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Indian Journal of Clinical Anaesthesia

Journal homepage: www.ijca.in

Case Series

Combined opioid free and scalp block enhances the quality of recovery in supratentorial craniotomies done under ERAS protocol: A prospective case series

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Abstract

Post-craniotomy pain is often severe and poorly managed, leading to the exploration of alternatives to opioid-based anaesthesia. While it is a standard practice in neurosurgery, opioid-based anaesthesia can interfere with neurological monitoring and cause side effects. In a case series of ten supratentorial craniotomy patients, we implemented an Enhanced Recovery After Surgery (ERAS) protocol, utilizing opioid-free anaesthesia (OFA) with injections of Magnesium Sulfate and Dexmedetomidine, complemented by a scalp block for a multimodal analgesic approach. The primary outcomes included total postoperative analgesia duration and hemodynamic stability, while secondary outcomes assessed extubation time, rescue analgesic requirements, postoperative nausea and vomiting, sedation levels, and any other complications. The ERAS protocol with opioid-free anaesthesia (OFA) demonstrated excellent recovery outcomes, including rapid extubation, an average analgesia duration of 23 hours, minimal Visual Analog Scale (VAS) scores, low demand for rescue analgesics, minimal sedation, and no postoperative nausea, vomiting, or other complications, highlighting its potential as an effective method for expedited recovery.

Keywords: Supratentorial craniotomies, Opioid free anaesthesia, ERAS.

Received: 13-11-2024; **Accepted:** 05-06-2025; **Available Online**: 15-07-2025

1. Introduction

Neuroanaesthesia focuses primarily on maintaining cerebral perfusion pressure and hemodynamic equilibrium during neurosurgical procedures. Inadequate pain management in post-craniotomy patients can result in increased sympathetic activity, elevated blood pressure, cerebral blood flow, oxygen consumption, and intracranial pressure, which heightens the risk of complications such as cerebral oedema or hemorrhage.[1] Effective pain control accelerates recovery, reduces analgesic consumption, and mitigates complications.[2]

Opioids, commonly used for analgesia, carry risks of neurological interference and adverse effects such as nausea, vomiting, respiratory depression, muscle fatigue, ileus, and urinary retention during the perioperative period, necessitating careful management.[3] Amid growing concerns over opioid-related complications, there is an increasing interest in opioid-free approaches to anaesthesia and perioperative analgesia.

Moreover, the Enhanced Recovery After Surgery (ERAS) protocol, which integrates evidence-based strategies to optimize perioperative care for improved outcomes, is gaining traction in neurosurgical practice. Various previous studies have highlighted the efficacy of ERAS in major spine surgery, with accelerated recovery and reduced hospital stays.[3,4]

Keeping above facts in sight, an ERAS protocol was implemented in our case series that combined loco-regional anaesthesia with opioid-free anaesthesia. The approach utilized non-opioid analgesics, such as Magnesium Sulphate (NMDA blockade) and dexmedetomidine (alpha 2 agonist),

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https://doi.org/10.18231/j.ijca.2025.082

along with a scalp block in patients undergoing supratentorial neurosurgery.[5-9]

Primary outcomes included the total duration of postoperative analgesia and hemodynamic stability. Secondary outcomes included extubation time, rescue analgesic requirements, postoperative nausea and vomiting, sedation, and any additional complications. We hypothesized that non-opioid analgesic strategies may offer superior outcomes, potentially improving the quality of recovery

2. Case Series

This prospective case series, approved by the institutional ethical committee (IECHR/336-2023), was completed over two months and involved 10 adult patients aged 18-60 years, with ASA classifications II-III, undergoing elective supratentorial surgery with a duration of less than 5 hours. All patients had a GCS score of 15/15. Exclusion criteria included unwillingness to participate, scalp infections, cardiovascular, hepatic, or renal diseases, neuromuscular disorders, brain tumours larger than 30mm, allergies to study medications, substance abuse, neurological or cognitive deficits, myopathy, mental disability, hypermagnesemia, and failure to extubate postoperatively.

