

# THE EFFECT OF INFRA-RED DIODE LASER IRRADIATION ON THE DURATION AND SEVERITY OF POSTOPERATIVE PAIN: A DOUBLE BLIND TRIAL

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This trial was designed to test the hypothesis that LLLT reduces the extent and duration of postoperative pain. Twenty consecutive patients for elective cholecystectomy were randomly allocated for either LLLT or as controls. The trial was double blind. Patients for LLLT received 6–8-min treatment (GaAlAs: 830 nm: 60 mWCW: CM) to the wound area immediately following skin closure prior to emergence from GA. All patients were prescribed on demand postoperative analgesia (IM or oral according to pain severity). Recordings of pain scores (0–10) and analgesic requirements were noted by an independent assessor. There was a significant difference in the number of doses of narcotic analgesic (IM) required between the two groups. Controls  $n = 5.5$ : LLLT  $n = 2.5$ . No patient in the LLLT group required IM analgesia after 24 h. Similarly the requirement for oral analgesia was reduced in the LLLT group. Controls  $n = 9$ : LLLT  $n = 4$ . Control patients assessed their overall pain as moderate to severe compared with mild to moderate in the LLLT group. The results justify further evaluation on a larger trial population.

KEY WORDS LLLT GaAlAs laser Postoperative pain Double blind

## Introduction

During the last decade the commonest method of providing analgesia following surgery has continued to be the intermittent intramuscular injection of opioids.<sup>1</sup> However, many patients experience inadequate pain relief when this method is used.<sup>2–4</sup> In addition side effects such as nausea and vomiting and respiratory depression occur in a significant percentage.<sup>5</sup> Continuous intravenous infusions of opioids have been advocated but require a greater level of supervision than may be readily available on a general ward. In a study of 247 patients Ray and Drummond found that the opioid infusion had to be temporarily discontinued in 29% of patients due mainly to respiratory depression.<sup>6</sup> Whilst early studies suggested that this method of achieving postoperative pain relief was associated with a reduced incidence of pulmonary complications<sup>7, 8</sup> more recent work has thrown doubt on this hypothesis.<sup>9</sup>

A number of workers have suggested that the intrathecal or epidural administration of opioids is

superior in analgesic effect to the intravenous route.<sup>10, 11</sup> Nevertheless the same level of careful monitoring and strict supervision is required. In a comprehensive review of this subject, Morgan concluded that there was no conclusive evidence that the method was superior to other routes of administration.<sup>12</sup> Whilst the administration of non-steroidal anti-inflammatory drugs (NSAID's) may reduce the opiate requirement they are usually inadequate if used alone.<sup>13, 14</sup>

Regional anaesthetic techniques may be used to relieve pain following upper abdominal surgery. Intercostal nerve blocks provide a limited duration of pain relief. Insertion of an intrapleural catheter with infusion or serial bolus injections of analgesic solution will provide a longer period of analgesic solution. Both methods are associated with the risk of pneumothorax.<sup>1</sup> The use of low level laser therapy (LLLT) is known to ease the pain of acute soft tissue trauma.<sup>15</sup> This trial was designed to test the hypothesis that LLLT will reduce the extent and duration of postoperative pain following elective cholecystectomy.

## Materials and Methods

Twenty consecutive patients admitted for elective cholecystectomy were randomly allocated for either

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LLLT or to act as controls. The trial protocol required patients to be between the age of 16–65 years and to be graded Class 1 or 2 on the American Society of Anesthesiologists (ASA) grading of physical status. All patients were given the same premedication and subjected to a standardized general anaesthetic technique performed by the same anaesthetist. Similarly a standardized operative technique was used by the same surgeon in all cases. Patients were routinely prescribed postoperative on-demand analgesia, either intramuscular papaveretum (Omnopon) or oral coproxamol (Distalgic) depending upon the extent and severity of the postoperative pain. Recordings of pain scores and analgesic requirements were noted by an independent assessor. Pain severity was assessed on a visual analogue scale of 0–10 by patient self-assessment and recorded preoperatively and postoperatively at 1, 4, 8, 12, 24 and 48 h. Analgesic requirements were noted as follows. All intramuscular injections were charted for the first 72 h postoperatively. The administration of oral analgesics was noted up to the fifth day following surgery. The trial was double blind, neither the patient nor the independent assessor being aware of who had received LLLT. On the fifth postoperative day wound healing was assessed. Prior to discharge all patients were asked to assess the overall severity of their postoperative pain.

