Effect of clonidine, by infiltration and by intravenous route, on scalp block for supratentorial craniotomy

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Keywords: scalp block, supratentorial craniotomy

Abstract

Background: The aim of this research was to study and compare the haemodynamic and analgesic effects of (A) scalp block with bupivacaine 0.25%; (B) scalp block with bupivacaine 0.25% plus clonidine 2 μg/kg; and (C) scalp block with bupivacaine 0.25%, plus intravenous (IV) clonidine 2 μg/kg in supratentorial craniotomies.

Method: Sixty patients divided into three equal groups (A, B and C) were administered one of the above combinations. All the patients received propofol-based general anaesthesia. Propofol infusion was started at 25 μg/kg/minute, adjusted with an increment or decrement of 5 μg/kg/minute to obtain an A-line ARX index (AAI) of between 20 and 30 throughout the surgery, and stopped after dural closure. Fentanyl 0.5 μg/kg IV was given if a 20% increase in either heart rate (HR) and/or blood pressure (BP) was observed. HR and BP were monitored throughout the surgery and recorded on pin application, incision (planned 15 minutes after pins), at 15-minute intervals thereafter until dural closure, and every five minutes after dural closure. Propofol and fentanyl requirements were recorded for the duration of the surgery.

Results: There was a significant fall in HR, SBP (systolic blood pressure), MAP (mean arterial blood pressure) and RPP (rate-pressure product) after pin application in group B (HR p = 0.018, SBP p = 0.003, MAP p = 0.0042, RPP p = 0.000) and group C (HR p = 0.412, SBP p = 0.01, MAP p = 0.0084, RPP p = 0.001) when compared to group A. Propofol and fentanyl requirements were significantly lower in group B (propofol 67.9% and fentanyl 34.85% less) and group C (propofol 59.21% and fentanyl 36.36% less) when compared to group A.

Conclusions: The addition of clonidine, either to the scalp block or intravenously, offers better haemodynamic stability intraoperatively, and reduces analgesic and anaesthetic requirements.

Ⓟ Peer reviewed. (Submitted: 2010-04-27, Accepted:2010-10-07)   *S Afr J Anaesthesiol Analg 2010;16(6):13-21*

Introduction

The alpha-2-adrenergic receptor agonists are of the most versatile drugs in the hands of anaesthesiologists in modern-day practice. The sedative, haemodynamic and analgesic properties of this class of drugs place them in a unique group in modern anaesthesia practice. Clonidine is an alpha-2-adrenergic agonist that has antihypertensive and sedative actions, as well as being able to potentiate the effects of local anaesthetics in epidural anaesthesia[1] and brachial plexus block[2,3,4,5] and increase the duration of sensory and motor subarachnoid block.[6]

For many years, clonidine has been used for the prolongation of neuraxial and peripheral, nerve blocks with local anaesthetic agents. Blood pressure (BP) and heart rate (HR) reduction, brought about by the systemic absorption of clonidine, are important and desirable components of neuroanaesthesia.

We conducted this trial to compare the analgesic and haemodynamic effects of bupivacaine-only scalp block, bupivacaine and clonidine combination scalp block, and bupivavcaine scalp block with intravenous (IV) clonidine. The total doses of propofol and fentanyl required for achieving the

desired depth of anaesthesia in the three groups were also compared.

Method

Institutional ethics committee approval was granted and written, informed consent was obtained from the patients. Sixty patients were included in the study. They were to undergo supratentorial craniotomies and were allocated into any one of three groups of 20 patients each, by means of computer-generated randomisation:

- Group A: Patients receiving scalp block with injected bupivacaine 0.25% 20 ml and normal saline 1 ml, plus normal saline 1 ml IV.
- Group B: Patients receiving scalp block with injected bupivacaine 0.25% 20 ml and clonidine 2 µg/kg, plus normal saline 1 ml IV.
- Group C: Patients receiving scalp block with injected bupivacaine 0.25% 20 ml and normal saline 1 ml, plus clonidine 2 µg/kg IV.

Patient selection criteria

All the patients were between the ages of 18 and 55, and were classified as American Society of Anesthesiologists (ASA) Physical Status grade I or II.

