INTRODUCTION

Pain after rib harvest represents the most common postoperative complaint in patients requiring autologous costal cartilage graft for rhinoplasty and ear reconstruction. Unrelieved acute pain after the harvest can lead to pulmonary dysfunction but also be a factor in the development of chronic pain after thoracotomy. Traditionally, various agents such as non-steroidal anti-inflammatory analgesic drugs, opioids and local application of long lasting anaesthetic used close to intercostals nerves can be helpful. A relatively new and debatable pain control strategy is preemptive analgesia, which is intervention before the noxious stimulus, to block peripheral and central nociception. Studies have revealed that neuronal affrrent block put on ahead of injury can reduce the hyper-excitabile central state and also lessens postoperative pain.

ABSTRACT

Objective: To compare intercostal nerve block before and after rib harvest in terms of mean postoperative pain score and mean postoperative tramadol usage.

Study Design: Randomized controlled trial.

Place and Duration of Study: Department of Plastic Surgery, Mayo Hospital, KEMU, Lahore, from January 2011 to July 2012.

Methodology: Patients (n = 120) of either gender with ASA class-I and II requiring autogenous costal cartilage graft were inducted. Patients having history of local anaesthetic hypersensitivity and age < 15 years or > 60 years were excluded. Subjects were randomly assigned to pre-rib harvest (group-1) and post-rib harvest (group-2). Local anaesthetic mixture was prepared by adding 10 milliliters 2% lidocaine to 10 milliliters 0.5% bupivacaine to obtain a total 20 ml solution. Group-1 received local anaesthetic infiltration along the proposed incision lines and intercostals block before the rib harvest. Group-2 received the infiltration and block after rib harvest. Postoperative consumption of tramadol and pain scores were measured at 6 and 12 hours postoperatively using VAS.

Results: Mean age was 31.43 ± 10.78 years. The mean pain scores at 6 hours postoperatively were 1.033 ± 0.609 and 2.4667 ± 0.812 in pre-rib harvest and post-rib harvest groups respectively (p < 0.0001). The mean pain scores at 12 hours postoperatively were 1.45 ± 0.565 and 3.65 ± 0.633 in pre-rib harvest and post-rib harvest groups respectively (p < 0.0001). The mean tramadol used postoperatively in first 24 hours was 169 ± 29.24 mg and 255 ± 17.70 mg in pre-rib harvest and post-rib harvest groups respectively (p < 0.0001).

Conclusion: Intercostal block administered before rib harvest as preemptive strategy result in decreased postoperative pain scores and narcotic use.

Key Words: Intercostal block. Rib harvest. Preemptive analgesia.

INTRODUCTION

Pain after rib harvest represents the most common postoperative complaint in patients requiring autologous costal cartilage for rhinoplasty and ear reconstruction. Unrelieved acute pain after the harvest can lead to pulmonary dysfunction but also be a factor in the development of chronic pain after thoracotomy. Traditionally, various agents such as non-steroidal anti-inflammatory analgesic drugs, opioids and local application of long lasting anaesthetic used close to intercostals nerves can be helpful. A relatively new and debatable pain control strategy is preemptive analgesia, which is intervention before the noxious stimulus, to block peripheral and central nociception. Studies have revealed that neuronal affrrrent block put on ahead of injury can reduce the hyper-excitabile central state and also lessens postoperative pain. Many investigators have concentrated on means that not only treat the symptoms as they arise, but prevent windup from appearing through the use of protective analgesic practices. So far, the encouraging results from animal replicas have not been translated into clinical practice. Possible basis for the inability to clinically prove the beneficial effects of the preemptive analgesia include differences in pain-relieving techniques and the complicated and multifactorial nature of pain. It appears that there are two types of nociceptive contribution from peripheral inflamed tissue to the central nervous system. The first is put in by neural activity innervating the zone of injury. This may be decreased with local anaesthetic neural block. The second input is mediated through hormones, in which interleukins reach the central nervous system via systemic circulation, resulting in up regulation of COX-2 in the central nervous system. Regional anaesthesia does not block this latter pathway but centrally acting COX-2 inhibitors can block the central nervous system up regulations.

