A survey of post-craniotomy analgesia in Korea

Department of Anesthesiology and Pain Medicine, Chonnam National University Medical School, Gwangju, *Gyeongsang National University School of Medicine, Jinju, †Yonsei University College of Medicine, Seoul, Korea

Seongtae Jeong, Ju-Tae Sohn*, Seung Ho Choi†, and **Myung Ha Yoon**

Background: There is increasing evidence that more aggressive pain management is needed in patients undergoing craniotomy in Korea. However, no consensus or standardized analgesic regimen has been established to date. To achieve this consensus, we undertook a survey of the current state of post-craniotomy pain management in Korea.
Methods: A postal questionnaire was sent to anesthesiologists, neurosurgeons and nurses of neurosurgical departments at 44 university hospitals in Korea. Of the 44 centers that were sent questionnaires, 35 centers returned these from their anesthesiology department resulting in a response rate of 73%, and 25 returned the questionnaires from their neurosurgery department (response rate: 57%).
Results: Fifty-three percent of neurosurgeons answered that current postoperative pain management was adequate after craniotomy, whereas only 8% of anesthesiologists agreed. However, 72% of neurosurgeons also agreed that a more aggressive pain management was needed for post-craniotomy patients. Fifty-two percent and 23% of neurosurgeons used non-steroidal anti-inflammatory drugs (NSAIDs) and acetaminophen as a first-line analgesic, respectively. Twenty-five percent of neurosurgeons used opioids as a first-line analgesic. Fifty percent of anesthesiologists used strong opioids alone or with NSAIDs as a first-line analgesic. About 10% of both groups used weak opioids as a first-line drug.
Conclusions: Many clinicians agree that post-craniotomy pain is not adequately managed and more aggressive strategies are needed. Nevertheless, opioid analgesics are still avoided because of the concern of side effects despite no evidence to suggest increased risk when use carefully. **(Anesth Pain Med 2011; 6: 362～367)**

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Corresponding author: Myung Ha Yoon, M.D., Ph.D., Department of Anesthesiology and Pain Medicine, Chonnam National University Medical School, Hak-dong, Dong-gu, Gwangju 501-746, Korea. Tel: 82-62-220-6892, Fax: 82-62-232-6294, E-mail: mhyoon@jnu.ac.kr

INTRODUCTION

It was traditionally considered that patients undergoing craniotomy surgery experienced minimal pain postoperatively. This original understanding that post-craniotomy patients have minimal pain has since changed. Studies have shown that patients undergoing craniotomy surgery experience varying degrees of pain postoperatively from mild discomfort to severe pain [1-3]. It is now known that pain after craniotomy is common and has consequently received increased attention.

In several surveys, many clinicians felt that postoperative analgesia for craniotomy patients was inadequate and still poorly managed and undertreated [2,4-6]. Codeine shows inadequate analgesia in craniotomy patients and the use of more potent analgesics such as morphine is recommended [7]. Nevertheless, the majority of clinicians still use the weak opioid codeine as a first-line analgesic after craniotomy [4,6] because strong opioids have harmful effects on neurosurgical patients.

Opioids may produce sedation and miosis leading to an impaired neurologic examination [5]. Opioids may depress respiration, leading to hypercapnia and increased intracranial blood volume [8]. However, it was recently shown that morphine has superior analgesia effects to both tramadol and codeine in craniotomy patients without increasing side effects [9,10]. Furthermore, patient-controlled analgesia (PCA) using opioid analgesic is widely used after surgery. However, PCA is not commonly used in patients undergoing craniotomy surgery. Recent studies suggested that PCA is a useful option in craniotomy patients and more effective than other methods [11-13].

There is increasing evidence that more aggressive pain management is needed in patients undergoing craniotomy in Korea. However, no consensus or standardized analgesic regime has been established to date. Consensus between clinicians

about post-craniotomy pain management is needed the most to introduce a formal analgesic regime. For achieving this consensus, we undertook a survey of the current state of post-craniotomy pain management in Korea.

MATERIALS AND METHODS

A postal questionnaire (Appendix) was sent to anesthesiologists, neurosurgeons and nurses of neurosurgical departments in 44 university hospitals in Korea. A total of 20 questionnaires were sent to each hospital.

The questionnaire consisted mainly of 4 parts, which included the personal opinions of current pain management after craniotomy, the current state of pain management in their hospitals, routine assessment of pain after craniotomy, and experience of chronic pain. Finally, additional questions were asked from anesthesiologists only for the use of PCA (Appendix: question 11 and 12).