Patients with a history of hypertension, impaired renal function, Glasgow Coma Scale score of less than 13, non-communicative status, history of craniotomy, history of allergy to local anaesthetic agents and/or clonidine, and history of any other major systemic illness, were excluded from the study.

The nature of the anaesthesia and surgery was explained in detail to all the patients. In the operating theatre, each patient was connected to an electrocardiograph (ECG) monitor, a pulse oximeter, non-invasive blood pressure (NIBP) monitor, a train-of-four (TOF) neuromuscular function monitor, an AAI (A-line ARX index) depth of anaesthesia monitor, and nasopharyngeal temperature monitors. Baseline readings were obtained. Intravenous Ringer's lactate was administered through an 18 G IV cannula at a rate of around 100 ml/hour. The patients were premedicated with glycopyrrolate 0.004 mg/kg, ondansetron 4 mg, midazolam 0.03 mg/kg, and fentanyl 2 µg/kg. Preoxygenation was followed by induction with propofol 2 mg/kg and rocuronium 0.6 mg/kg. After intubating with an appropriately sized endotracheal tube, anaesthesia was continued on a circle absorber system with nitrous oxide and oxygen (60:40) in volume-controlled mode.

This process was followed by scalp block using the above combinations. The standard technique for scalp ring block was used to block the supratrochlear and supraorbital branches of the trigeminal nerve, the auriculotemporal nerve, and the greater and lesser occipital nerves on both sides, using 20 ml of solution (approximately 1.5-2 ml at each site). Clonidine 2 µg/kg (group B) or placebo in the form of normal saline 1 ml IV (groups A and C) were administered at the time of scalp block.

The infusion of propofol at 25 µg/kg/minute was started immediately after induction and adjusted (5 µg/kg/minute increase or decrease) so as to maintain an AAI of between 20 and 30 throughout the surgery. Fentanyl 0.5 µg/kg IV was given after an increase of 20% in either HR and/or BP from baseline. Propofol infusion was stopped immediately after dural closure.

Vital parameters were monitored throughout the surgery and recorded at the time of pin application, incision (which was planned 15 minutes after pins), at 15-minute intervals thereafter until dural closure, and every five minutes after dural closure.

The total duration of surgery and the requirement for propofol and additional doses of fentanyl were recorded. At the end of surgery, neuromuscular blockade was reversed using neostigmine 0.05 mg/kg and glycopyrrolate (0.008 mg/kg), and the patient was extubated after achieving a TOF > 1.

Statistical analysis was done using the statistical package SPSS 9.0. Mean, standard deviation (SD) and 95% confidence intervals (CI) were calculated in all three groups for the measurable demographic data, such as age and weight. For a comparison of this demographic data between the three groups, a one-way ANOVA (analysis of variance) test was applied. For the comparison of categorical data, such as sex ratios in the three groups, a chi-square test was applied. A repeated measure ANOVA model was used for an inter-group and intra-group comparison of study parameters like heart rate, systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP) and rate-pressure product (RPP). A p value (significance) of < 0.05 was deemed statistically significant. A significance of 0.000 should be read as p < 0.0001 (very highly significant), as the software can detect significance up to three decimal points only.

Results

Demographic data
The demographic data for the three groups are provided in Table I.

Table I: Demographic data

Parameters	Group A	Group B	Group C
No of patients	20	20	20
Age (yrs)[a] Mean SD Range	39.95 15.13 19–68 yrs	39.85 11.65 18–60 yrs	41.05 14.51 18–70 yrs
Weight (kg)[a] Mean SD Range	51.40 5.39 43–64 kg	49.80 4.86 40–60 kg	48.98 5.48 42–60 kg
Sex (%)[b] Male Female	10 (50.0) 10 (50.0)	11 (55.0) 09 (45.0)	12 (60.0) 08 (40.0)
Duration of surgery(min)	375.5 ± 43.06	370.75 ± 50.84	370.3 ± 40.64

[a] from Student's t-test
[b] from chi-square test
p > 0.05 not significant

The three groups were similar in terms of age, weight, sex, ASA physical status and duration of surgery (p > 0.05). The baseline haemodynamic parameters in all three groups were comparable and not statistically significant (p > 0.05).

