Supplement

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Characteristics of included studies (order by year of publication)
Supplemental Figure 1. Forest plot summarizing meta-analysis of studies reporting early pain score.

| Visual analogue scale at the early period | Mean Difference (95% CI) | % Weight |
|------------------------------------------|--------------------------|---------|
| Pre-incision scalp block                 |                          |         |
| Carella 2021                             | -4.00 (-4.90, -3.10)     | 16.15   |
| Hussien 2020                             | -1.80 (-2.64, -0.96)     | 16.38   |
| Tschinda 2010                            | 0.10 (-1.46, 1.66)       | 13.31   |
| Guasani 2008                             | -1.45 (-2.90, 0.00)      | 13.79   |
| Subgroup, DL (I² = 88.2%, p = 0.000)    | -1.87 (-3.50, -0.23)     | 59.64   |
| Post-incision scalp block                |                          |         |
| Rigamonti 2020                           | -0.75 (-1.51, 0.01)      | 16.66   |
| Zhang 2003                               | -2.80 (-4.57, -1.03)     | 12.38   |
| Nguyen 2001                              | -2.10 (-4.12, -0.08)     | 11.32   |
| Subgroup, DL (I² = 61.9%, p = 0.073)    | -1.67 (-3.05, -0.29)     | 40.36   |
| Heterogeneity between groups: p = 0.860 |                          |         |
| Overall, DL (I² = 84.0%, p > 0.000)     | -1.84 (-2.95, -0.73)     | 100.00  |

NOTE: Weights and between-subgroup heterogeneity test are from random-effects model.
### Supplemental Figure 2. Forest plot summarizing meta-analysis of studies reporting intermediate pain score.

| Visual analog scale at the intermediate period | Mean Difference (95% CI) | Weight |
|-----------------------------------------------|--------------------------|--------|
| **Pre-incision scalp block**                  |                          |        |
| Carella 2021                                  | −2.00 (−3.11, −0.89)     | 16.35  |
| Hussien 2020                                  | −1.06 (−2.05, −0.07)     | 17.97  |
| Tuchinda 2010                                 | 0.57 (−0.78, 1.93)       | 13.50  |
| Subgroup, DL (I^2 = 76.9%, p = 0.016)         | −0.88 (−2.23, 0.47)      | 47.82  |
| **Post-incision scalp block**                 |                          |        |
| Rigamonti 2020                                | −0.64 (−1.66, 0.38)      | 17.61  |
| Dudko 2014                                    | −1.68 (−3.00, −0.36)     | 13.81  |
| Zhang 2003                                    | −2.30 (−3.94, −0.66)     | 10.80  |
| Nguyen 2001                                   | −1.30 (−3.04, 0.44)      | 9.96   |
| Subgroup, DL (I^2 = 10.8%, p = 0.339)         | −1.31 (−2.03, −0.59)     | 52.18  |
| **Heterogeneity between groups: p = 0.583**   |                          |        |
| Overall, DL (I^2 = 50.1%, p = 0.062)          | −1.16 (−1.84, −0.49)     | 100.00 |

**NOTE:** Weights and between-subgroup heterogeneity test are from random-effects model.
Supplemental Figure 3. Forest plot summarizing meta-analysis of studies reporting late pain score.

| Visual analogue scale at the late period | Mean Difference (95% CI) | % Weight |
|------------------------------------------|--------------------------|----------|
| |                          |                         |          |
| Pre-incision scalp block                 |                          |          |
| Hussien 2020                             | -0.80 (-1.60, 0.00)     | 20.75    |
| Tuchinda 2010                            | 0.16 (-1.18, 1.42)      | 18.07    |
| Subgroup, DL (I² = 37.2%, p = 0.207)     | -0.45 (-1.36, 0.46)     | 38.82    |
| Post-incision scalp block                |                          |          |
| Rigamonti 2020                           | 0.13 (-0.48, 0.73)      | 21.69    |
| Zhang 2003                               | -2.87 (-3.74, -1.99)    | 20.35    |
| Neuvon 2001                              | -1.50 (-2.59, -0.41)    | 19.14    |
| Subgroup, DL (I² = 93.6%, p = 0.000)      | -1.39 (-3.31, 0.53)     | 61.18    |
| Homogeneity between groups: p = 0.382    |                          |          |
| Overall, DL (I² = 88.3%, p = 0.000)      | -0.98 (-2.13, 0.17)     | 100.00   |