During the past 4 years, the problem of postoperative pain has been studied in several prospective trials with variable results. In a prospective randomized study comparing paravertebral block with ropivacaine prior to
and subsequent to rib splitting demonstrated that the
time of giving ropivacaine did not seem to affect
postoperative pain scores.\textsuperscript{7} In another randomized
controlled trial studying the effect of “preemptive
analgesia” in postoperative pain relief did not show
any statistical significance as regards postoperative pain
and analgesic requirement which was attributed to the
small size effect.\textsuperscript{8} A recent study demonstrated that
preemptive analgesia with bilateral intrapleural blocks
using bupivacaine offered comparatively less distressing
conditions during the first 24 hours after surgery.\textsuperscript{9}

The rationale of this study was to evaluate the outcome of
pre and post-rib harvest infiltration of a combination of
local anaesthetic drugs on mean postoperative pain
scores and analgesic usage so that varied opinions about the benefits of preemptive analgesia can be verified. If found effective, use of pre-rib harvest infiltration of local anaesthetic can be practiced while harvesting autologous costal cartilage so that patients
can have better postoperative outcome regarding donor
site morbidity.

The objective of the study was to compare intercostal
nerve block before and after rib harvest in terms of mean
postoperative pain score measured on visual analogue
pain scale and mean postoperative tramadol usage
measured in milligrams.

**METHODOLOGY**

This double blind randomized controlled trial was carried
out at Department of Plastic Surgery, Mayo Hospital,
KEMU, Lahore, from January 2011 to July 2012. Ethical
issues were considered and study protocol was
permitted by the Institutional Review Board. Patients of
either genders with ASA class-I and II scheduled for
auricular reconstruction or rhinoplasty requiring auto-
genous costal cartilage graft from one or more than one
ribs were entered into the trial. Patients having history of
local anaesthetic hypersensitivity and aged less than 15
years or more than 60 years were excluded.

The aims of the research, methods involved, and the
use of the visual analog scale (VAS),\textsuperscript{10} were made clear
to all the patients prior to surgery. Informed consent was
taken from each patient. Sample size of 120 cases was
 calculated with 80% power of study, 95% confidence
interval and taking mean ±SD of analgesia (morphine)
required in both groups as 13.5 mg ± 10 in pre-rib
harvest group versus 18 mg ± 7.6 in post-rib harvest
group.\textsuperscript{8} Simple random sampling technique was used
to sample the patients. Sampled patients were at
random divided into one of the two groups according to
the wound infiltration (group-1: pre-rib harvest local
anaesthetic mixture infiltration; group-2: post-rib harvest
local anaesthetic infiltration). All the inclusive patients
were given COX-2 inhibitor celecoxib 200 mg the
evening prior to surgery, in the morning ahead of surgery,
and then two times a day for 48 hours after operation.\textsuperscript{11}

All the operations were performed under standardized
general anaesthesia. Local anaesthetic mixture was
prepared by adding 10 milliliters 2% lidocaine to 10
milliliters 0.5% bupivacaine to obtain a total 20 ml
solution.\textsuperscript{8} For the pre-rib harvest group adrenaline
1:100000 was added to the preparation whereas the
post-rib harvest group received the preparation without
the addition of adrenaline. Group-1 received 4 ml local
anaesthetic mixture solution injected subcutaneously at
incision site. After making the incision and identifying the
ribs to be harvested, rest of the local anaesthetic mixture
solution was injected along the lower border of each rib
to be harvested as well as along the lower borders of the
ribs located immediately above and below the ribs to
be harvested. After infiltration, required ribs were
harvested. In the second group incision was made and
required ribs were harvested first. Then 4 ml of local
anaesthetic mixture solution was filtered in the wound
edges and rest of the solution was injected along the
lower border of each harvested rib as well as along the
lower borders of the ribs located immediately above
and below the ribs harvested.\textsuperscript{8,9} Postoperative pain
scores were measured at 6th and 12th hours using VAS
taking the time of first verbal response after recovery
from general anaesthesia as zero hour. Tramadol was
given as slow intravenous injection in standard dose of
1-2 mg/kg body weight/dose, when patient demanded
analgesia repeating the injection 6 hourly for a maximum
dose of 400 mg in 24 hours. Quantity of tramadol used
in first 24 hours was measured in milligrams. This was
the end point of study. Both patients and the persons
recording visual analogue scale and quantity of tramadol
used in first 24 hours were blinded to the group
allocation.

