preoperative or postoperative LA.**

***Methods*—90 patients scheduled for vitrectomy without buckling were enrolled in the study. 60 patients underwent GA, 30 without LA, 15 with preoperative LA, and 15 with postoperative LA. 30 patients received LA alone. Subjective postoperative pain was determined using the visual analogue scale.**

***Results*—Postoperative pain was less under LA alone compared to GA alone ($p < 0.0001$). Additional preoperative application of LA resulted in less pain than additional postoperative application ($p < 0.05$). Additional postoperative peribulbar aneasthesia did not differ from GA alone.**

***Conclusion*—The authors conclude that LA alone or preoperatively in addition to GA provides the best comfort for the patient in vitreoretinal surgery.**

(*Br J Ophthalmol* 2001;**85**:1328–1331)

Our knowledge about the physiology and the treatment of postoperative pain has improved in recent years. Experimental and basic science studies have shown that injury produces a prolonged change in the responsiveness of the nervous system: peripheral sensitisation leads to a reduction in the threshold of nociceptor afferent peripheral terminals and central sensitisation increases the excitability of spinal neurons. Consequently, there is a reduction in the intensity of stimuli necessary to initiate pain (allodynia), an exaggerated responsiveness to suprathreshold stimulation (hyperalgesia), and a spread of hypersensitivity to non-injured tissue (secondary hyperalgesia).[1] This clinical pain elicited through frank tissue or nerve injury is quite different from physiological pain. Physiological pain is well localised, transient, and has a high threshold. It is important to leave this physiological pain mechanism intact using no or less postoperative analgesia to detect postoperative surgical complications. However, a painless postoperative period can often only be obtained with an extreme high postsurgical analgesic therapy. These findings led to clinical studies to test whether preoperative administration of local, epidural, intraspinal, or systemic analgesic drugs can prevent central sensitisation and pre-empt postoperative pain. The hypothesis of pre-emptive analgesia is that analgesia initiated before a nociceptive event will be more effective than analgesia commenced afterwards. Local anaesthetics, opioids, and non-steroidal anti-inflammatory drugs have been used as analgesics. The efficacy of treatment has been assessed, most commonly, with the visual analogue scale (VAS) to rate the intensity of pain, the time for the first request of a postoperative analgesic, and the total dose of analgesic received during the postoperative period.

The aim of the present study was to evaluate the effect of pre-emptive analgesia using local anaesthesia to block nociceptive impulses and to prevent central sensitisation. We compared postoperative analgesia in patients undergoing vitrectomies under general anaesthesia (GA) combined with preoperative, postoperative, or no local anaesthesia.

Materials and methods

This study was performed at the department of ophthalmology at the Ludwig-Maximilians-University in Munich after obtaining approval from the institutional ethics committee and written informed consent from all patients. Ninety patients scheduled for vitrectomy or combined vitrectomy with cataract surgery without buckling were prospectively enrolled in the study. Sixty patients undergoing surgery under GA were randomly allocated to one of three groups: group A ($n = 30$) with no additional peribulbar local anaesthesia (LA); group C ($n = 15$) with preoperative, and group D ($n = 15$) with postoperative additional peribulbar LA (Table 1). Thirty patients undergoing surgery without GA received preoperatively retrobulbar LA (group B). All patients were ASA 1 or 2 and aged between 18 and 86 years. Premedication consisted of oral midazolam 7.5 mg and was given approximately 1 hour preoperatively to all patients. GA was induced with propofol (2–3 mg/kg). A laryngeal mask was used for ventilation. Anaesthesia was maintained with sevoflurane (0.8–1.0 vol%) in oxygen (60%) and nitrous oxide

Table 1 Number of patients in the study groups, and different methods of anaesthesia

Group	*Patients*	*Anaesthesia*
A	30	General anaesthesia (GA)
B	30	Retrobulbar local anaesthesia (LA)
C	15	GA + preoperative peribulbar LA
D	15	GA + postoperative peribulbar LA