NOTE: Weights and between-subgroup heterogeneity test are from random-effects model.
Supplemental Figure 4. Forest plot summarizing meta-analysis of studies reporting very late pain score.

|                          | Mean Difference (95% CI) | %  |
|--------------------------|--------------------------|----|
| **Visual analogue scale at the very late period** |                          |    |
| Pre-incision scalp block |                          |    |
| Carella 2021             | -2.00 (-2.80, -1.20)     | 15.12 |
| Hussien 2020             | -0.27 (-1.05, 0.51)      | 15.20 |
| Tuchinda 2010            | 0.31 (-0.91, 1.52)       | 13.77 |
| Subgroup, DL ($I^2 = 85.2\%$, $p = 0.001$) | -0.70 (-2.06, 0.67)      | 44.10 |
| Post-incision scalp block|                          |    |
| Rigamonti 2020           | 0.82 (0.16, 1.47)        | 15.52 |
| Dadko 2014               | -2.44 (-4.04, -0.84)     | 12.31 |
| Zhang 2003               | -2.75 (-3.70, -1.80)     | 14.68 |
| Nguyen 2001              | -1.60 (-2.92, -0.28)     | 13.39 |
| Subgroup, DL ($I^2 = 93.3\%$, $p = 0.006$) | -1.45 (-3.47, 0.57)      | 55.90 |
| Heterogeneity between groups: $p = 0.545$ |                      |     |
| Overall, DL ($I^2 = 89.7\%$, $p = 0.000$) | -1.09 (-2.22, 0.03)      | 100.00 |

**NOTE:** Weights and between-subgroup heterogeneity test are from random-effects model.
Supplemental Figure 5. Forest plot summarizing meta-analysis of studies reporting time of the first request of rescue analgesia.

| Time of the first request of rescue analgesia | Mean Difference | 95% CI             | Weight |
|-----------------------------------------------|-----------------|--------------------|--------|
| Pre-incision scalp block                      |                 |                    |        |
| Hussien 2020                                  | 109.80          | (72.98, 146.62)    | 23.01  |
| Tuchinda 2010                                 | −15.00          | (−40.94, 10.94)    | 23.38  |
| Subgroup, DL ($I^2 = 96.6\%$, $p = 0.000$)  | 46.69           | (−75.61, 168.98)   | 46.39  |
| Post-incision scalp block                     |                 |                    |        |
| Skatulien? 2021                               | 365.00          | (225.46, 504.54)   | 16.18  |
| Dudko 2015                                    | 402.00          | (240.69, 563.31)   | 14.61  |
| Dudko 2014                                    | 110.00          | (68.65, 151.35)    | 22.82  |
| Subgroup, DL ($I^2 = 90.9\%$, $p = 0.000$)  | 282.48          | (67.17, 497.79)    | 53.61  |
| Heterogeneity between groups: $p = 0.062$    |                 |                    |        |
| Overall, DL ($I^2 = 95.0\%$, $p = 0.000$)  | 164.65          | (65.28, 264.01)    | 100.00 |

NOTE: Weights and between-subgroup heterogeneity test are from random-effects model.
Supplemental Figure 6. Forest plot summarizing meta-analysis of studies reporting additional analgesia requirement in first 24h.

| Additional analgesia requirement in first 24h | Standard Mean Difference (95% CI) | % Weight |
|---------------------------------------------|----------------------------------|---------|
| Pre-incision scalp block                     |                                  |         |
| Carolla 2021                                 | −1.60 (−2.24, −0.96)            | 14.66   |
| Hussien 2020                                 | −4.65 (−6.06, −3.23)            | 10.33   |
| Tuchinda 2010                                | −0.21 (−0.75, 0.33)             | 15.14   |
| Gazoni 2008                                  | −0.46 (−1.19, 0.27)             | 14.22   |
| Subgroup, DL (I² = 92.4%, p = 0.000)         | −1.58 (−2.92, −0.24)            | 54.34   |
| Post-incision scalp block                    |                                  |         |
| Rigamonti 2020                               | 0.26 (−0.17, 0.68)              | 15.60   |
| Dukko 2014                                   | −0.74 (−1.31, −0.16)            | 14.98   |
| Ayoub 2006                                   | 0.04 (−0.52, 0.59)              | 15.07   |
| Subgroup, DL (I² = 73.6%, p = 0.023)         | −0.13 (−0.71, 0.45)             | 45.66   |
| Heterogeneity between groups: p = 0.050      |                                  |         |
| Overall, DL (I² = 90.2%, p = 0.000)          | −0.88 (−1.62, −0.13)            | 100.00  |