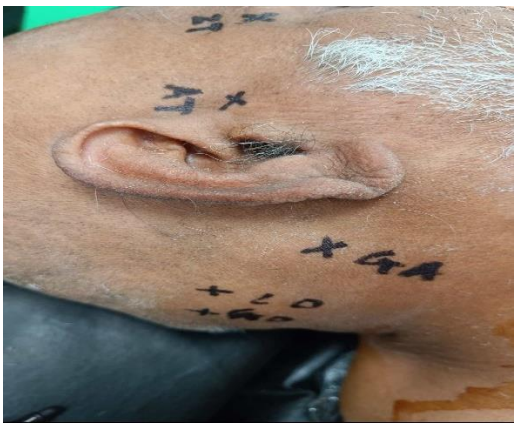
Upon arrival in the operating room, standard monitors as per ASA guidelines were applied, including End-Tidal Carbon Dioxide (EtCO2) and Bispectral Index (BIS). Baseline vital parameters were recorded before premedication with Inj. Glycopyrrolate (0.2 mg IV), Inj. Ondansetron (4 mg IV), Inj. Midazolam (0.1 mg/kg IV), and Inj. Paracetamol (1 gram IV). Additionally, Inj. Magnesium Sulfate (40 mg/kg IV in 100 ml NS) and Inj. Dexmedetomidine (0.5 µg/kg IV in 100 ml NS) were administered.

Anaesthesia induction was performed with propofol (2 mg/kg) and Atracurium (0.5 mg/kg IV) for neuromuscular blockade. After tracheal intubation, anesthesia was maintained with Oxygen (0.4), Air, and Desflurane under pressure-controlled ventilation with a tidal volume of 6-8 ml/kg. The depth of anaesthesia was monitored with BIS (40-60) and $EtCO_2$ (30-35). Intermittent doses of Atracurium were administered as needed. Intraoperative vital parameters, including Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), Mean Arterial Pressure (MAP), Heart Rate (HR), Peripheral Oxygen Saturation (SpO2), EtCO2, and BIS, were continuously monitored.

After induction of general anaesthesia, a bilateral scalp block was performed targeting six sensory nerves: supraorbital, supratrochlear, zygomaticotemporal, auriculotemporal, lesser occipital, and greater occipital nerves (**Figure 1** and **Figure 2**). Each nerve received 2 ml of local anaesthetic, consisting of 11 ml of 0.5% Bupivacaine hydrochloride (1.5 mg/kg), 11 ml of 2% Lignocaine (5 mg/kg), Inj. Adrenaline (5 µg/kg), and 2 ml of preservative-free Dexamethasone (8 mg), totalling 24 ml. Sugita skull pin fixation began 20 minutes after the scalp block.

(**SO:** Supraorbital, **ST:** Supratrochlear, **ZT:** Zygometotemporal, **AT:** Auriculotemporal)

Figure 1: Scalp block



(**ZT**: Zygometotemporal, **AT:** Auriculotemporal; **GA**: Greater auricular; **LO**: Lesser occipital; **GO:** Greater occipital)

Figure 2: Scalp block

An additional intraoperative dose of Inj. Dexmedetomidine (0.5 µg/kg IV) was administered if there was a >20% increase in heart rate, MAP from baseline values, or a rise in BIS value above 60. Intraoperative fluid and blood loss were managed with IV fluids, blood, and blood products. Reversal agents were administered post-surgery, and extubation occurred once the patient responded to verbal commands. The extubation time (from stopping the inhalation agent to removal of the endotracheal tube) was recorded.

Postoperatively, patients were monitored for vital parameters, and the Visual Analog Scale (VAS) score was assessed for 48 hours. The total duration of analgesia was defined as the time from the scalp block to the first demand for rescue analgesia (VAS score ≥ 4). The postoperative analgesia protocol included fixed-dose IV Paracetamol (15 mg/kg) every 8 hours, with IV Tramadol for rescue analgesia if the VAS score exceeded 4. Total rescue analgesia requirements within 48 hours were assessed, along with any complications.

