COMPARATIVE STUDY TO EVALUATE EFFECT THE DEXMEDETOMIDINE IN ATTENUATING THE HAEMODYNAMIC AND NEUROENDOCRINE RESPONSES TO SKULL-PIN HEAD HOLDER APPLICATION DURING CRANIOTOMY

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ABSTRACT

BACKGROUND

Application of skull-pin head holder to stabilise the head in craniotomies causes stress in the haemodynamic response (increase in heart rate and mean arterial pressure) and neuroendocrine response (increase in blood glucose, serum cortisol and serum prolactin). In this study, attenuation of haemodynamic and neuroendocrine stress response with dexmedetomidine, an alpha-2 adrenoreceptor agonist versus placebo (normal saline) were compared.

MATERIALS AND METHODS

Forty patients posted for elective craniotomy in the age group of 18 to 60 years of both sexes were divided into two groups of 20 each as dexmedetomidine and placebo (normal saline) and the attenuation of haemodynamic response and neuroendocrine response to intravenous dexmedetomidine or placebo to the application of skull-pin head holder were compared. Data of haemodynamic and neuroendocrine responses were analysed statistically by Student's t-test, independent t-test and paired t-test and the p value of <0.05 was considered statistically significant.

RESULTS

The results of study showed that the increase in heart rate, mean arterial pressure and increase in blood glucose, serum cortisol and serum prolactin was attenuated by dexmedetomidine.

CONCLUSION

Concludes that the dexmedetomidine attenuates the haemodynamic and neuroendocrine response to the application of skull-pin head holder in craniotomy surgeries.

KEYWORDS

Craniotomy, Skull-Pin Head Holder, Haemodynamic and Neuroendocrine Response.

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BACKGROUND

The Mayfield skull-pin head holder is used to stabilise the head during neurosurgical procedures.[1,2]

They support the head without any direct pressure on the face, allow access to the airway and hold the head firmly in one position that can be finely adjusted for optimal neurosurgical exposure. When properly applied, the pins cause considerable periosteal stimulation.[1,2] This results in abrupt increase in mean arterial pressure and cerebral blood pressure under general anaesthesia.[2,3,4,5,6]

These haemodynamic responses may lead to brain oedema, increase in ICP or ICH in aneurysm patient. Different anaesthetic techniques have been used to blunt this deleterious effect with variable success.[7,8,9,10,11]

The stress response to intense nociceptive surgical stimulus is characterised by increased secretion of pituitary hormones and activation of the sympathetic nervous system.[2,3,4,5]

Attenuation of the haemodynamic and neuroendocrine responses to intense noxious stimuli during operation may improve outcome by beneficial effects on organ function.[12,13,14,6]

Dexmedetomidine is a highly specific potent and selective α-2 adrenoreceptor agonist.[15,16,17] It has sedative, analgesic and anaesthetic sparing effects and it decreases HR, MAP and sympathetic nervous system activity in a dose-dependent fashion. Also, it has the potential to exert inhibitory effects on cortisol and catecholamine synthesis.[18,19,20,13]

In this prospective randomised-controlled study, the hypotheses that dexmedetomidine would attenuate the increase in HR, MAP and plasma glucose, cortisol and prolactin concentrations to skull-pin placement for craniotomies was investigated.

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MATERIALS AND METHODS

Forty consecutive ASA I and II patients aged between 18 years and 60 years old undergoing elective craniotomy for resection of supratentorial tumour or clipping of an unruptured cerebral aneurysm with the aid of skull-pin head holder were randomised into 2 groups.

Forty patients with the above criteria were divided into two equal groups. Group DEX receives bolus dose of Inj. Dexmedetomidine 1 mcg/kg over ten minutes before induction of anaesthesia.

Group NS receives equal amount of normal saline.

Preoperative investigations report like HB, blood urea, serum creatinine, platelets, clotting time and bleeding time were recorded.

On arriving to the operating room, monitors were connected and baseline, vital parameter were noted. Two peripheral IV lines with 18G IV cannula, one for IV infusion and other for studied drug were started. Preloading was done with 10 mL/kg of balanced salt solutions.

Patients received either IV dexmedetomidine or placebo over a period of 10 mins. before induction.

Then, anaesthesia was induced with Inj. Thiopental 5 mg/kg, Inj. Fentanyl 2 mcg/kg and Inj. Vecuronium 0.1 mg/kg and intubated with appropriate size endotracheal tube.