NOTE: Weights and between-subgroup heterogeneity test are from random-effects model.
Supplemental Figure 7. Summary of the Egger’s publication bias plot.
Supplemental Figure 8. “Leave-one-out” sensitivity analysis of studies reporting very early pain score.

| Study          | Meta-analysis estimates, given named study is omitted |
|----------------|-------------------------------------------------------|
| Carella 2021   | -----------------------------------------------------|
| Hussien 2020   | -----------------------------------------------------|
| Tuchinda 2010  | -----------------------------------------------------|
| Gazoni 2008    | -----------------------------------------------------|
| Rigamonti 2020 | -----------------------------------------------------|
| Dudko 2014     | -----------------------------------------------------|

| Lower CI Limit | Estimate | Upper CI Limit |
|----------------|----------|----------------|
Supplemental Figure 9. “Leave-one-out” sensitivity analysis of studies reporting early pain score.

| Study        | Meta-analysis estimates, given named study is omitted |
|--------------|-------------------------------------------------------|
|              | Lower CI Limit | Estimate | Upper CI Limit |
| Carella 2021 | | | |
| Hussien 2020 | | | |
| Tuchinda 2010| | | |
| Gazoni 2008  | | | |
| Rigamonti 2020| | | |
| Zhang 2003   | | | |
| Nguyen 2001  | | | |

Values range from approximately -3.28 to -0.43.
Supplemental Figure 10. “Leave-one-out” sensitivity analysis of studies reporting intermediate pain score.

| Study          | Lower CI Limit | Estimate | Upper CI Limit |
|----------------|----------------|----------|----------------|
| Carella 2021   |                |          |                |
| Hussien 2020   |                |          |                |
| Tuchinda 2010  |                |          |                |
| Rigamonti 2020 |                |          |                |
| Dudko 2014     |                |          |                |
| Zhang 2003     |                |          |                |
| Nguyen 2001    |                |          |                |

-2.07 -1.84 -1.16 -0.49 -0.28
Supplemental Figure 11. “Leave-one-out” sensitivity analysis of studies reporting late pain score.

Meta-analysis estimates, given named study is omitted

| Study          | Lower CI Limit | Estimate | Upper CI Limit |
|----------------|----------------|----------|----------------|
| Hussien 2020   |                |          |                |
| Tuchinda 2010  |                |          |                |
| Rigamonti 2020 |                |          |                |
| Zhang 2003     |                |          |                |
| Nguyen 2001    |                |          |                |
Supplemental Figure 12. “Leave-one-out” sensitivity analysis of studies reporting very late pain score.
Supplemental Figure 13. “Leave-one-out” sensitivity analysis of studies reporting time of the first request of rescue analgesia.

| Study          | Meta-analysis estimates, given named study is omitted |
|----------------|-------------------------------------------------------|
| Hussien 2020   | ......................................................................... |
| Tuchinda 2010  | ......................................................................... |
| Skutulienė 2021| ......................................................................... |
| Dudko 2015     | ......................................................................... |
| Dudko 2014     | ......................................................................... |

|            | Lower CI Limit | Estimate | Upper CI Limit |
|------------|----------------|----------|----------------|
| Hussien 2020 |                |          |                |
| Tuchinda 2010 |                |          |                |
| Skutulienė 2021 |              |          |                |
| Dudko 2015     |                |          |                |
| Dudko 2014     |                |          |                |

23.75 65.28 164.65 264.01 330.93
Supplemental Figure 14. “Leave-one-out” sensitivity analysis of studies reporting additional analgesia requirement in first 24h.
Supplemental Figure 15. “Leave-one-out” sensitivity analysis of studies reporting nausea and vomiting in first 24h.