The laser used for therapy was a Gallium-Aluminium-Arsenide Diode laser (Proli, Japan)<sup>16</sup> delivering a 60 mW continuous wave output at 830 nm with a power density of 3 W/cm<sup>2</sup>. Patients selected for LLLT received 6–8-min treatment in the contact mode around the periphery of the incision immediately following wound suture but prior to emergence from general anaesthesia. Contact laser irradiation was applied in two concentric circles at 1 cm intervals for 8 s per point using moderate pressure and below the subcostal margin over the gall bladder bed for a similar period of time using firm pressure. Each point irradiated thus receiving an incident energy density of 24 J/cm<sup>2</sup>. All patients gave written informed consent to the trial, which had been approved by the local Research and Ethical Committee.

## Results

There was no significant difference between the control group and the group of patients receiving laser therapy in the male to female ratio, the mean age in years, the mean weight in kilograms, the ASA grading of physical status, the operative time in minutes and the inpatient stay in days. (Table 1).

A review of the pain score summation (Figure 1) showed no difference between the two groups up

**Table 1.** Patient statistics

	LLLT	CONTROL
M:F ratio	3:7	3:7
Mean age (years)	54 (24–65)	57 (40–64)
Mean weight (kg)	66.6 (47–84)	64.4 (54–70)
ASA grade 1	6	5
2	4	5
Operative time (mins)	53 (40–65)	56 (35–65)
Inpatient stay (days)	8 (5–10)	8 (4–10)

to 4 h postoperatively. Thereafter the pain score in the LLLT group diminished rapidly. At 8 h it was 75% of the control group; at 12 h 50% of the control group; at 24 h 30% of the control group and at 48 h 25% of the control group. Figure 2 shows the pain score comparison between the two groups represented in linear graphic form demonstrating a sustained reduction in the level of pain in the LLLT group from the fourth postoperative hour.

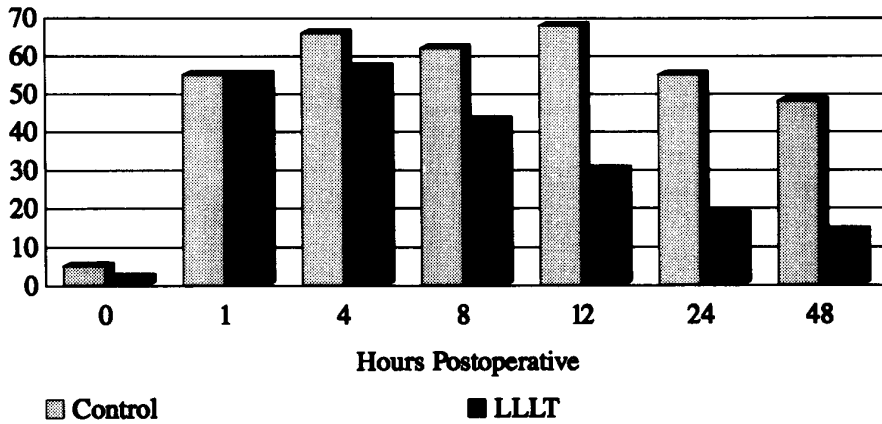
Figures 3 and 4 show the overall requirement for postoperative analgesia and demonstrate a significant difference between the two groups. The control group of 10 patients required a total number of 55 injections of papaveretum compared with a total number of 25 injections in the LLLT group (Figure 3). The comparison of mean doses per patient demonstrated 5.5 for control patients as compared with 2.5 for LLLT patients. No patient in the laser therapy group required intramuscular analgesia after 24 h following surgery. Similarly a comparison of oral analgesia (Figure 4) showed that control patients required a total dosage of 90 compared with only 39 dosages in the LLLT group, again a mean average of nine doses for the control patients as compared with four doses for the LLLT group.

When asked to assess the overall severity of their postoperative pain 90% of patients in the control group assessed their pain as being moderate to severe whereas all patients in the LLLT group reported their pain as being mild to moderate in severity (Table 2). Assessment of wound healing on the fifth postoperative day showed no significant difference between the two groups there being no complications in either group.

## Discussion

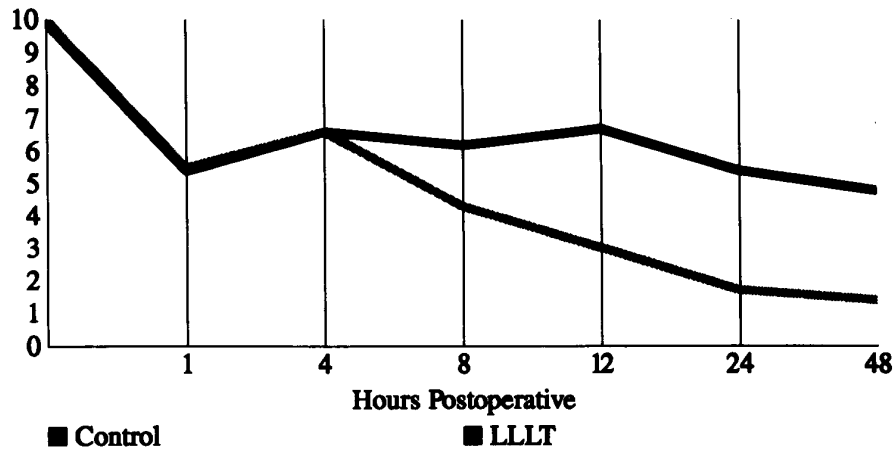
The adequate relief of postoperative pain is currently a major discussion topic within the United Kingdom. A recent working party set up by the Royal College