Table II and Figure 1 show that the mean HR value in group A was 81.15 at the baseline. After pin application, the mean HR showed a significant increase in group A, of 12.3% from the baseline. The mean HR at the baseline was 83.85 in group B, and 84.95 in group C.

In group A, there was a progressive increase in the mean HR from DC 0 (defined as the point of dural closure) to DC 40 (40 minutes after dural closure), and it was significant at 25 to 40 minutes after dural closure (15.7% at DC 40).

In group B, there was a progressive decrease in HR at pin application (8.6% of baseline, p = 0.0063) until 60 minutes, and also from 0 to 35 minutes after DC, which was statistically significant.

Table II: Comparison of changes in mean heart rate between the groups

| Heart rate	Group A mean	SD	Group B	SD	Group C	SD	Group A p	Group B p	Group C p
Baseline	81.15	7.60	83.85	8.82	84.95	8.91	–	–	–
15	91.15 (12.3%↑)	13.52	76.85 (8.4%↓)	10.20	78.90 (7.9%↓)	11.00	0.0037*	0.0063*	0.0236*
30	81.40 (0.3%↑)	15.64	71.60 (14.6%↓)	8.04	73.50 (13.4%↓)	8.19	0.9441	0.0000*	0.0000*
45	81.00 (0.1%↓)	16.92	70.25 (16.2%↓)	10.28	71.95 (15.3%↓)	9.75	0.9685	0.0000*	0.0000*
60	77.50 (4.5%↓)	15.10	67.80 (18.9%↓)	10.00	71.85 (15.5%↓)	11.34	0.2932	0.0000*	0.0000*
DC 0	82.55 (1.7%↑)	21.00	66.80 (20.0%↓)	11.07	76.50 (9.9%↓)	13.23	0.7689	0.0000*	0.0101*
5	87.45 (7.7%↑)	23.48	69.70 (16.8%↓)	10.45	78.70 (7.1%)	12.63	0.2449	0.0000*	0.0393*
10	89.00 (9.6%↑)	23.13	71.45 (14.7%↓)	10.44	80.80 (4.9%↓)	11.83	0.1455	0.0000*	0.1332
15	88.05 (8.6%↑)	22.11	72.20 (14.2%↓)	10.39	81.10 (4.7%↓)	12.00	0.1788	0.0000*	0.1675
20	81.95 (0.9%↑)	24.13	74.25 (11.5%↓)	10.20	83.10 (2.2%↓)	10.69	0.8839	0.0005*	0.4485
25	90.00 (10.9%↑)	17.97	76.90 (8.3%↓)	9.33	84.80 (0.2%↓)	10.58	0.0402*	0.0035*	0.9504
30	91.15 (12.2%↑)	20.38	77.15 (7.9%↓)	11.46	84.50 (0.5%↓)	10.37	0.0409*	0.0158*	0.8482
35	93.35 (↑15.0%)	21.15	78.60 (6.2%↓)	8.71	84.90 (↓0.1%)	10.17	0.0184*	0.0154*	0.9827
40	93.8 (↑15.6%)	17.90	81.15 (3.2%↓)	9.15	87.60 (3.1%↑)	10.32	0.0050*	0.2025	0.2652