Anaesthesia was maintained with 66% N_2O, 33% O_2 + IPPV and vecuronium.

Ventilation was controlled to maintain a target value of end-tidal CO_2 between 33 and 38 mmHg.

The skull-pin was placed within a few minutes. Throughout the operation, 1 mcg/kg fentanyl was administered every 45 mins. until the last 30 mins. of surgery.

Any incidence of hypotension or bradycardia was recorded. Hypotension is defined as decreased in MAP 30% or more from baseline is treated with Inj. Atropine 0.6 mg.

Haemodynamic Measurement and Blood Sampling

The outcome variables of HR and MAP were recorded at the following time intervals.

Baseline value 20 mins. before IV administration of dexmedetomidine or placebo.

- T_0 1 mins. before the pin insertion.
- T_1,T_5,T_{10},- 1, 5 and 10 mins., respectively after pin insertion.

Blood sample were obtained 15 mins. before IV administrations of dexmedetomidine or placebo (baseline) and at 30 mins. after the pin insertion for the determination of plasma glucose, cortisol and prolactin levels.

Results were analysed and tabulated.

Statistical Analysis

Results for parametric data were reported as mean ± SD demographic parameter data were analysed by Student's t-tests. Haemodynamic data and hormone levels were analysed by the independent t-tests for differences between group and the paired t-test for differences within groups. A value of <0.05 was considered as statically significant.

OBSERVATION AND ANALYSIS

Forty patients were taken into the study group; 20 belong to the group NS and remaining 20 belong to DEX.

	Group	N	Mean	Std. Deviation	P
Age in years	Normal saline dexmed	20 20	41.55 46.10	11.601 11.369	>0.05 not significant

Table 1. Demographic Profile - Age

The mean age and age distribution in both the group were found to be similar. P value was found to be not significant.

			Group		
			Normal Saline	**Dexmed**	**Total**
Sex	Male	Count percentage within group	12 60.0%	15 75.0%	27 67.5%
	Female	Count percentage within group	8 40.0%	5 25.0%	13 32.5%
Total		**Count percentage within group**	**20 100.0%**	**20 100.0%**	**40 100.0%**

Table 2. Demographic Profile - Sex

Of the 40 patients, 27 were males and 13 were females. The distribution were similar in both the group of patients.

	Group	N	Mean	Std. Deviation	P
HR-baseline	DEX NS	20 20	86.55 86.15	7.373 5.687	P=0.962 Not significant
HR-T0	DEX NS	20 20	68.00 80.45	8.615 5.586	0<0.05 Significant
HR-T1	DEX NS	20 20	81.60 99.80	7.883 5.578	0<0.05 Significant
HR-T5	DEX NS	20 20	75.65 88.70	6.968 3.988	0<0.05 Significant
HR-T10	DEX NS	20 20	70.70 86.20	6.744 3.820	0<0.05 Significant

Table 3. Heart Rate Changes (Beats/Min.)

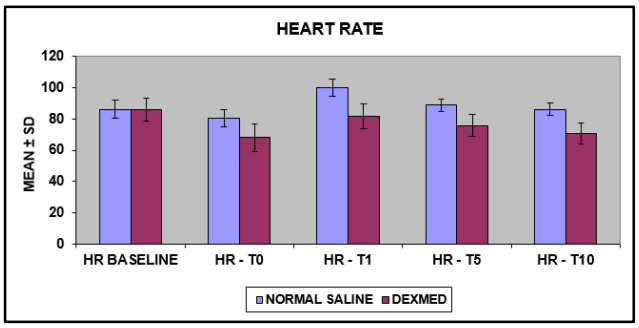

Figure 1. Heart Rate Changes (Beats/Min.)

Baseline Haemodynamic Parameters

There was no statistically significant difference in the baseline haemodynamic parameters between the two groups.

The lowest level of heart rate for the DEX group was 68 ± 8.615 and was observed at T_0. This was significantly lower than the baseline value. Pin attachment significant increase heart rate at T_1, T_5 and T_{10}.

