

# Comparison of Fentanyl with Sufentanil for Chest Tube Removal

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**Background:** After cardiac surgery, the chest tubes cause pain and their removal is painful and unpleasant for patients. The aim of this research was to study and compare the analgesic effect of fentanyl and sufentanil on pain relief during chest tube removal in post-cardiac surgical patients.

**Patients and Methods:** A total of 80 patients scheduled for elective cardiac surgery, were recruited in prospective, randomized and double-blind study. Patients received 1.5 $\mu$ g/kg fentanyl or 0.15 $\mu$ g/kg sufentanil, intravenously 10 minutes before removal of chest tube. Pain intensity was assessed by measuring visual analog scale (VAS) pain score, 10 minutes before, during, and 5 and 10 minutes after removing chest tubes. Level of sedation, heart rate, arterial blood pressure, and oxygenation saturation were recorded at each stage by a blinded observer.

**Results:** Mean pain intensity scores 10 minutes before removal of chest tube in fentanyl, and sufentanil groups were 29.5 $\pm$ 12.1 and 31 $\pm$ 11.2 respectively. Pain scores during chest tube removal were 38.5 $\pm$ 11.6 in fentanyl group and 44.7 $\pm$ 12.8 in sufentanil group (P=0.02). In addition, pain scores during chest tube removal were significantly (P value=0.02) more reduced in fentanyl (17.21 $\pm$ 7.5) than in sufentanil group (21.51 $\pm$ 11.2). Sedation scores remained low in two groups. None of the patients showed any adverse side effects of opioids. No differences were seen in the heart rate or arterial blood pressure, but oxygenation saturation was significantly greater in sufentanil group than in fentanyl group.

**Conclusion:** Both fentanyl and sufentanil provide adequate analgesia for chest tube removal without increasing untoward side effects.

**Keywords:** Fentanyl, Sufentanil, Cardiac Surgery, Chest Tube

## Introduction

Patients undergoing cardiac surgery often require insertion of chest tube to facilitate drainage of fluid and lung expansion. When no longer needed, the tubes are removed usually on the second or third postoperative day.<sup>1,2</sup> Chest tube removal is a painful procedure and is often very unpleasant event for most of the patients.<sup>3</sup> Although, no national standard have been described for management of pain with chest tube removal,<sup>4</sup> there are a number of analgesic methods described for alleviating pain

due the chest tube removal. These include propofol,<sup>5</sup> isoflurane,<sup>6</sup> ketorolac,<sup>7</sup> opioids,<sup>7</sup> and local anesthetic infiltration or instillation.<sup>8</sup> Carson et al. compared morphine with subfascial lidocaine, and they demonstrated that subfascial lidocaine might be useful in reducing discomfort during chest tube removal.<sup>9</sup> Bryden et al. compared the efficacy of Entonox with that of 0.25% isoflurane in Entonox and concluded that pain was better controlled by isoflurane 0.25% in Entonox than by Entonox alone.<sup>6</sup> Akrofi et al. studied the efficacy of subcutaneous bupivacaine infiltration, IV morphine and mixed of %50 nitrous oxide and %50 oxygen (Entonox) and demonstrated that bupivacaine and morphine provided more effective

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analgesia for chest tube removal than Entonox.<sup>10</sup> Singh et al. showed that topical Valdecoxib was a suitable drug for pain relief during chest tube removal.<sup>11</sup> Removal of chest tube is usually associated with moderate to severe pain and would take a short period. It seems, Intravenous administration and bolus short acting potent opioids such as fentanyl and sufentanil, seems to simply alleviate such pain without any need for additional nursing and medical care in intensive care unit required by a number of other methods. In this connection, only one similar study about efficacy of these drugs for chest tube removal was done by Joshi et al.<sup>12</sup> The aim of this research was to study and compare the analgesic effect of fentanyl and sufentanil on pain relief during chest tube removal in post-cardiac surgical patients.

### Patients and Methods

After obtaining approval from the Institutional Ethics Committee and written informed consent from the patients, the present randomized prospective and double-blind study was conducted on 80 adult patients, who had undergone coronary artery bypass graft surgery, valve surgery, and other cardiac surgeries in Oromieh Imam Khomeini Hospital. Exclusion criteria included disability to communicate because of language barrier, chronic exposure to opioids, allergy to opioids and renal, hepatic, neurologic or respiratory failure. The patients were randomly allocated into two groups of fentanyl and sufentanil. All patients received injections of opioid or non-opioids, as systemic analgesics, in the intensive care unit (ICU). The last dosing was administered at least 4 hours before chest tube removal. fentanyl group received Fentanyl

(1.5µg/kg), sufentanil group received sufentanil (0.15µg/kg) as intravenous bolus injections. The injections were given by an ICU nurse, with the drug's name kept in a sealed envelope, 10 minutes before removal of mediastinal or pleural chest tubes. Before chest tube removal, the patients were informed about the procedure of chest tube removal. Chest tubes were removed, one at a time, 10 minutes after injecting the drug, while observing the hospital's standard practice. The 100 mm Visual analog scale (VAS) was explained to each of the patients by investigator before removal of chest tubes, as 0 corresponding to no pain and 100 as worst imaginable pain. The patients were asked to mark on the VAS scale, the pain experienced 10 minutes before chest tube removal (baseline) during procedure and 5 min and 10 min after chest tube removal. Patients were asked if the pain relief during chest tube removal was adequate or they would have preferred further analgesia. Level of sedation was observed using Bloomsbury sedation score (Appendix 1). Apart from these data, heart rate, arterial blood pressure, and oxygen saturation (Spo<sub>2</sub>) were recorded at the baseline, during procedure and 5 min and 10 min after removal of chest tubes. Patients were closely monitored for any adverse effects of opioid for example, respiratory depression, nausea or vomiting.