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Accepted for publication 19 April 2001

Table 2 Basic data of the study groups. Values are arithmetic mean (SD). The asterisk indicates the shortest surgical time (p <0.001). Absolute numbers are given for postoperative analgesic requirement

	Group			
	A	B	C	D
Premedication (oral midazolam 7.5 mg)	✓	✓	✓	✓
Local anaesthesia (5 ml bupivacaine 0.5%)	—	✓	Preop	Postop
Age (years) (SD)	54 (4)	58 (3)	48 (5)	51 (5)
Duration of surgery (minutes) (SD)	76 (5)	56 (4)*	85 (8)	92 (7)
Postoperative analgesics (n) (paracetamol, diclofenac, or talvosilen)	13/30	3/30	3/15	7/15

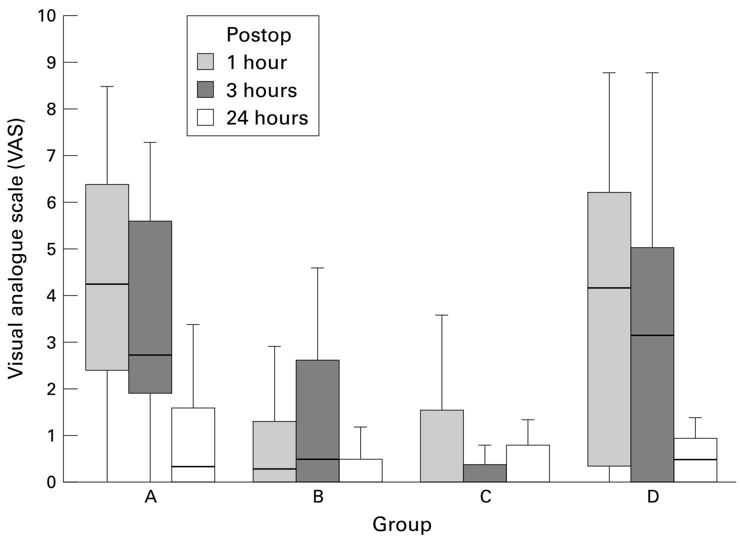

Figure 1 The postoperative pain score was assessed using the visual analogue scale (VAS) 1, 3, and 24 hours after surgery. Group A: general anaesthesia (GA); group B: retrobulbar local anaesthesia (LA); group C: GA and preoperative peribulbar LA; group D: GA and postoperative peribulbar LA. The solid line shows the median, the box blot the interquartile range. The errors bars indicate 100% of the range.

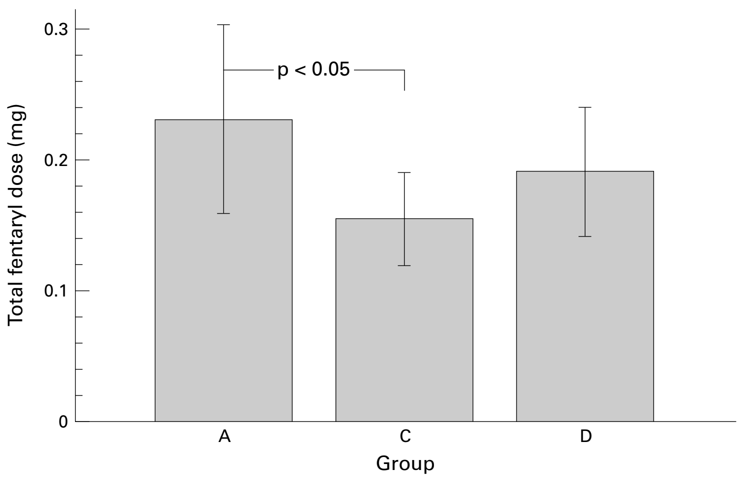

Figure 2 Mean dose of intraoperative fentanyl infusion. Values are expressed as arithmetic mean (SD). Groups A, C, and D see Figure 1. Mean fentanyl dose was lower in group C than in group A.