	Group	N	Mean	Std. Deviation	P
MAP-baseline	DEX	20	97.50	5.267	P=0.849
	NS	20	97.80	4.584	Not significant
MAP-T0	DEX	20	76.95	5.276	0<0.05
	NS	20	93.40	5.276	Significant
MAP-T1	DEX	20	89.90	4.844	0<0.05
	NS	20	119.20	5.053	Significant
MAP-T5	DEX	20	86.05	4.989	0<0.05
	NS	20	112.55	5.558	Significant
MAP-T10	DEX	20	80.45	5.145	0<0.05
	NS	20	97.45	4.883	Significant

Table 4. Mean Arterial Pressure Changes (mmHg)

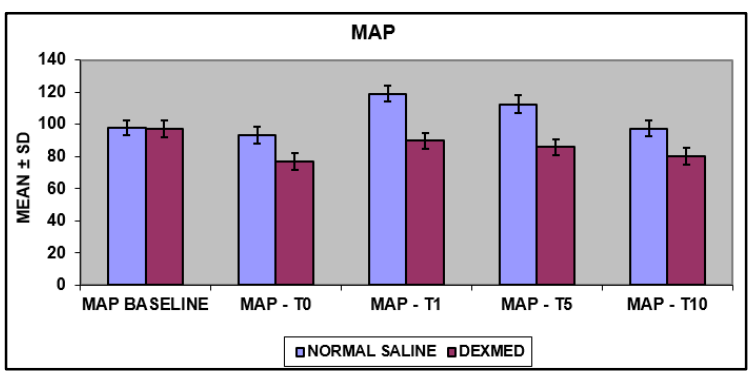

Figure 2. Mean Arterial Pressure Changes (mmHg)

The lowest level of MAP was observed in the DEX group, it was 76.95 ± 5.276 at T_0. This was significantly lower than the baseline value. Pin attachment significantly increased the MAP level at T_1, T_5 and T_{10} (<0.05).

	Group	N	Mean	Std. Deviation	P
RBS-baseline	Normal saline dexmed	20	75.15	14.005	=0.317
		20	71.30	9.576	Not significant
RBS-after	Normal saline dexmed	20	127.90	26.987	=0.05
		20	105.65	19.535	Significant

Table 5. Hormonal Changes - Blood Glucose

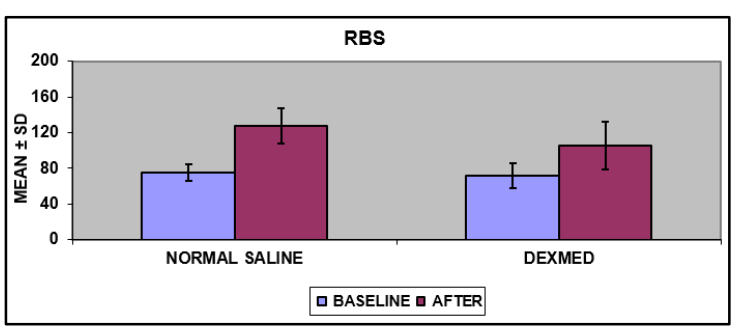

Figure 3. RBS

The baseline value was not statistically significant. Sample taken 30 mins. after pins were statically significant (P<0.05).

	Group	N	Mean	Std. Deviation	P
Prolactin-baseline	Normal saline dexmed	20 20	13.6880 10.3490	9.56236 6.49961	=0.204 Not significant
Prolactin-after	Normal saline dexmed	20 20	60.3050 22.4325	47.27146 20.92367	=0.002 Significant

Table 6. Hormonal Changes - Prolactin

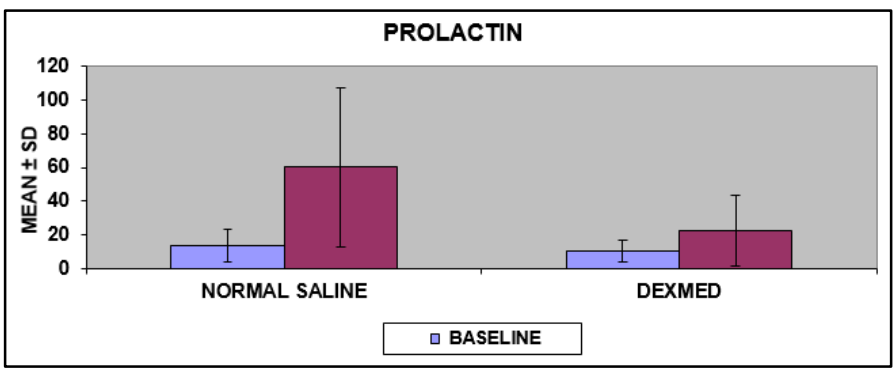

Figure 4. Prolactin

Baseline value showed P=0.204, which is not significant while values taken after pin insertion shows a P=0.002, which is statistically significant.