### Statistical Analysis

Data were entered into the SPSS statistical software package from each patient's files. VAS score analyzed by student's t-test. Proportions tested by  $\chi^2$  test. Repeated-measure analysis of variance was applied to hemodynamic data between two groups. Data was expressed as mean  $\pm$  SD. A P value of less than 0.05 was

**Table 1.** Demographic data of the patients

		Fentanyl (n=40)	Fentanyl (n=40)	P value
<b>Age</b>		56/9±13/2	56/6±12/8	NS
<b>Weight</b>		70/3±12/3	72/1±14/4	NS
<b>Sex</b>	Male	30(75%)	25 (62.5%)	NS
	Female	10 (40%)	15(37.5%)	
<b>Kind of surgery</b>	CABG	35	33	NS
	Valve	4	4	NS
	Others	1	3	NS
<b>Site of chest tube</b>	Mediastinal&pleural	35 (90%)	34 (85%)	NS
	Mediastinal	4 (10%)	6 (15%)	NS

All values are expressed as mean ±SD, NS: Not significant (P>0.05), CABG: coronary artery bypass graftin

taken as statistically significant.

### Results

There were 55 (68/75) male and 25 (31/25) female patients, with a median age of 59±13 years. A total of 68 patients underwent coronary revascularization, 8 having valve replacements, and 4 underwent intra-cardiac repair for atrial septal defects. The chest tubes were removed on the second and third postoperative days for 71 and 9 patients respectively.

The patients' characteristics are shown in Table 1. The mean VAS pain score and hemo-

dynamic variables in fentanyl and sufentanil groups at baseline, during removal of chest tube and 5 and 10 min after procedure are given in Tables 2,3. Comparison between groups revealed a lower pain score in fentanyl than sufentanil groups during chest tube removal after removal of chest tube and the result was significant at 5 min after the procedure (P =0.02). Sufentanil group had significantly higher arterial oxygen saturation percent compared with fentanyl group during, and at 5 and 10 min after removal of chest tube with respective

**Table 2.** Homodynamic data in the two groups

		Baseline	During CT removal	5 minutes after
<b>Fentanyl group(40)</b>	Sys	114/1±16/6	116 /3±19/3	113/1±18/4
	Dia	67/9±13/8	67/8±12/4	66/±113/7
	HR	90/6±13/1	90/3±11/9	91/05±12/3
	O2 saturation	91/5±4/5	91/7±3/8	91/8±3/9
<b>Sufentanil group(40)</b>	Sys	116/3±18/7	117/8±19/1	112/9±17/9
	Dia	68/2±12/8	68/2±12/5	67/2±14/3
	HR	87/2±14/1	88±13/8	87/7±15
	O2 saturation	93/3±3/8	93/7±3/4	93/6±3/5

All values are expressed as mean ±SD, Sys: systolic blood pressure, Dia: diastolic blood pressure, HR: heart rate, CT:chest tube

**Table 3.** Mean pain intensity Scores(VAS) in the two groups

Time	Fentanyl (n=40)	Sufentanil (n=40)	P value
Baseline	29/5±12/1	31±11/2	0.370
During CT removal	38/5±11/6	44/7±12/8	0.020
5 minutes after	17/2±7/5	21/5±11/2	0.110
10 minutes after	14/1±5/4	15/5±8/1	0.700

All values are expressed as mean ±SD, CT: Chest tube

P values 0.01, 0.03 and 0.007. On the other hand, heart rate in sufentanil was lower than in fentanyl groups during chest tube removal and 5 and 10 minutes after the procedure. There was no significant difference in blood pressure parameters among two groups.

The mean sedation score variable in fentanyl and sufentanil groups at baseline, during removal of chest tube and 5 and 10 minutes after procedure are given in Table 4. Sedation scores were low in two groups. Fentanyl group had significantly lower sedation score than sufentanil group during chest tube removal and 5 minutes after removal of chest tube with corresponding P values of 0.07 and 0.013. There were no adverse effects such as nausea, vomiting or respiratory depression in any of the patients.