* Statistically significant
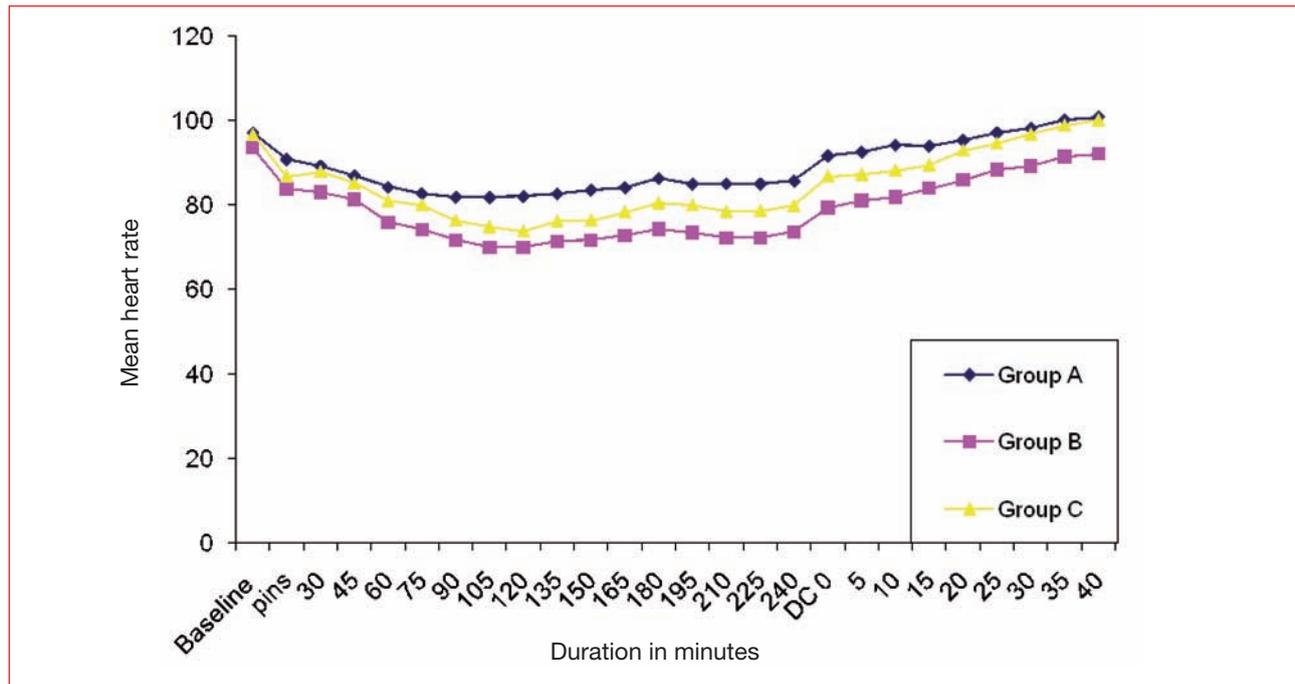
Figure 1: Comparison of changes in mean heart rate between the groups

In group C, there was a progressive and statistically significant decrease in mean HR from the time of pin application (7.12%, p = 0.0236) to 60 minutes, continuing up to five minutes after DC. The change in the mean HR was not significant from DC 10 to 40 minutes.

The MAP decreased significantly during pin application (Table III, Figure 2) (p = 0.0013) and showed a gradual increase after dural closure, though this was not statistically significant in group A. In groups B and C, there was a significant fall in MAP during pin application (p value 0.0000 and