Data was analysed using statistical software Statistical
Package for Social Sciences (SPSS) version 18.

Independent sample t-test was used to compare the
mean pain scale number and postoperative tramadol
use in two groups and p < 0.05 was considered statisti-
cally significant.

**RESULTS**

There were 74 male and 46 female patients. Mean age was
31.43 ± 10.78 years. The mean pain scores at 6 hours
postoperatively were 1.03 ± 0.609 and 2.44667 ± 0.812 in
pre-rib harvest and post-rib harvest groups respectively
(p < 0.0001). The mean pain scores at 12 hours post-
operatively were 1.45 ± 0.565 and 3.65 ± 0.633 in pre-
rib harvest and post-rib harvest groups respectively
(p < 0.0001). The mean tramadol used postoperatively in
the first 24 hours was 169 ± 29.24 mg and 255 ± 17.70 mg
in pre-rib harvest and post-rib harvest groups respectively
(p < 0.0001). The outcome measures are detailed in
Table I.
The diversity of literature on the subject of anticipatory analgesic intervention has raised question on its effectiveness. Optimistic views on the utility of preemptive analgesia have mostly come from trials comparing pre-incision intervention with no intervention.12 Thinking realistically the inference of these trials should not be considered valid. In contrast, results of trials comparing pre-incision versus post-incision intervention are mostly pessimistic.13 Potential reasons for these negative results are: stress on blocking afferent input from surgical incision without considering the role of systemic inflammatory products in pain pathways; an unsatisfactory afferent blockade (inadequate block cannot be preemptive, even if it is dispensed prior to the incision) and different interventions like epidural analgesia, peripheral local anaesthetic infiltrations/nerve blocks, systemic NSAIDs or systemic opioids used as monotherapy. Moreover, the variation in timing of drug dispensation between the PRE and POST groups results in considerably higher concentrations in the POST group.14 Thus, the preemptive effect of the therapy on the postoperative factor of pain-stimulated plasticity may be further enhanced in the POST group (also lessening the difference between outcomes of the PRE and POST groups).

Although the timing of giving an analgesic in the peri-operative period becomes an important secret of the mystery, the importance of assertive and thorough pain management strategy for surgical patients should not be taken too lightly. To successfully check the development of central neuroplasticity, one needs to dispense analgesics throughout the pre, intra, and postoperative phases. Additionally, the issue of postoperative pain after thoracotomy has been brought to light from studies addressing the problem and it has been learnt that local block by itself may be inadequate in offering comprehensive pain relief and inhibiting central sensitization. An analgesic plan offering a combination of regional block, NSAIDs, and other peripherally and centrally acting analgesics dispensed throughout the peri-operative period may be the most effective method.11 Thus, the most comprehensive description of preemptive analgesia is “a treatment that prevents establishment of central sensitization caused by incisional and inflammatory injuries; it starts before incision and covers both the period of surgery and the initial postoperative period.”14 These results demonstrate that more comprehensive preclusion of sensitization (triggered not only by incisional but also inflammatory injuries) has greater clinical significance.