**Table 4.** Sedation score in the two groups

		Fentanyl (n=40)(%)	Sufentanil (n=40) (%)	P Value
Baseline	1	10(25)	12 (30)	0.400
	2	30(75)	28(70)	
During CT removal	1	22(55)	34(85)	0.007
	2	18(45)	6(15)	
5 minutes after	1	0	6(15)	0.013
	2	40(100)	34(85)	
10 minutes after	1	0	4(10)	0.058
	2	40(100)	36(90)	

All values are expressed as no(%), CT: Chest tube

## Discussion

The inserted chest tube cause pain after cardiac surgery and their removal is painful with unpleasant experience for the patients.<sup>2,9</sup> For this reason had recommend administration of analgesia before chest tube removal; however, there are no specific recommendations in this area. This can be attributed partly to varying institutional practices and different result.<sup>1</sup> This study was designed to determine whether there was a difference in analgesic effects of fentanyl and sufentanil in relieving pain during chest tube removal in post cardiac surgical patients. Pain score in fentanyl group at all stages were lower than sufentanil group. This suggests that fentanyl is more effective than sufentanil in relieving pain due to chest tube removal. In contrast to our findings, Joshi et al.,<sup>12</sup> compared analgesic efficacy of Fentanyl and Sufentanil for chest tube removal, and demonstrated that sufentanil proved to be a more effective analgesia than fentanyl.<sup>12</sup>

Such differences may relate to several factors, namely the method of measuring pain.<sup>13, 14</sup> Although originally developed for measuring chronic pain, the VAS is a well-described tool for acute pain assessment. Variability in VAS scores is a well-recognized phenomenon<sup>15</sup> and the relationship between changes in pain severity and changes in pain scores is not always consistent.<sup>16,17</sup> Furthermore, it was considered unethical not to allow our patients to receive analgesia to ensure comfort during their stay in the ICU. The conventionally accepted VAS score that corresponds to adequate analgesia is 30 mm. Bryden et al, reported variable extent of pain associated with removal of each chest tube.<sup>6</sup> and we therefore recorded the worst pain experienced by the patient immediately after the procedure. The pain as recorded

on the VAS on removal of the chest tubes was more severe than the baseline pain score in both the fentanyl and sufentanil groups. Akrofi in her study reported that pain score during chest tube removal by morphine and bupivacaine was lower than that of the baseline.<sup>10</sup> The reason for this probably related to insufficient dosing of fentanyl and sufentanil or shorter time allowed for drugs to achieve their peak effect.<sup>10</sup>

Sedation score in fentanyl group was significantly higher in sufentanil group during, and at 5 min after chest tube removal, although sedation scores were low in both groups. The heart rate in sufentanil group was lower than that of fentanyl group throughout the procedure, Although, this difference was not significant but suggested that Sufentanil was more effective in suppressing sympathetic increase in heart rate in response to pain stimuli associated with removal of chest tube. In addition, O<sub>2</sub> saturation was higher in Sufentanil group than in fentanyl group although the difference was not significant, indicating the maintenance of satisfactory respiratory parameter while using fentanyl and sufentanil during chest tube removal.

This study had several limitations. Because it was our intention to start from a baseline of patient's comfort, this required examining the efficacy of the two techniques against a background of analgesics. This preexisting analgesia load will have masked some of the differences in efficacy among the two study maneuvers. A different level of stimulus, were evenly distributed among the groups. Therefore, this study was not specifically designed to evaluate the difference between tube sizes, and we took the opportunity of comparing the pain scores retrospectively. According to earlier finding by

Akouwah, pain scores were lower on removal of the smaller tubes.<sup>18</sup>

Pain intensity and distress scores reported 10 min after chest tube removal were extremely low.

In fact, pain intensity and distress decreased to even less than that of baseline pain. This was not an unusual finding and suggested that removal of the source of potentially constant irritation would improve comfort.<sup>19, 20</sup> In this study pain score by VAS at 5 and 10 min after chest tube removal were lower than baseline in both groups and this result was consistent with those of Puntillo,<sup>20</sup> Houston,<sup>21</sup> Broscious,<sup>22</sup> and Joshi.<sup>12</sup>

Use of the opioids can obtund anxiety, distress and other negative emotions associated with pain. Mimnaugh et al found significant correlation between anxiety and pain sensation during this procedure.<sup>23</sup> This may be a reason why patients in fentanyl and sufentanil groups remained calm and comforted. Clearly treatment of pain during chest tube removal has been inadequate, and systematic investigation is required to determine optimal treatment to decrease pain and negative emotion. Future studies should be undertaken to determine the efficacy of strong and short acting opioids like fentanyl and sufentanil compared with other methods regarding patients undergoing chest tube removal. On the other hand, appropriate administration seems to be very important which includes using sufficient dosing and performing the procedures corresponding to the drug's peak effect. Thus, clinicians have latitude in planning safe and effective interventions for pain management in patients undergoing chest tube removal.

We concluded that both fentanyl and sufentanil provide adequate analgesia for chest

tube removal without increasing untoward side effects, with fentanyl being more effective analgesic than sufentanil in controlling pain due to chest tube removal in ICU.

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### Appendix 1. Bloomsbury sedation score

3	Agitated and restless
2	Awake and comfortable
1	Aware but calm
0	Roused by voice, remain calm
-1	Roused by movement
-2	Roused by noxious or painful stimuli
-3	Impossible to rouse
A	Natural sleep

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