Table III: Comparison of changes in mean MAP between the groups

| Duration in minutes	Mean MAP (± SD)					
	Group A		**Group B**		**Group C**	
SX baseline	97.12 ± 7.05		93.42 ± 6.67		96.67 ± 8.81	
SB/IV clonidine	103.58 ± 7.86		100.93 ± 4.94		102.48 ± 6.75	
pins	90.82 ± 7.47	0.0013	83.83 ± 5.14	0.0000	86.78 ± 6.45	0.0001
30	89.20 ± 8.78	0.0007	82.95 ± 9.16	0.0001	87.87 ± 9.37	0.0005
45	86.90 ± 8.15	0.0000	81.28 ± 8.17	0.0000	85.18 ± 8.94	0.0000
60	84.20 ± 9.11	0.0000	75.88 ± 4.78	0.0000	80.93 ± 6.04	0.0000
DC 0	91.63 ± 15.34	0.1259	79.38 ± 9.84	0.0000	86.70 ± 9.39	0.0001
5	92.53 ± 14.58	0.1753	81.03 ± 10.09	0.0000	87.18 ± 9.05	0.0002
10	94.17 ± 14.60	0.3773	81.85 ± 9.08	0.0000	88.22 ± 7.72	0.0004
15	93.97 ± 12.36	0.2685	83.88 ± 8.63	0.0001	89.47 ± 7.74	0.0017
20	95.30 ± 12.13	0.5103	85.88 ± 9.03	0.0014	92.93 ± 8.94	0.0768
25	97.12 ± 10.97	1.0000	88.33 ± 7.68	0.0080	94.57 ± 8.59	0.2998
30	98.17 ± 12.00	0.7001	89.18 ± 8.00	0.0285	96.80 ± 8.07	0.9481
35	100.22 ± 10.96	0.2212	91.37 ± 6.40	0.1854	98.85 ± 8.15	0.2821
40	100.82 ± 9.62	0.1017	92.07 ± 6.03	0.3768	100.17 ± 8.74	0.0916
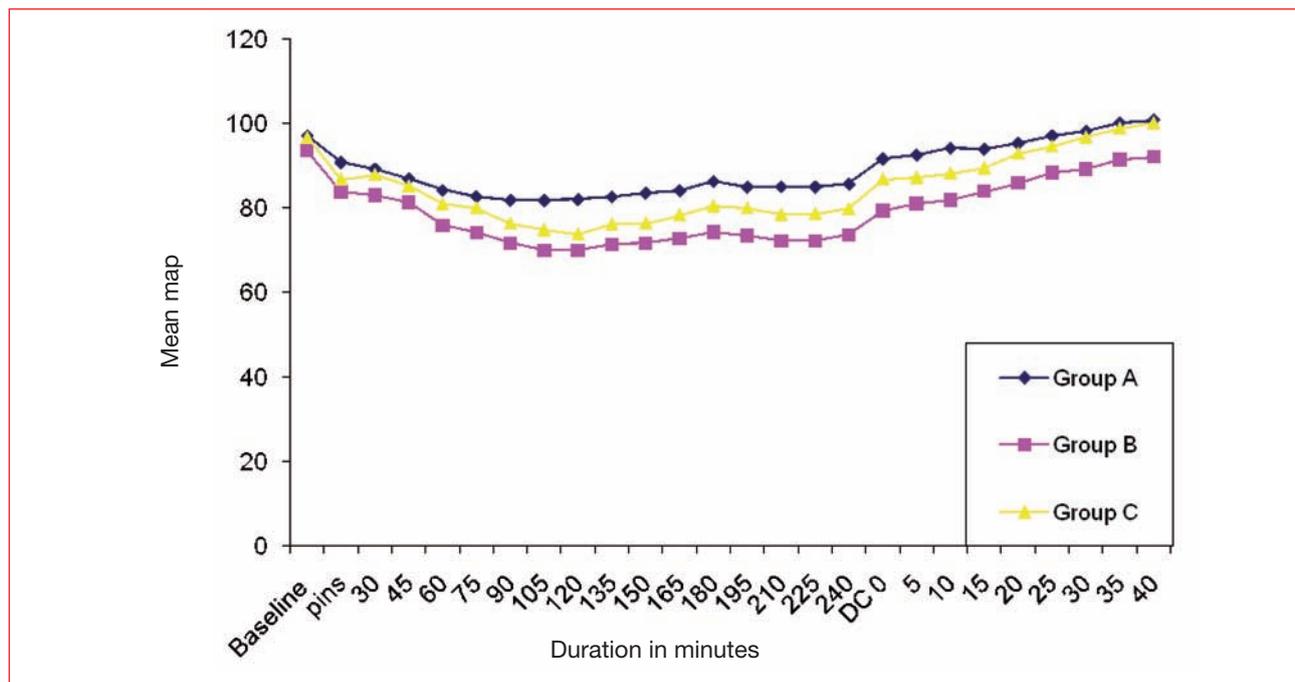
Figure 2: Comparison of changes in mean MAP between the groups

0.0001, respectively). The MAP remained below baseline after dural closure, and the decrease was statistically significant for 30 and 15 minutes after dural closure in groups B and C, respectively.

Table IV: Change in haemodynamics on pin application

Pin application	Group A % decrease	Group B % decrease	Group C % decrease	p for A + B	p for A + C	p for B + C
SBP	8.6	13.3	12.1	0.003*	0.0159*	0.896
DBP	7.7	4.9	8.8	0.0042*	0.0084*	0.915
MAP	6.5	10.3	10.2	0.0042*	0.0084*	0.915
RPP	12.4	20.4	18.1	0.000*	0.0011*	0.915

* Statistically significant

Table V: Statistical significance of changes in haemodynamic parameters among the groups [post-hoc ANOVA (pairwise comparisons)]

Among groups	HR		SBP		MAP		RPP	
	Mean diff	p value	Mean diff	p value	Mean diff	p value	Mean diff	p value
A + B	12.73	0.018*	9.36	0.003*	8.48	0.0042*	2614.3	0.000*
B + C	6.15	0.365	0.48	0.896	0.72	0.915	982.1	0.915
A + C	6.35	0.412	8.45	0.0159*	8.45	0.0084*	1632.4	0.0011*

* Statistically significant

As can be seen in Tables IV and V, there was a significant reduction in SBP, DBP, MAP and RPP during pin application in groups B and C when compared to group A.