3. Results

This case series highlights the efficacy of opioid-free anaesthesia (OFA) in conjunction with scalp block, ensuring hemodynamic stability both intraoperatively and postoperatively (**Table 1**). The data, collected over a period of 2 months from 10 patients, were processed using median (range) statistical tests, with analysis performed using Microsoft Excel, version 2024.

The quality of recovery was assessed through parameters such as total duration of analgesia 23 hours (18-26 hours), extubation time 5 minutes (4-7 minutes), and post-extubation Visual Analog Scale (VAS) scores at 4, 8, 12, 24, and 48 hours were recorded as 0, 0, 0, 1 (1-2), and 1 (1-4), respectively across 48 hours postoperatively. Notably, rescue analgesic requirements remained minimal, with only one patient necessitating a singular dose over the 48-hour postoperative span. Moreover, there were no instances of sedation, nausea, vomiting, or other complications (**Table 2**, **Figure 3**).

Table 1: Perioperative haemodynamic parameter

Time	HR (beats per min)	SBP (mmHg)	DBP (mmHg)	MAP (mmHg)	EtCO2	SpO_2 (%)	BIS
Preinduction	86 (74-100)	132 (112-160)	79 (74-94)	98 (86-116)	36.5 (34-38)	99 (98-99)	98 (94-100)
After pin insertion	89 (72-106)	125 (105-140)	75 (70-86)	90.67 (80.67-102.67)	36.5 (35-45)	99 (98-99)	48 (40-58)
10 min	82 (76-104)	118 (102-128)	72 (62-86)	86.33 (82-98.63)	38 (35-43)	99 (98-99)	44 (42-54)
30 min	82 (80-104)	117 (102-126)	69 (62-78)	85 (75.33-88.67)	36.8 (35-42)	99 (97-99)	44 (42-48)
2 hours	82 (76-104)	116 (102-134)	70 (62-82)	85.33 (82-98.7)	37 (35-42)	99 (97-99)	44 (42-48)
5 Hours	81 (82-90)	116 (110-122)	70 (60-80)	84 (75-88)	37 (35-42)	99 (97-99)	44 (42-48)
Extubation	80 (74-88)	116 (106-136)	70 (62-80)	85.67 (71-97)	38 (35-40)	99 (97-99)	98 (94-100)
Post extubation 1 hour	80 (75-98)	117 (110-120)	69 (62-78)	84 (75-88)	-	99 (97-99)	-
4 hours	81 (76-90)	119 (102-124)	70 (62-80)	85.33 (82-98.7)	-	99 (97-99)	-
8 hours	82 (70-90)	118 (110-124)	69 (62-78)	84 (75-88)	-	99 (97-99)	-
24 hours	82 (74-86)	117 (110-130)	70 (62-80)	85.33 (82-98.7)	-	99 (97-99)	-

(Data were expressed in MEDIAN AND RANGE) (HR: Heart Rate SBP- Systolic Blood Pressure DBP: Diastolic Blood Pressure ETCO2: End Tidal CO_2 Concentration BIS: Bispectral index, MAP: Mean Arterial Pressure, SpO_2: Saturated of peripheral oxygen)

Table 2: Qualities of recovery

Parameter	Values
Extubation Time	5 minutes (4-7)
VAS Score	
Up to 8 hours	0
12 hours	1(1-2)
24 Hours	1(1-4)
36 hours	1.5(1-3)
48 hours	1 (1-3)
Duration of analgesia	23 hours (18-26)
Number of doses of rescue analgesics	1(0-1)
Ramsay SEDATION score	3 (2-3)
Complication	
Postoperative Nausea and vomiting	-
Local anaesthesia toxicity	-

(Data were expressed in MEDIAN AND RANGE)