Meta-analysis estimates, given named study is omitted
| Study         | Lower CI Limit | Estimate | Upper CI Limit |
|---------------|----------------|----------|---------------|
| Yang 2020     |                |          |               |
| Gazoni 2008   |                |          |               |
| Skutulienè 2021 |              |          |               |
| Rigamonti 2020 |                |          |               |
| Ayoub 2006    |                |          |               |

0.1023 0.61 1.67 3.09
### Characteristics of included studies (order by year of publication)

**Skutulienė 2021**

| Methods | Study design: randomized controlled trial (3 arms)  
Study duration: not reported  
Study setting: hospital, single center, Lithuanian |
|---------|---------------------------------------------------------------------------------------------------|
| Participants | Adults undergoing scheduled supratentorial brain tumor removal (n=141)  
**Inclusion criteria**  
1. ASA I–III  
**Exclusion criteria**  
1. Glasgow Coma Score (GCS) of less than 15  
2. Allergy to local anesthetics  
3. Undergoing long-term analgesic or corticosteroid therapy,  
4. Cardiac arrhythmias  
5. Impaired liver function  
**Mean age (years)**  
1. 57.2  
**Numbers allocated to each arm**  
1. Group wound infiltration (n = 47)  
2. Group scalp nerve blockade (n = 47)  
3. Group systemic analgesia (n = 47)  
**Male gender**  
1. Group wound infiltration: 13/34  
2. Group scalp nerve blockade: 15/32  
3. Group systemic analgesia: 16/31 |
| Interventions | Technique and occasion  
Scalp block of the following nerves with 0.25% bupivacaine combined with 1% lidocaine and 1:200,000 epinephrine after suturing the wound:  
1. The supraorbital and supratrochlear nerves  
2. The zygomaticotemporal nerve  
3. The auriculotemporal nerve  
4. The greater and lesser occipital nerves  
**Dosage**  
20 mL |
| Outcomes | **Primary**  
1. Pain as measured by the visual analogue score during the first 24 hours postoperatively (measured at 1, 3, 6 and 24 hours)  
**Secondary**  
1. The duration for the request of additional analgesics  
2. Adverse effects  
3. Baseline hemodynamic variables during induction through operation and postoperatively |
| Notes | **Funding**  
No funding source reported |
**Carella 2021**

| Methods | Study design: randomized controlled trial (2 arms)  
Study duration: October 2016 to December 2019  
Study setting: hospital, single center, Belgium |
|---|---|
| Participants | Adults undergoing scheduled supratentorial brain tumor removal (n=60)  
**Inclusion criteria**  
1. ASA I–III  
**Exclusion criteria**  
1. Allergy to local anesthetic  
2. Psychiatric disease  
3. Inability to consent  
4. Uncontrolled intracranial hypertension  
**Mean age (years)**  
1. 57  
**Numbers allocated to each arm**  
1. Group SB (n = 30)  
2. Group CO (n = 30)  
**Male gender**  
1. Group SB: 13/17  
2. Group CO: 13/17 |
| Interventions | **Technique and occasion**  
Scalp block of the following nerves with 0.33% levobupivacaine after induction of general anesthesia:  
1. The supraorbital and supratrochlear nerve  
2. The auriculotemporal nerve  
3. The postauricular branches of the greater auricular nerve  
4. The zygomaticotemporal nerve  
5. The greater, lesser, and third occipital nerves  
**Dosage**  
30 mL |
| Outcomes | **Primary**  
1. Hemodynamic stability  
**Secondary**  
1. Cumulative intraoperative remifentanil consumption  
2. Cumulative postoperative morphine consumption  
3. Postoperative pain scores |
| Notes | **Funding**  
No funding source reported |
### Methods

| Study design: randomized controlled trial (4 arms) |
|--------------------------------------------------|
| Study duration: October 2016 to December 2019     |
| Study setting: hospital, single center, Belgium |

### Participants

Adults aged 18 to 60 years, who were waiting for elective craniotomy that acquired general anesthesia (n=85)

**Inclusion criteria**

1. ASA I–II
2. Body mass index 18 to 30 kg/m²

**Exclusion criteria**

1. Unable to understand or use VAS
2. Allergic to local anesthetics
3. Glasgow coma scale scores <15
4. History of opioid dependence, coagulopathy, scalp infection, pregnancy and previous craniotomy

**Mean age (years, Mean±SD)**

1. 44±12

**Numbers allocated to each arm**

1. Group R₀.2 (n = 21)
2. Group R₀.3 (n = 20)
3. Group R₀.5 (n = 22)
4. Group C (n = 22)

**Male gender**

1. Group R₀.2: 11/10
2. Group R₀.3: 12/8
3. Group R₀.5: 11/11
4. Group C: 7/15

### Interventions

**Technique and occasion**

Scalp block of the following nerves with 0.33%, 0.33% or 0.5% levobupivacaïne before surgical incision and after intubation:

1. Unilateral supraorbital, auriculotemporal and lesser occipital nerve of the side of craniotomy
2. Bilateral greater occipital nerve