RESULTS

Of the 44 centers that were sent questionnaires, 35 centers returned these from their anesthesiology department resulting in a response rate of 73%, and 25 returned the questionnaires from their neurosurgery departments (response rate: 57%). A total of 359 questionnaires were used for the data analysis.

None of the hospitals appeared to have a standardized regime or protocol for post-craniotomy pain management. Furthermore, the analgesic regime was different for clinicians even in the same hospital. Therefore, we analyzed the data by two groups instead of by each hospital, which were the neurosurgeon group and the anesthesiologist group. Data from nurses (48 questionnaires in 18 centers) were only used for pain assessment in the wards or neurosurgical intensive care unit.

Fifty-three percent of neurosurgeons answered that current postoperative pain management was adequate after craniotomy, whereas only 8% of anesthesiologists agreed. However, 72% of neurosurgeons also agreed that more aggressive pain management was needed for post-craniotomy patients (Table 1).

The reasons why more aggressive pain management was not carried out in post-craniotomy patients included adverse effects of opioid analgesics (45% of neurosurgeons, 65% of anesthesiologists), minimal pain after craniotomy (21% of neurosurgeons and 9% of anesthesiologists) and annoyances in managing opioids and pain control apparatus (12% of neurosurgeons and 10% of anesthesiologists) (Table 1).

Fifty-two percent and 23% of neurosurgeons used nonsteroidal anti-inflammatory drugs (NSAIDs) and acetaminophen as a first-line analgesic, respectively. Twenty-five percent of neurosurgeons used opioids as a first-line analgesic, 48% of which were weak opioids such as codeine or tramodol and 52% strong opioids such as fentanyl or morphine. Sixty percent of anesthesiologists used opioids alone or with NSAIDs as a first-line analgesic, 17% of which were weak opioids and 83% strong opioids. About 10% of both groups used weak opioids as a first-line drug (Table 2).

If additional analgesics were needed for pain management, 75% of both neurosurgeons and anesthesiologists used opioids. Fifty percent of neurosurgeons used weak opioids as the additional opioid analgesic compared to only 19% of anesthesiologists. Fentanyl is the most frequently used strong opioid analgesic in both groups (Table 2).

Most hospitals used the intermittent intravenous or intramuscular bolus injection method for drug delivery, while 6 hospitals sometimes used intravenous patient-controlled anal-

Table 1. Different Opinions of Current Pain Management for Patients Undergoing Craniotomy

Current pain management is adequate		Yes	No	N/A
Neurosurgeon		53%	31%	16%
Anesthesiologist		8%	65%	27%
More aggressive pain management is needed		Yes	No	N/A
Neurosurgeon		72%	18%	10%
Anesthesiologist		88%	5%	7%
Main problem that aggressive pain management is not carried out				
	Minimal pain	Side effects of opioid	Difficulties in pain management	N/A
Neurosurgeon	21%	45%	12%	22%
Anesthesiologist	9%	65%	10%	16%

N/A: not available.

Table 2. Current State of Various Pain Management Strategies

First-line analgesics	Acetaminophen (paracetamol)	NSAIDs	Weak opioid	Strong opioid	NSAIDs + strong opioids
Neurosurgeon	23%	52%	12%	7%	6%
Anesthesiologis	2%	38%	10%	43%	7%
Additional analgesics (2nd line)	Acetaminophen	NSAIDs	Opioids	No addition	
Neurosurgeon	3%	20%	75%	2%	
Anesthesiologis	0%	17%	75%	2%	
Opioid analgesics	Weak opioid	Morphine	Fentanyl	Reminfentanil	Others
Neurosurgeon	50%	21%	23%	2%	6%
Anesthesiologist	19%	18%	53%	3%	7%

NSAIDs: Non-steroidal anti-inflammatory drugs.

gesia (PCA) on a case by case basis. One hospital used additional regional block or local infiltration combined with an intermittent bolus injection.

Forty-eight percent of neurosurgeons prescribed analgesics at regular intervals in the ward or at ICU, with 52% prescribing analgesia as required.