Thus, the current trial was designed in a way to overcome the above mentioned confounders and was redirected from the question of timing to completeness of intervention. All our study subjects received a comprehensive analgesic regimen extending into the pre, per and postoperative periods. To equalize the duration of blocks in pre and post-groups, adrenaline was added to the local anaesthetic preparation used in pre-rib harvest group. Adrenaline was added only to prolong the duration of block in pre-rib harvest group and not to potentiate the analgesic effect as adrenaline has no direct analgesic activity when added to local anaesthetics used in peripheral nerve blocks. It has been demonstrated that the postoperative pain intensity courses after lignocaine 2% and lignocaine 2% with adrenaline 1 : 160,000 demonstrate a similar pattern.15 The reported analgesic activity of adrenaline is mediated through presynaptic α2A receptors located in spinal cord and central nervous system whereas adrenaline added to local anaesthetics to be used in peripheral nerve blocks acts through α1 receptors and transiently enhances lidocaine’s potency by a pharmacokinetic effect that alters the distribution of the same net content of lidocaine within the nerve.16,17 To ensure an effective block, infiltration was done under vision along the lower borders of the ribs harvested as well as along the lower border of the ribs located above and below the ribs being harvested. This was done to account for the overlap from the intercostal nerves above and below. Acute pain can be reliably assessed, either at rest or during movement (dynamic pain) with one-dimensional tools such as numeric rating scales or visual analogue scales. Both these are more powerful in detecting changes in pain intensity than a verbal categorical rating scale.18 Moreover, pain intensity scores rated by the patient at rest and total analgesic consumption are perhaps the most adequate outcome measures for showing a true preemptive effect. Same outcome variables were assessed in the present study.

Kawamata and colleagues investigated the idea of preemptive analgesia in an experimental model. In this experiment, human volunteers received local infiltration with lidocaine either before a 4 mm incision in the forearm or 30 minutes after incision. In the pre-anaesthetized group, the acute, most intense, phase of pain was nearly eliminated for up to 4 hours after the incision. Those who received anaesthetic only after the incision had significantly higher pain readings at various postoperative time intervals up to 4 hours. From this experimental research, one could extrapolate the usefulness of pre-incision local anaesthesia as an adjunct in managing postoperative pain.19 Duellman et al. reported the usefulness of preemptive analgesia and

---

**Table I: Details of outcome measures.**

<table>
<thead>
<tr>
<th>Outcome measure</th>
<th>Pre-rib harvest group (n = 60)</th>
<th>Post-rib harvest group (n = 60)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain score at 6th hour</td>
<td>1.033 ± 0.609</td>
<td>2.44667 ± 0.812</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Pain score at 12th hour</td>
<td>1.45 ± 0.565</td>
<td>3.65 ± 0.633</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Tramadol use in 24 hours</td>
<td>169 ± 29.24 mg</td>
<td>259 ± 17.70 mg</td>
<td>&lt; 0.0001</td>
</tr>
</tbody>
</table>

Independent sample t-test: p < 0.05 considered significant.
concluded that intricacy of pathways in pain perception and transmission warrants a combination of therapies for the preemptive analgesia strategy to be effective.20 The results of this study suggest that mean post-operative pain scores at 6 and 12 hours postoperatively are less in pre-rib harvest group when compared to post-rib harvest. The difference in these scores is statistically significant (p < 0.0001). These results add to the growing body of literature favouring the use of multi-model preemptive analgesia approach as an effective tool to reduce the postoperative pain associated with rib harvest. Opioids remain the mainstay of treatment for the postoperative pain. Clinicians have always been fearful of the side effects such as respiratory depression, drowsiness, nausea and vomiting etc. These become particularly bothersome in the postoperative period after rib harvest.21 A fine balance between pain control and respiratory depression is desirable in patients after rib harvest. Increasing efforts are being put forward to block the pain pathways at the site of injury so that opioids requirement can be reduced in the critical postoperative period. In this study, tramadol along with celecoxib was used in the postoperative period in both the groups. Tramadol requirement in pre-rib harvest group was less as compared to post-rib harvest group and this difference was statistically significant (p < 0.0001). These results augment the findings of the studies stressing the role of preemptive analgesia in reducing the postoperative pain scores and opioid requirement.22,23

CONCLUSION

Intercostal block administered before rib harvest as preemptive strategy resulted in decreased postoperative pain scores and narcotic use.

REFERENCES