**Dosage**

8 mL

### Outcomes

**Primary**

1. Pain as measured by the visual analogue score during the first 24 hours postoperatively (measured at 2, 4, 6 and 24 hours)

**Secondary**

1. Intraoperative hemodynamic variables (MAP and HR)
2. Additional sufentanyl requirements
3. Total consumption of dezocine during the first 24 hours after surgery
4. The time to first injection
5. Incidence of postoperative nausea and vomiting (PONV)
6. Complications both from local anesthetic and the nerve block

### Notes

**Funding**

No funding source reported
| Methods          | Study design: randomized controlled trial (2 arms) |
|------------------|--------------------------------------------------|
|                  | Study duration: March 2010 to December 2011       |
|                  | Study setting: hospital, single center, Canada    |

| Participants     | Adults aged 18 years and over, scheduled for supratentorial craniotomy (n=89) |
|------------------|--------------------------------------------------------------------------------|
| Inclusion criteria| 1. ASA physical status < IV                                                    |
| Exclusion criteria| 1. History of significant coronary artery disease                              |
|                  | 2. Presence of pre-existing pain related to the Intracranial pathology         |
|                  | 3. Active history of alcohol or recreational drug abuse                        |
|                  | 4. Active history of psychotic disorder                                         |

| Mean age (years, Mean±SD) | 1. 54.5±15                                                                          |

| Numbers allocated to each arm | 1. Group treatment (n = 44) | 2. Group control (n = 45) |
|-------------------------------|-------------------------------|-------------------------|
| Male gender                   | 1. Group treatment: 16/28     | 2. Group control: 24/21  |

| Interventions | Technique and occasion         | Scalp block of the following nerves with 0.5% bupivacaine and 1:200,000 epinephrine at the end of the procedure: |
|---------------|-------------------------------|-------------------------------------------------------------------------------------------------------------------|
|               | 1. The supraorbital and supratrochlear nerves                              |
|               | 2. The auriculotemporal nerve                                               |
|               | 3. The postauricular branches of the greater auricular nerve                |
|               | 4. The greater, lesser, and third occipital nerves                         |
| Dosage        | 20 mL                                                                       |

| Outcomes | Primary | 1. Pain as measured by the visual analogue score during the first 48 hours postoperatively (measured at 0.5, 1, 2, 4, 8, 12, 24 and 48 hours) |
|----------|---------|-------------------------------------------------------------------------------------|
|          | Secondary | 1. The total PCA hydromorphone consumption in the first at 24 and 48 post-operative hours |
|          |          | 2. Total hydromorphone demands and delivered doses in the first 24 and 48 post-operative hours |
|          |          | 3. The incidence of nausea and vomiting in the first 24 and 48 post-operative hours |
|          |          | 4. The time for patients to reach discharge eligibility from the PACU/ICU          |
|          |          | 5. The time for patients to reach discharge eligibility from hospital             |
|          |          | 6. Presence of long term pain as measured with the Numeric Rating Scale (NRS) at days 5, 30 and 60 postoperatively |
|          |          | 7. Karnofsky Performance Scale Index and modified pain treatment satisfaction scale (PTSS) at day 5 |

| Notes | Funding | This study was supported by the Physicians Services Incorporated Grant (PSI 09-22, PI Andrea Rigamonti). |
## Hussien 2020