Almost all respondents (85% neurosurgeons, 89% anesthesiologists and 89% nurses) answered that regular pain assessment is necessary in post-craniotomy patients. Routine pain assessment in post-craniotomy patients was performed in 48% of the hospitals (17/35 hospital). In the remaining 18 hospitals, pain assessment was performed only when patients complained of pain. The majority of hospitals that performed pain assessment used the numeric rating scale (NRS, 88%) while the remainder used the visual analogue scale (VAS, 12%). However, routine formal pain assessment in patients with impaired communication was hardly performed, except for face legs activity cry consolability scale (FLACC) at some instances. Seventy-one percent of neurosurgeons had experience with patients who complained of chronic pain after craniotomy.

In 33 hospitals (91%), postoperative pain management was mainly performed by neurosurgeons after craniotomy. The main reasons why anesthesiologists did not manage the post-craniotomy pain were the objection of neurosurgeons (62%) and other causes of the anesthesiology department (20%): difficulty, unnecessariness and annoyingness of the post-craniotomy pain management. Fifty-five percent of anesthesiologists answered that more aggressive pain management is needed using PCA, and a majority of them preferred fentanyl (80%) as an opioid analgesic compared to morphine (9%), remifentanil (9%), and others (2%).

DISCUSSION

It is known that over half of the patients (55%−69%) undergoing elective craniotomy surgery experienced moderate to severe pain postoperatively [2,3]. However, post-craniotomy pain is still ignored or underestimated.

The present survey demonstrates that post-craniotomy pain management is inadequate and more aggressive pain management is needed. There is certainly a need for standardized pain management protocols in Korea.

There was a difference in opinions towards post-craniotomy pain managements between neurosurgeons and anesthesiologists. Fifty-two percent of neurosurgeons answered that post-craniotomy pain management is adequate, although 72% of them also said that more aggressive pain management is necessary. However, most anesthesiologists disagreed with the opinions of neurosurgeons. Only 8% of anesthesiologists replied that pain management after craniotomy is adequate. This discrepancy may result in several differences between the two groups for managing patients undergoing craniotomy.

Over 50% of neurosurgeons used NSAIDs as the first-line analgesic in patients undergoing craniotomy. This is quite different to other surveys in different countries [2,4,6]. NSAIDs are used as additional drugs and not as first-line drugs for the management of post-crainotomy pain in the UK [4,6]. Furthermore, NSAIDs are rarely used in the USA for post-craniotomy patients because of their antiplatelet effects [2].

The safety and efficacy of NSAIDs for post-craniotomy analgesia arenot clear. Few studies have reported the risks of short-term postoperative use, whereas the risks of long-term usage have been well defined [14]. The most serious concern of NSAIDs in patients undergoing craniotomy is the hemostatic

complication due to antiplatelet effects of NSAIDs. In a retro-prospective study of neurosurgical patients, NSAIDs in the 2 weeks preceding surgery were considered a possible cause of postoperative hemorrhage [15]. Selective cyclooxygenase 2 (COX-2) inhibitors are safer than other nonselective NSAIDs in the view of hemostasis [16]. However, NSAIDs alone show inadequate analgesia after craniotomy, but can decrease the doses of opioids [17].

Twenty-three percent of neurosurgeons (2% of anesthesiologist) used acetaminophen (paracetamol) as a first-line drug. Paracetamol is extremely safe and does not induce platelet dysfunction. However, paracetamol alone did not achieve adequate analgesia for post-craniotomy pain [18].

In the present survey, approximately 10% of both neurosurgeons and anesthesiologists used weak opioid analgesics such as codeine and tramadol as the first-line drug. Codeine is widely used as the first-line opioid in the UK [4,6]. Codeine is not routinely used for postoperative pain management in other surgical procedures because of its weak analgesic effect but is still used because it does not affect the neurosurgical examination. However, the efficacy of codeine is questionable [19]. The analgesic effect of codeine is dependent on demethylation to morphine, and only 5-15% of the administered codeine is metabolized by this pathway [20,21]. In addition, codeine is ineffective in 15% of the population who have a dysfunction in this metabolic pathway [22]. Moreover, many clinicians have questioned the ethics of intramuscular injection to who have an intravenous fluid line.

Tramadol was more frequently used compared to codeine because it is available for intravenous use in post-craniotomy patients in Korea. Tramadol inhibits the reuptake of serotonin and norepinephrine, as well as weakly binding to opioid receptors [23,24]. Therefore, it has similar side effects to opioids, including nausea, sedation and respiratory depression [25]. Higher incidence of nausea and vomiting than codeine [9] or morphine [26], which can result in increase of intracranial pressure, were reported. In addition, tramadol also exhibits potential risks of seizure [27]. However, in a recent study for craniotomy patients, combination treatment of tramadol and oxycodone provided better pain control and decreased the use of oxycodone and opioid side effects [28]. According to a recent survey by Kotak et al. [6], tramadol is used as a third or fourth line analgesic in 42% of the centers in the UK.