(60%). The local anaesthetic was 5 ml bupivacaine 0.5% injected retrobulbar or peribulbar. All patients under GA received fentanyl intravenously (0.1–0.3 mg) intraoperatively.

The visual analogue scale (VAS) was used to determine subjective postoperative pain with a range from 0–10 (0 = no pain; 10 = worst pain ever felt). Before surgery patients were trained to use the VAS. Patients with poor vision, dementia, or language difficulties were excluded from the study. The postoperative pain score was assessed using the VAS 1, 3, and 24 hours after surgery. The accuracy and reproducibility of this method is well documented.[2] For postoperative pain paracetamol, diclofenac, or talvosilen were given. Clinical data for the four groups are presented in Table 2.

The Kruskal-Wallis test was used for statistical analysis. Data obtained with the VAS were analysed using the Mann-Whitney test for non-parametric data. The p value <0.05 indicated significant differences.

Table 3 The corresponding p values for differences of postoperative pain evaluated with the VAS; see Figure 1

Groups	Postoperative	p Value
A–B	1 hour + 3 hours	<0.0001
A–C	1 hour + 3 hours	<0.001
B–C	3 hours	<0.05
B–D	1 hour	<0.01
C–D	1 hour + 3 hours	<0.05

Results

We performed vitreoretinal surgery in 90 consecutive cases in our clinic between October 1997 and May 1998 and between February 1999 and July 1999. Mean patient age was 54 years (range 18–86 years) with no differences among the four groups. The mean duration of surgery for all patients was 74 minutes (range 25–180 minutes) with the shortest duration of 56 minutes in group B. Postoperative requirement for additional analgesics was less in patients in group C compared to patients in group A or D (Table 2). We did not see any side effects related to GA or LA.

Figure 1 shows data of postoperative pain evaluated with the VAS. There was no difference between all four groups 24 hours after surgery. The corresponding p values for differences are given in Table 3. The median of postoperative pain was lowest in group C and differed 1 hour and 3 hours after surgery from group A (p <0.001) and from group D (p <0.05) as well as from group B 3 hours after surgery (p <0.05). The median of postoperative pain 1 hour and 3 hours postoperatively was lower in group B than in group A (p <0.0001) and 1 hour postoperatively lower than in group D (p <0.01). There was no difference between groups A and D. No correlation existed between the postoperative pain score and the duration of surgery.

Figure 2 shows the mean dose of intraoperative fentanyl infusion for patients under GA. The mean dose of fentanyl infusion in group C was lower than in group A. It did not differ from that in group D.

Discussion

The results of the present study demonstrate that preoperative local anaesthesia (LA) is beneficial to lower postoperative pain and analgesic consumption. Changes in central neural function—central sensitisation—that are presumed to underlie this effect are induced by surgical incision and other noxious inputs during surgery. The evidence for the existence of pre-emptive analgesia in clinical settings has been recently documented.[1 3 4] The majority of studies focus on systemic NSAIDs or opioids or epidural local anaesthetics. In one trial knee joint surgery was performed under general anaesthesia (GA) with preoperative or postoperative LA and it was found that patients under additional preoperative LA required less analgesia postoperatively.[5] Two further reports demonstrated a reduction of the requirement of postoperative analgesics, a prolonged interval for analgesic demand, or lower postoperative pain in patients receiving preoperative LA.[6 7] Three studies demonstrated no difference between additional preoperative or postoperative analgesia in terms of postoperative pain, one done in patients scheduled for tonsillectomy,[8] one in patients undergoing elective laparotomy,[9] and one in patients undergoing herniorrhaphy.[10] Aida *et al* demonstrated pre-emptive analgesia in limb surgery and mastectomy, but found no effect for gastrectomy, hysterectomy, herniorrhaphy, and appendectomy.[11] Three other studies in patients after orthopaedic or general surgery demonstrated that additional preoperative LA resulted in less analgesic requirement or postoperative pain than no regional anaesthesia.[12–14]