| Methods | Study design: randomized controlled trial (2 arms)  
Study duration: March 2018 to December 2020  
Study setting: hospital, single center, Egypt |
|-----------------|--------------------------------------------------|
| Participants | Patients aged 21–60 years of both genders and prepared to undergo craniotomy under general anesthesia for supratentorial tumors. (n=30)  
**Inclusion criteria**  
1. ASA grade I-II  
2. Body mass index <35 kg/m²  
**Exclusion criteria**  
1. Glasgow coma score < 14  
2. Huge tumor with marked midline shift And incision extending beyond the areas covered by regional scalp block  
3. Uncontrolled hypertension  
**Mean age (years, Mean±SD)**  
1. 54.5±15  
**Numbers allocated to each arm**  
1. Group treatment (n = 15)  
2. Group control (n = 15)  
**Male gender**  
1. Group treatment: 10/5  
2. Group control: 11/4 |
| Interventions | Technique and occasion  
Scalp block of the following nerves with 0.5% bupivacaine, 2% lidocaine and 1:200,000 epinephrine before skull pinning:  
1. The supraorbital and supratrochlear nerves  
2. The auriculotemporal nerve  
3. The postauricular branches of the greater auricular nerve  
4. The greater, lesser, and third occipital nerves  
5. The zygomaticotemporal nerve  
**Dosage**  
17 mL |
| Outcomes | **Primary**  
1. Intra-operative Heart rate (HR) at different times  
2. Intraoperative mean arterial pressure changes  
**Secondary**  
1. Pain as measured by the visual analogue score during the first 24 hours postoperatively (measured at 0.5, 1, 2, 4, 8, 16 and 24 hours)  
2. Time from extubation to the first request of analgesia  
3. Total dose of postoperative Fentanyl consumption in the first 24 hours |
| Notes | **Funding**  
No funding source reported |
| Methods | Study design: randomized controlled trial (3 arms)  
Study duration: not reported  
Study setting: hospital, single center, Lithuania |
|---------|-----------------------------------------------------|
| Participants | Adults aged 18 years and over, scheduled for supratentorial craniotomy under general anesthesia (n=120)  
**Inclusion criteria**  
1. ASA status I-III  
**Exclusion criteria**  
Not reported  
**Mean age (years, Mean±SD)**  
Not reported  
**Numbers allocated to each arm**  
1. Group B (n ~40)  
2. Group I (n ~40)  
3. Group S (n ~40)  
**Male gender**  
Not reported |
| Interventions | **Technique and occasion**  
Scalp block with 0.25% bupivacaine, 1% lidocaine and 1:200,000 adrenaline after skin closure  
**Dosage**  
Not reported |
| Outcomes | **Primary**  
1. Pain as measured by the visual analogue score during the first 24 hours postoperatively  
**Secondary**  
1. Administered ketorolac doses  
2. Duration for the requirement of first rescue analgesia |
| Notes | **Funding**  
No funding source reported |
| Methods          | Study design: randomized controlled trial (3 arms) |
|------------------|---------------------------------------------------|
|                  | Study duration: not reported                       |
|                  | Study setting: hospital, single center, Lithuania  |
| Participants     | Adults aged 18 years and over, scheduled for supratentorial craniotomy under general anesthesia (n=75) |
|                  | **Inclusion criteria**                             |
|                  | 1. ASA status I-III                               |
|                  | **Exclusion criteria**                            |
|                  | Not reported                                      |
|                  | **Mean age (years, Mean±SD)**                     |
|                  | Not reported                                      |
|                  | **Numbers allocated to each arm**                 |
|                  | 1. Group B (n =25)                               |
|                  | 2. Group I (n = 25)                              |
|                  | 3. Group S (n = 25)                              |
|                  | **Male gender**                                   |
|                  | Not reported                                      |
| Interventions    | **Technique and occasion**                        |
|                  | Scalp block with 0.25% bupivacaine, 1% lidocaine and 1:200,000 adrenaline after skin closure |
|                  | **Dosage**                                        |
|                  | 20ml                                              |
| Outcomes         | **Primary**                                       |
|                  | 1. Pain as measured by the visual analogue score during the first 24 hours postoperatively (measured at 1, 3, 6 and 24 hours) |
|                  | **Secondary**                                     |
|                  | 1. Administered ketorolac doses                    |
|                  | 2. Duration for the requirement of first rescue analgesia |
| Notes            | **Funding**                                       |
|                  | No funding source reported                        |
Methods

| Study design: randomized controlled trial (3 arms) |
|--------------------------------------------------|
| Study duration: not reported |
| Study setting: hospital, single center, Thailand |

Participants

| Patients aged 16 to 65 years undergoing elective supratentorial craniotomy (n=60) |
|-------------------------------------------------------------------------------|
| **Inclusion criteria** |
| 1. ASA I and II |
| **Exclusion criteria** |
| 1. Unable to assess pain |
| 2. Documented allergy to local anesthetics |
| 3. With hypertension |
| 4. History of opioid dependence, coagulopathy, scalp infection, and previous craniotomy |

| Mean age (years, Mean ± SD) |
|----------------------------|
| 1. 34.3 ± 11 |

| Numbers allocated to each arm |
|-------------------------------|
| 1. Group 0.5% bupivacaine (n = 20) |
| 2. Group 0.25% bupivacaine (n = 19) |
| 3. Group normal saline (n = 20) |

| Male gender |
|-------------|
| 1. Group 0.5% bupivacaine: 10/11 |
| 2. Group 0.25% bupivacaine: 8/11 |
| 3. Group normal saline: 14/6 |