In the present survey, 13% of neurosurgeons and 50% of anesthesiologists used strong opioids alone or combined with NSAIDs as first-line drugs. These results are comparable to other survey, in which, 30% of centers used morphine as a first-line opioid analgesic [6].

The main reason to avoid the use of strong opioids in post-craniotomy patients is the concern that strong opioids may increase the ICP and interrupt the neurologic examination because of their side effects. Indeed, in this survey, the majority of respondents considered the side effects of opioids as the main reason preventing aggressive pain management in post-craniotomy patients. However, there were no increases observed in the adverse events of strong opioids compared with weak opioids in post-craniotomy patients. In many studies, morphine provided superior analgesia to both tramadol and codeine in patients following a neurosurgical procedure without increasing the opioid side effects [5,9,10,19] and morphine provided more consistent pain relief [10].

Six of the surveyed hospitals (17%) used PCA for post-craniotomy analgesia on a case-by-case basis. This result is slightly higher than another survey [6] despite of the lower rate of opioid use. Patient-controlled analgesia (PCA) is widely used for management of postoperative pain after surgery. PCA using strong opioid analgesics has been shown to be a more effective method of pain control after craniotomy in cooperative patients [11,12,17]. PCA is generally performed by anesthesiologists in Korea. Nevertheless, 60% of the anesthesiologists answered that they did not involve the pain management for craniotomy patients due to the objection of neurosurgeons.

In fact, post-craniotomy pain management was mainly performed by neurosurgeons (91% of hospitals) in this survey. Several reasons were proposed for this. First, the majority of craniotomy patients are routinely admitted to the neurointensive care unit where they are not served by anesthesiologists like in most hospitals. Second, there is concern about opioids causing sedation and respiratory depression, so neurosurgeons dislike pain management by anesthesiologists who mainly use opioid analgesics in the recovery room. Third, anesthesiologists themselves do not want to be annoyed by pain management for craniotomy patients.

Seventy-one percent of neurosurgeons have experienced chronic pain after craniotomy. In a recent study, 56% of patients reported persistent pain 2 months after craniotomy (chronic headache) and 26% of patients reported neuropathic pain [29]. In that study, chronic pain was reduced by local infiltration of anesthetics to the surgical site at the end of the surgery. This means adequate postoperative pain management

may reduce the incidence of chronic pain in craniotomy patients.

Post-craniotomy pain is common but underestimated. The management of this pain is very important because acute pain *per se* causes many physiologic adverse effects and delays recovery, consequently predisposing chronic pain. Many clinicians are in agreement that post-craniotomy pain is not adequately managed and more aggressive strategies are needed. Nevertheless, opioid analgesics are still avoided because of the concern of side effects despite no evidence to suggest increased risk when use carefully.

There is currently no consensus on post-craniotomy pain management in Korea. For this consensus, more studies for the safety and efficacy of several regimens or protocols and more attentions for the post-craniotomy pain will be needed.

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Appendix. Questionnaire of post-craniotomy pain management

1. Do you think postoperative pain managements are being well controlled on undergoing craniotomy patients?
2. Do you think more aggressive post-operative pain management in craniotomy patients is necessary?
   If aggressive pain management for craniotomy patients is not being right fully carried out, what do you think the main problem would be?
3. What is the first-line analgesic for post-craniotomy patients in the immediate postoperative period?
4. If the above method is not effective, what additional drug is used for pain management?
5. In what way is pain management being controlled in post-craniotomy patients, and by what route is this analgesic delivered?
6. Are these drugs being used regularly or as required?
7. Do you think regular assessment of pain in post-craniotomy patients is needed?
8. Is a formal, documented pain assessment of post-craniotomy patients undertaken? If yes, what pain assessment tool is utilized?
9. Have you experienced a patient who referred post-craniotomy chronic pain, for example headache or pain in surgical region persisted for more than 2 months?
10. By whom is post-craniotomy pain management usually carried out in your hospital?
    If pain management is not carried out by anesthesiologists, what is the main reason?

* Questions for anesthesiologist only

11. Currently patient controlled analgesia (PCA) is largely being used for post-operative pain management. Do you think aggressive pain management using PCA in post-craniotomy patients is necessary?
12. If PCA is used, what kind of drugs will you be using?