The propofol requirement (Table VI, Figure 3) was 49.15 ± 11.27 ml in group A. In group B, the requirement was 15.75 ± 6.72 ml (decreased by 67.9%), and in group C it was 20.05 ± 4.24 ml (decreased

Table VI: Comparison between the groups of mean propofol required

Group	Mean propofol required (mg) (± SD)
A	49.15 ± 11.27
B	*15.75 ± 6.72
C	*20.05 ± 4.24

By Student's t-test
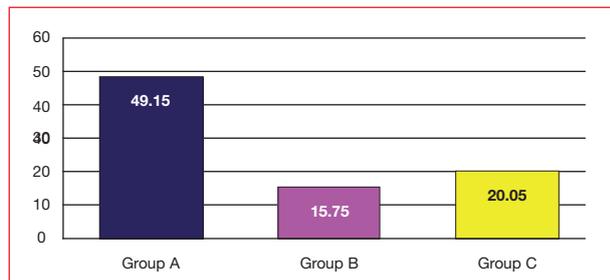*$p < 0.05$ significant between groups
$p > 0.05$ not significant

Figure 3: Requirement of propofol (1%) among the groups in ml

by 59.21%). Fentanyl premedication was used in all three groups, as a 2 µg/kg bolus.

The fentanyl requirement (Table VII, Figure 4) was 165.00 ± 20.52 µg in group A. In group B, the fentanyl

Table VII: Comparison of mean fentanyl required between the groups

Groups	Mean fentanyl required (µg) (± SD)
A	165.00 ± 20.52
B	*107.50 ± 18.32
C	105.00 ± 15.39

By Student's t-test
*$p < 0.05$ significant among the groups
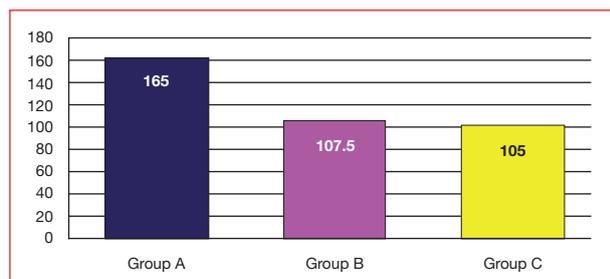$p > 0.05$ not significant

Figure 4: Requirement of fentanyl among the groups in µg

requirement was 107.50 ±18.32 µg (decreased by 34.85%), and in group C it was 105.00 ± 15.39 µg (decreased by 36.36%).

Discussion

Twenty millilitres of 0.25% bupivacaine was used for the scalp block. The reduced concentration from the standard 0.5% allowed safe infiltration of the volume required.

Scalp block is used to attenuate the pain response to pin application and incision prior to craniotomy. It is performed for both the awake craniotomy procedure and for patients subjected to general anaesthesia, as in this study.

Scalp block with any of the combinations used in the study proved an effective adjuvant treatment for the maintenance of stable haemodynamics for patients undergoing craniotomy under general anaesthesia during skin incision and dural closure.[7]

Clonidine causes a decrease in HR and BP through its alpha-2-agonistic action. When introduced into the scalp as infiltration, the slow release of clonidine from the scalp into the circulation may serve the purpose of controlled haemodynamics intraoperatively. This was one of the reasons that prompted us to undertake the study.