Interventions

| Technique and occasion |
|------------------------|
| Scalp block of the following nerves with 0.5% or 0.25% bupivacaine and 1:200,000 adrenaline before skull pinning: |
| 1. The supraorbital and supratrochlear nerves |
| 2. The auriculotemporal nerve |
| 3. The greater auricular nerve |
| 4. The greater, lesser, and third occipital nerves |
| 5. The zygomaticotemporal nerve |

| Dosage |
|--------|
| Not reported |

Outcomes

| Primary |
|---------|
| 1. Pain as measured by the visual analogue score during the first 24 hours postoperatively (measured at 0.5, 1, 1.5, 2, 6, 12 and 24 hours) |

| Secondary |
|-----------|
| 1. Sedation and nausea vomiting scores and antiemetics given to the patients |
| 2. Time from extubation to the first analgesic given |
| 3. Total morphine consumption in 24 hours post-operatively |

Notes

| Funding |
|---------|
| This study was supported by the Ratchadapiseksompotch Fund, Faculty of Medicine, Chulalongkorn University. |
| Methods          | Study design: randomized controlled trial (2 arms)          |
|------------------|-------------------------------------------------------------|
|                  | Study duration: not reported                                 |
|                  | Study setting: hospital, single center, America              |

| Participants     | Adult patients (aged > 18 years) with a supratentorial brain tumor scheduled for resection. (n=30) |
|------------------|--------------------------------------------------------------------------------------------------|
|                  | **Inclusion criteria**                                                                          |
|                  | Not reported                                                                                   |
|                  | **Exclusion criteria**                                                                          |
|                  | 1. Pregnancy                                                                                    |
|                  | 2. The presence of a preexisting intracranial defect                                             |
|                  | 3. Allergy to remifentanil or ropivacaine                                                       |
|                  | 4. History of malignant hyperthermia.                                                            |
|                  | **Mean age (years, Mean ± SD)**                                                                  |
|                  | Not reported                                                                                   |
|                  | **Numbers allocated to each arm**                                                                |
|                  | 1. Group treatment (n = 14)                                                                      |
|                  | 2. Group control (n = 16)                                                                        |
|                  | **Male gender**                                                                                 |
|                  | Not reported                                                                                   |

| Interventions    | **Technique and occasion**                                                                     |
|------------------|------------------------------------------------------------------------------------------------|
|                  | Scalp block of the following nerves with 0.5% ropivacaine after the induction of anesthesia and endotracheal intubation: |
|                  | 1. The supraorbital and supratrochlear nerves                                                 |
|                  | 2. The auriculotemporal nerve                                                                   |
|                  | 3. The greater, lesser, and third occipital nerves                                              |
|                  | 4. The zygomaticotemporal nerve                                                                 |
|                  | **Dosage**                                                                                     |
|                  | Not reported                                                                                   |

| Outcomes         | **Primary**                                                                                    |
|------------------|------------------------------------------------------------------------------------------------|
|                  | 1. BP and HR during the surgery and in the immediate postoperative period                       |
|                  | 2. Intraoperative mean arterial pressure changes total dose of remifentanil and expired concentration of sevoflurane |
|                  | **Secondary**                                                                                  |
|                  | 1. Pain as measured by the visual analogue score during the first 4 hours postoperatively (measured at 1, 2 and 4 hours) |
|                  | 2. Total opioid consumption                                                                     |
|                  | 3. Incidence of postoperative nausea and vomiting                                              |