	Group	N	Mean	Std. Deviation	P
Cortisol-baseline	Normal saline dexmed	20 20	8.7785 9.9530	4.55955 4.46692	=0.416 Not significant
Cortisol-after	Normal saline dexmed	20 20	20.2505 16.0930	4.90432 7.72431	=0.049 Significant

Table 7. Hormonal Changes - Cortisol

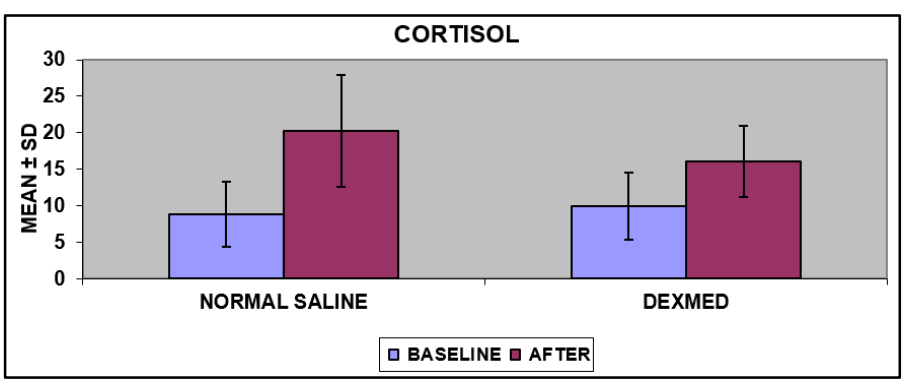

Figure 5. Cortisol

Baseline value showed P=0.416, which is not significant while values taken after pin insertion shows a P=0.049, which is statistically significant.

DISCUSSION

This study was done to compare the efficacy of a bolus injection of dexmedetomidine with a placebo on attenuating the sympathoadrenal response accompanying Mayfield skull-pin application in 40 patients divided into two groups.
Group DEX- Dexmedetomidine 1 mcg/kg.
Group NS- Normal saline as a placebo.

40 ASA I and II patients aged 18 to 60 yrs. undergoing elective craniotomy surgeries under general anaesthesia were chosen for the study.

Heart rate, mean arterial blood pressure, blood sugar values, serum prolactin and cortisol levels were recorded as baseline values.

All patients were monitored with ECG, pulse oximetry, $ETCO_2$ continuously and NIBP intermittently. Patients received study drug 5 mins. prior to induction according to the group. HR, MAP were monitored 1 min. before insertion of the skull-pin and 1, 5 and 10 mins. after skull-pin insertion. Blood sampling was done for blood glucose, serum cortisol and serum prolactin levels 20 mins. before induction of anaesthesia and 30 mins. after skull-pin insertion.

Dexmedetomidine[14,15] is a highly selective and potent α-2 adrenoreceptor agonist. It is a pure α-2 adrenergic receptor agonist (α1:α2 ratio-1:1600) than clonidine,[21,22,23] which has only less selective agonist activity (α1:α2 ratio 1:200).

The efficacy of dexmedetomidine in attenuating haemodynamic and neuroendocrinal stress response (increase in heart rate and increase in mean arterial pressure)[5,14,24,25,26] (increase in blood glucose, serum cortisol, serum prolactin)[27,28,29] to Mayfield skull-pin insertion is evaluated. This study demonstrated that preoperative administration of single bolus of dexmedetomidine attenuates increase in HR and MAP in neurosurgical patients during skull-pin insertion. The concomitant modulation of increases in plasma cortisol, prolactin and glucose concentrations suggests that this haemodynamic effect mediated by the sympatholytic properties of dexmedetomidine.[13,18,19,20] The haemodynamic effects of dexmedetomidine are predictable from the pharmacology of alpha-adrenoreceptor agonists.[13,19,15]

The hypotensive and bradycardia effects of dexmedetomidine[15,14,16,18] are presumably mediated by the sympatholytic effect of dexmedetomidine, which is confirmed in our study by significant reduction of cortisol, prolactin and glucose levels in the dexmedetomidine group compared with NS groups.

CONCLUSION

The study conclude that dexmedetomidine 1 mcg/kg given slowly over 10 mins. intravenously 5 mins. prior to induction attenuates the haemodynamic and neuroendocrinal responses to skull-pin head holder application.

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