In a study by Hall et al, normal human volunteers administered clonidine infusion at 4 µg/kg/minute for one hour demonstrated a significant decrease in visual analogue scale (VAS) score (29%) in response to the cold pressure test.[8] The MAP response during the cold pressure test after 60 minutes of infusion increased by 4% in the placebo group, but decreased by 23%, 31% and 74% for clonidine infusion of 1, 2 and 4 µg/kg/minute, respectively. The mean HR and MAP tended to decrease in this study, but these changes were found to be non-significant.[8]

The increase in mean HR in group A, compared to groups B and C, may be due to inadequate analgesia provided by the scalp block. The significant decrease in HR on pin application in comparison to baseline may be attributed to the action of clonidine at the local site (group B), as well as to its systemic action (group C). In group B, this action may be attributed to the local, as well as systemic, effect of clonidine after systemic absorption from the injection site.

In group A, the progressive increase in HR after dural closure may be due to inadequate analgesia, as the anaesthetic depth was maintained at 20-30 AAI.

The significant decrease in HR in group B and the non-significant increase in HR in group C after dural closure may be attributed to the haemodynamic effects of clonidine (in scalp block for group B and intravenous for group C). The absence of an increased HR in group B may be due to the prolongation of analgesia by clonidine when added to the scalp block regimen, which continued even after dural closure, and may also be because of the systemic effect of clonidine absorbed from the scalp (group B).

Costello and Cormack suggested that oral clonidine (3 µg/kg, 90 minutes prior to induction) is effective in controlling the increase in MAP (p = 0.03) resulting from pin head-holder application.[9] Lee et al were of the opinion that scalp block with 0.25% bupivacaine helps to maintain stable haemodynamics in patients undergoing craniotomy under general anaesthesia, especially at the time of skin incision and dural opening. Unfortunately, they failed to discern any correlation between the elevation in haemodynamic parameters and a rise in serum catecholamine levels.[7]

In a comparison of bupivacaine infiltration with saline during incision and pin application, Mohammadi et al suggested, in their study of 36 patients randomly allocated to two groups, that changes in HR (p = 0.03) and MAP (p = 0.001) were significant between the two groups.[10]

Altan et al did a study on 60 patients undergoing spinal surgery who were allocated randomly into three groups, namely group M (who received magnesium sulphate 30 mg/kg as a bolus before induction, and 10 mg/kg/hour by infusion), group CL (who received clonidine 3 µg/kg as a bolus before induction, and 2 µg/kg/hour by infusion during the operation period), and the control group CT (who received the same volume of isotonic solution). They found that the MAP in the clonidine group was reduced significantly for all measurements, with the exception of intubation and after infusion (p < 0.001). HR in the clonidine group decreased significantly in all periods, with the exception of post-intubation, post-infusion and extubation (p < 0.001).[11]

It can be concluded that the haemodynamic response to pin application is significantly blunted by scalp block (with or without clonidine), although parameters such as SBP, MAP and RPP decreased more significantly in group B (clonidine in scalp block) and group C (intravenous clonidine) than in group A. Better haemodynamic control could be achieved in groups B and C than in group A after dural closure. This can be attributed to the enhanced analgesic effect of bupivacaine by clonidine (intravenous, group C; or in scalp block, group B) in comparison to only bupivacaine in scalp block (group A). Comparisons between changes in the haemodynamic parameters of groups B and C were non-significant.

Clonidine provided beneficial effects in terms of sedation, analgesia and increased cardiovascular stability in all phases of patient care.[12,13] Clonidine has been shown to reduce the requirement for volatile anaesthetics when assessed on haemodynamic responses.[14,15]

Imai et al found that a reduced dose of propofol was required after the administration of clonidine,[16] whereas Goyagi et al found a reduced induction (but not maintenance) dose of propofol when using haemodynamic end-points.[17] However, using haemodynamic parameters as a measuring tool for depth of anaesthesia after the administration of clonidine may not be ideal. An absence of tachycardia or hypertension does not necessarily indicate an adequate depth of anaesthesia. Moreover, due to the incomplete MAC-sparing effect of clonidine, care must be taken when it is used as an adjuvant in anaesthesia to ensure an adequate depth of anaesthesia.[8] Bischoff et al[18] suggested that, as centrally acting alpha-2 receptor agonists have effects on the EEG and the bispectral index (BIS) in the awake patient, BIS can be used as a measure of the depth of anaesthesia produced by clonidine.[18,19]