| Notes            | **Funding**                                                                                    |
|------------------|------------------------------------------------------------------------------------------------|
|                  | No funding source reported                                                                      |
| Methods | Study design: randomized controlled trial (2 arms)  
Study duration: not reported  
Study setting: hospital, single center, Canada |
|---|---|
| Participants | Patients aged 18–70 years of both genders and scheduled for an elective supratentorial craniotomy. (n=50)  
**Inclusion criteria**  
1. ASA grade I-III  
**Exclusion criteria**  
1. Inability to understand a numerical rating scale (NRS)  
2. Proven or suspected allergy to local anesthetics or morphine  
3. A craniotomy incision extending beyond the field covered by the SNB  
4. Chronically treated with opioid medications (>2 week)  
5. Presenting with a history of alcohol abuse and with active psychiatric disorders  
**Mean age (years, Mean±SD)**  
1. 50.5±13.4  
**Numbers allocated to each arm**  
1. Group block (n = 25)  
2. Group morphine (n = 25)  
**Male gender**  
1. Group block: 14/11  
2. Group morphine: 15/10 |
| Interventions | **Technique and occasion**  
Scalp block of the following nerves with 0.5% bupivacaine and 2% lidocaine at the end of surgery:  
1. The supraorbital and supratrochlear nerves  
2. The auriculotemporal nerve  
3. The postauricular branches of the greater auricular nerve  
4. The greater, lesser, and third occipital nerves  
**Dosage**  
20 mL |
| Outcomes | **Primary**  
1. Pain as measured by the numerical rating scale during the first 24 hours postoperatively (measured at 1, 2, 4, 8, 12, 16 and 24 hours)  
**Secondary**  
1. Cumulative doses of codeine  
2. Incidence of nausea, and vomiting as well as periods of confusion  
3. Total dose of postoperative Fentanyl consumption in the first 24 hours |
| Notes | **Funding**  
This study was supported in part by a Grant from the Canadian Anesthesiologist Society |
Methods | Study design: randomized controlled trial (4 arms)  
Study duration: not reported  
Study setting: hospital, single center, China

Participants | Patients aged 21–60 years of both genders and prepared to undergoing elective supratentorial craniotomy. (n=60)  
**Inclusion criteria**  
1. ASA grade I-III  
**Exclusion criteria**  
1. Preoperative use of analgesic  
**Mean age (years, Mean±SD)**  
Not reported  
**Numbers allocated to each arm**  
1. Group control (n = 10)  
2. Group SNB (n = 17)  
1. Group WIA (n = 17)  
2. Group SCPB (n = 16)  
**Male gender**  
Not reported

Interventions | **Technique and occasion**  
Scalp block of the following nerves with 0.75% ropivacaine at skin closure before the patient was awakened:  
1. The supraorbital and supratrochlear nerves  
2. The auriculotemporal nerve  
3. The postauricular branches of the greater auricular nerve  
4. The greater and lesser nerves  
**Dosage**  
Not reported

Outcomes | **Primary**  
1. Pain as measured by the visual analogue score during the first 48 hours postoperatively (measured at 4, 8, 12, 16, 24 and 48 hours)  
**Secondary**  
Not reported

Notes | **Funding**  
No funding source reported
| Methods       | Study design: randomized controlled trial (2 arms) |
|--------------|---------------------------------------------------|
|              | Study duration: not reported                       |
|              | Study setting: hospital, single center, Canada     |
| Participants | Patients aged 18 to 70 years of both genders and scheduled to undergo a craniotomy for either a supratentorial mass or an aneurysm clipping. (n=30) |
|              | **Inclusion criteria**                             |
|              | 1. ASA physical status I–III                       |
|              | **Exclusion criteria**                             |
|              | 1. Inability to understand or incapacity to use the visual analog scale (VAS) |
|              | 2. Proven or suspected allergy to local anesthetics or codeine phosphate |
|              | 3. A craniotomy incision extending beyond the field of the block |
|              | 4. Chronically (more than 2 weeks) treated with narcotic medications |
|              | **Mean age (years, Mean ± SD)**                   |
|              | 1. 48 ± 10.4                                      |
|              | **Numbers allocated to each arm**                 |
|              | 1. Group ropivacaine (n = 15)                     |
|              | 2. Group saline (n = 15)                          |
|              | **Male gender**                                   |
|              | 1. Group ropivacaine: 8/7                         |
|              | 2. Group saline: 5/10                             |
| Interventions| **Technique and occasion**                        |
|              | Scalp block of the following nerves with 0.75% ropivacaine at skin closure before the patient was awakened: |
|              | 1. The supraorbital and supratrochlear nerves      |
|              | 2. The auriculotemporal nerve                      |
|              | 3. The postauricular branches of the greater auricular nerve |
|              | 4. The greater, lesser, and third occipital nerves |
|              | **Dosage**                                         |
|              | 20 mL                                              |
| Outcomes     | **Primary**                                       |
|              | 1. Pain as measured by the visual analogue score during the first 48 hours postoperatively (measured at 4, 8, 12, 16, 20, 24 and 48 hours) |
|              | **Secondary**                                     |
|              | 1. Glasgow coma score                              |
|              | 2. Localization of the site of pain                |
|              | 3. Cumulative doses of codeine                     |
| Notes        | **Funding**                                       |
|              | No funding source reported                         |