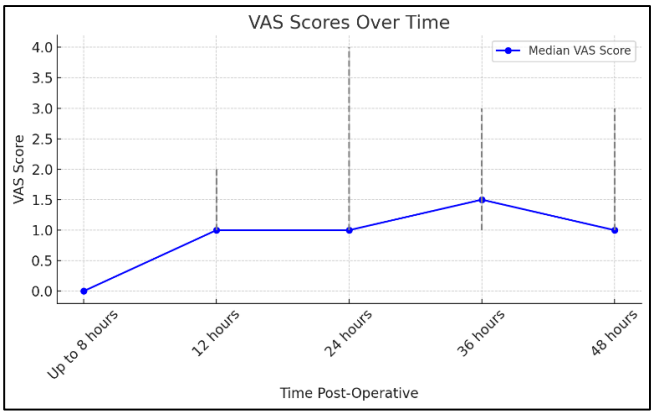


Figure 3: VAS scores over time, with the median values and ranges for each time point

4. Discussion

In our case series, we observed hemodynamic stability throughout the perioperative period, with the total duration of analgesia extended to approximately 23 hours. Postoperative pain scores remained low, with a median VAS score of 1 (range 1-3). Additionally, we followed our protocol by administering intravenous paracetamol 1g every 8 hours postoperatively, and we kept Inj. Tramadol (50 mg/kg) as a rescue analgesic, to be used if the primary analgesics were insufficient. Notably, only one patient required a single dose of tramadol (50 mg/kg), while the others did not require any additional analgesics beyond the paracetamol.

These positive outcomes can be attributed to several factors. Firstly, preemptive analgesia via the scalp block was found to attenuate the hemodynamic response to cranial fixation preoperatively, as it reduces levels of cortisol and adrenocorticotropic hormone.[1] Secondly, the inclusion of dexamethasone as an adjuvant in the scalp block not only enhanced its efficacy but also prolonged the duration of analgesia.[1,9] Moreover, the use of Dexmedetomidine, an alpha-2 agonist, and Magnesium Sulfate, which has NMDA blockade properties, contributed significantly to both analgesia and hemodynamic stability by ameliorating cerebral vasospasm.[8]

We also observed expedited recovery, as evidenced by a rapid extubation time of 5 minutes (range 4-7 minutes) and the absence of sedation (sedation score 3, range 2-3). There were also no incidences of nausea or vomiting, as we did not use opioids and included Inj. Ondansetron, which is a proven antiemetic. Additionally, no other complications were observed. These findings align with previous studies, which have highlighted the absence of sedative and emetic properties associated with the agents used in our protocol.[7,1-12]

By implementing the ERAS protocol, which incorporated a multimodal approach to analgesia, we effectively minimized preoperative noxious stimuli. The use of opioid-free analgesia (OFA) alongside a scalp block provided exceptional analgesia both intraoperatively and postoperatively, resulting in optimal recovery and the prevention of unintended complications.

Our case series also had some shortcomings that need to be addressed in future research. More extensive sampling is necessary, and the inclusion of a control group would strengthen the robustness of the conclusions. The study's limited focus on a single neurosurgical procedure also restricts the broader applicability of the findings. To validate these preliminary results, further randomized controlled trials across various surgical contexts are essential.

5. Conclusion

In supratentorial craniotomies, the ERAS protocol involving opioid-free analgesia (OFA) with a scalp block demonstrates promising quality of recovery, including rapid extubation time, prolonged duration of analgesia, and excellent hemodynamic stability in the perioperative period. These findings indicate its potential as an expedited recovery method.

6. Source of Funding

None.

7. Conflict of Interests

Nil.

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Cite this article: Ganvit KS, Bumiya PR, Pampaniya VD, Shah A. Combined opioid free and scalp block enhances the quality of recovery in supratentorial craniotomies done under ERAS protocol: A prospective case series. *Indian J Clin Anaesth*. 2025;12(3):534–538.