Kreuer et al, comparing BIS and AAI during propofol-remifentanil induction, suggested that a decrease in the depth of anaesthesia, as indicated by BIS, is accompanied by a corresponding change in AAI.[20] In our study, we maintained an AAI value of between 20 and 30 by adjusting the dose of propofol. Fehr et al suggested that clonidine results in a decrease in BIS during propofol anaesthesia, and allows for a reduction in the target concentration of propofol in order to maintain a certain BIS. The propofol saving in this study was 20% (p = 0.002).[21]

Another study investigated the effect of clonidine (150 µg oral) on IV anaesthesia with propofol and fentanyl, and found a reduction of approximately 40% in propofol requirement, with similar doses of fentanyl after clonidine.[16] According to the same authors, the pharmacological effect of clonidine can be monitored with BIS.[16]

In our study, the propofol requirement was decreased by 67.9%, p < 0.05 (for clonidine added to scalp block, group B) and 59.21%, p < 0.05 (for clonidine given intravenously, group C), and fentanyl

premedication was used in all three groups, as a 2 µg/kg bolus.

A study by Bernard et al confirmed that IV clonidine can be useful in reducing IV fentanyl doses in post-surgical patients.[22] By contrast, two studies, by Fehr et al[21] and Engelman et al,[23] have suggested that clonidine does not have any additional effect in reducing the intraoperative requirement of opioids.

Bernard et al performed a study to document the analgesic properties of intravenous clonidine during the postoperative period.[24] Immediately after spinal fusion, 50 ASA I patients were randomly assigned to two groups, with one group receiving 5 µg/kg of clonidine infused in the first hour, and then 0.3 µg/kg/hour during the next 11 hours, and the other group receiving a placebo. They found that clonidine delayed the onset of pain and the first request for morphine injection.[24]

Ghignone et al observed a marked reduction in fentanyl requirement to attain similar anaesthetic depth and to prevent the hyperdynamic cardiovascular response to laryngoscopy and intubation in a group of patients premedicated with clonidine. They suggested a synergistic inhibitory action of opiates and alpha-2 adrenoceptor agonists on central sympathetic outflow.[25]

Another study suggested that, when clonidine is used as oral premedication (5 µg/kg), it improves the intraoperative haemodynamics and reduces the analgesic requirements.[26] In our search for information on the use of clonidine as scalp infiltration, we were unable to find any previous articles on the matter. A study by Yildiz et al compares the effects of intravenous fentanyl, and intravenous fentanyl combined with bupivacaine infiltration, on the haemodynamic response to skull pin insertion in 120 ASA I and II patients scheduled for elective craniotomy.[27] The fentanyl group (group F; n = 60) received fentanyl during induction and prior to skull pin insertion (2 and 1 µg/kg, respectively). The fentanyl-bupivacaine group (group FB; n = 60) received the same doses of fentanyl, as well as scalp infiltration with 0.25% bupivacaine. The researchers found that the haemodynamic response to skull pin insertion was effectively suppressed with both methods. However, the addition of scalp infiltration to fentanyl still did not provide any additional benefit.[27]

A study by Agarwal et al compared the efficacy of a subanaesthetic dose of intravenous ketamine (0.5 mg/kg) and/or lidocaine infiltration (1%) at pin fixation sites before pinning. They found maximum attenuation of the haemodynamic responses when a subanaesthetic dose of intravenous ketamine (0.5 mg/kg) was administered with a 1% lidocaine infiltration.[28]

Conclusion

In our study, we found a significant decrease in fentanyl requirement when clonidine was added either intravenously (36.36%, $p < 0.05$) or into the scalp block (34.85%, $p < 0.05$). The addition of clonidine either to the scalp block, or intravenously, causes a significant decrease in HR with pin application. Haemodynamic parameters such as SBP, DBP, MAP and RPP are decreased significantly with the addition of clonidine to the scalp block, as well as intravenously. The addition of clonidine to the scalp block may have the added advantage of increasing the duration of analgesia, as is evident from the sustained, stable haemodynamic parameters for a longer duration after dural closure, although the difference seen with intravenous clonidine is not statistically significant. Clonidine also reduces mean propofol and fentanyl requirements intraoperatively.

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