Clinical reports of pre-emptive analgesia in patients undergoing eye surgery show inconsistent results. Ates *et al* compared postoperative pain in children undergoing strabismus surgery under GA with or without additional preoperative LA. No difference was demonstrated in terms of postoperative analgesic requirement or postoperative pain.[15] A pre-emptive analgesic effect was found in two further studies.[16 17] Other studies compared postoperative pain in patients undergoing retinal detachment surgery or cataract surgery under LA or GA with various results. Maberley *et al* demonstrated that surgery under LA was associated with more postoperative pain than under GA. There was no difference in the demand for analgesics during 24 hours after surgery.[18] Barker *et al* found no difference in postoperative pain or in postoperative demand for analgesics.[19]

Comparing different methods of anaesthesia showed that LA had the advantage of a lower perioperative dose of anaesthetics, a faster recovery after surgery, and less postoperative pain. LA bears the risk of serious but rare side effects such as cardiopulmonary problems, convulsion, loss of consciousness, perforation of the bulb, or retrobulbar haemorrhage.[20] The incidence of these complications is very low. Peribulbar anaesthesia reduces the risk especially for local side effects. For these reasons we decided to use peribulbar anaesthesia in these patients where additional LA under GA was applied.

In our study we found a marked difference regarding postoperative pain in patients with or without additional LA under GA. Patients felt less postoperative pain under GA with additional LA preoperatively. In addition, patients under that treatment had the lowest dose of intraoperative fentanyl infusion and only three patients required analgesics postoperatively. We found a clear difference in terms of postoperative pain between patients receiving retrobulbar LA or GA. We speculated that the prolonged effect of the local anaesthetic is responsible for lower postoperative pain in patients under LA. To our surprise we found that patients receiving additional LA preoperatively felt less postoperative pain than patients with additional LA postoperatively. Furthermore, there was no difference in postoperative pain between patients under GA alone und under GA with additional postoperative LA. Therefore, an additional effect is obvious that diminishes postoperative pain in these patients. We propose that the timing of the additional LA to GA is important. The most comfort for the patient regarding postoperative pain is achieved after preoperative local anaesthesia either solely or additional to GA. That means that analgesia initiated before a nociceptive event will be more effective than analgesia commenced afterwards. The transmission of pain was blocked before it was created by surgical trauma, which is termed pre-emptive analgesia.

In a recent study it was suggested that the pre-emptive effect of the LA could have been reduced because patients received intraoperative opioids as part of the standard anaesthetic treatment.[10] Although our patients received intraoperative fentanyl infusion similar to that study, we nevertheless were able to demonstrate the phenomenon of pre-emptive analgesia.

Duration of surgery was shortest in patients under LA because most likely the surgeons were forced to perform the procedure quickly to achieve the most comfort for the patient. Under LA the patient may complain about pain and ask about the remaining time for surgery, which may force the surgeon to finish. Although time of surgery was shorter in patients under LA alone, we found similar scores for postoperative pain in patients receiving LA alone and in patients under GA with additional LA preoperatively. Therefore, we conclude that surgical time does not influence postoperative pain, at least less than individual levels for pain tolerance.

Our hypothesis is supported by further data. Firstly, there is no benefit of additional postoperative LA to GA compared to GA alone in terms of postoperative pain or postoperative analgesic consumption. Secondly, patients with additional preoperative LA required lower doses of fentanyl during surgery compared to patients under GA alone.

In conclusion we advocate additional LA before surgery to give the patient the most comfort in the postoperative phase.

Presented in part at the Association for Research in Vision and Ophthalmology annual meeting, Ft Lauderdale, Florida, May 2000.

None of the authors has any proprietary interest related to this article.

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Br J Ophthalmol 2001 85: 1328-1331
doi: 10.1136/bjo.85.11.1328