**Pain Score Totals**



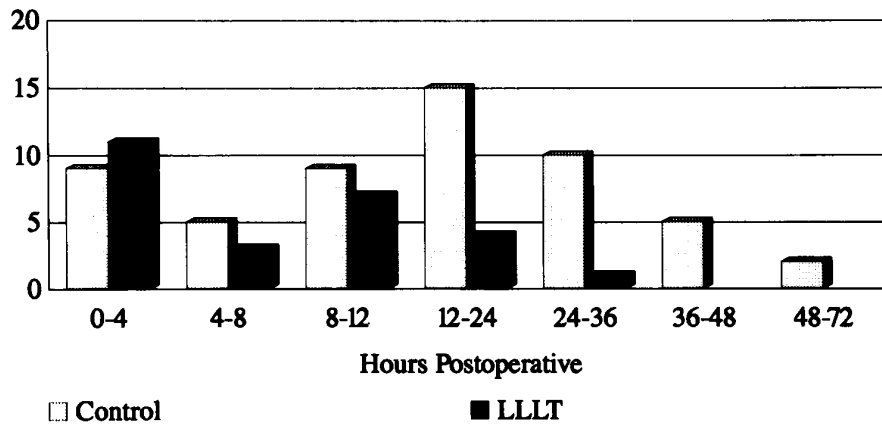
**Figure 1. Pain score summation**

**Pain Score (VAS) 0 to 10**



**Figure 2. Pain score comparison**

**Total Doses**



**Figure 3. Analgesia—papaveretum**

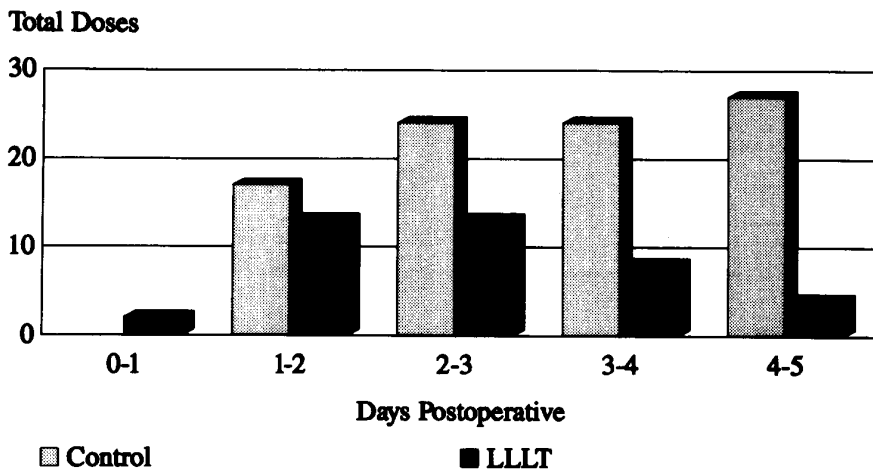


Figure 4. Analgesia—coproxamol

Table 2. Overall pain assessment

	LLLT	CONTROL
Severe pain	0	6
Moderate pain	3	3
Mild pain	7	1

concluded that current measures utilized for the relief of postoperative pain were inadequate.<sup>17</sup> The report advocates the establishment of Pain Management Teams in all acute hospitals with the extensive use of patient controlled analgesia (PCA) systems. The provision of such a service involves considerable expense not only for the capital cost of providing sufficient PCA devices to satisfy demand but also in the recurrent funding of trained personnel to supervise and operate the service. Many of the other recommended techniques such as continuous intravenous opioid infusion, intrathecal or epidural administration of opioids or regional anaesthetic techniques are not without a significant risk of side effects or complications and most require an increased level of monitoring and supervision.

This trial of LLLT in the treatment of postoperative pain has demonstrated that it is possible with one short treatment at the end of surgery to reduce by more than 50% the extent and severity of patients' postoperative pain and as a consequence reduce their need for analgesia. The technique requires the provision of one low powered laser system, one therapist and beyond that no additional supervision, treatment or expense during the full extent of the postoperative period. It is concluded therefore that the use of LLLT following operative procedures offers a new and cost-effective method of reducing both the extent of postoperative pain

severity and the analgesic requirement following surgery.

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