

# The Relative Effects of Dexmedetomidine and Propofol on Cerebral Blood Flow and Brain Oxygenation



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## Background

Dexmedetomidine is a promising perioperative sedative. However, it can cause cerebral vasoconstriction without a concomitant reduction in cerebral metabolic oxygen consumption, thus potentially compromising safety in patients with neurological diseases. We therefore tested the hypothesis that dexmedetomidine is non-inferior to propofol with regards cerebral blood flow velocity and brain oxygenation.

## Methods

44 Patients were randomly assigned to either dexmedetomidine or propofol sedation during deep-brain stimulator insertion [Table-1]. Both drugs were given using target-control infusion. Propofol was targeted to a plasma concentration of 2-3 µg/ml and dexmedetomidine to 0.8-1.0 ng/ml. Cerebral blood flow velocity was measured with transcranial Doppler, and brain oxygenation was assessed with infrared spectroscopy.

## Results

The relative effects of dexmedetomidine and propofol on cerebral blood flow velocity was 0.94 (90% CI: 0.84, 1.05), P = 0.011]. Similarly, the relative effects of dexmedetomidine and propofol on brain oxygenation was 0.94 (90% CI: 0.84, 1.05, P = 0.011). Both blood flow and oxygenation during dexmedetomidine administration were significantly non-inferior to propofol [Tables 2-3]. Therefore effects of dexmedetomidine were similar to those of propofol on cerebral perfusion pressure. However, dexmedetomidine was superior to propofol on observer assessment of alertness and sedation.

## Conclusion

The effect of dexmedetomidine is non-inferior to propofol on cerebral blood flow velocity and brain oxygenation during awake deep-brain stimulator insertion.

**Table 1. Demographics and baseline characteristics for dexmedetomidine and propofol patients**

Factor	Dexmedetomidine (N = 23)	Propofol (N = 21)	STD
Age, years.	65 ± 7	63 ± 10	0.22
Gender, Female, N (%)	5 (22)	3 (14)	0.19
Race, Caucasian, N (%)	21 (91)	21 (100)	-0.44
BMI	26 ± 5	29 ± 6	-0.39
ASA Status			0.32
II	5 (25)	8 (40)	
III	15 (75)	12 (60)	
Medical history, yes, N (%)			
Parkinson	16 (70)	16 (76)	-0.15
Essential tremor	8 (35)	6 (29)	0.13
Use of drug, yes, N (%)			
Antiparkinson	20 (87)	16 (76)	0.28
Antihypertensive	13 (57)	12 (57)	0.01
Lead implantation placements, N (%)			-0.42
STN	16 (70)	16 (76)	
VIM	4 (17)	1 (5)	
Thalamic	3 (13)	4 (19)	
Year of Surgery, N (%)			0.13
2011	5 (22)	4 (19)	
2012	11 (48)	13 (62)	
2013	7 (30)	4 (19)	
Baseline measurements			
FVm, cm/sec	48 ± 9	49 ± 11	-0.12
Pulsatility index	1.0 [0.9, 1.2]	0.9 [0.8, 1.1]	0.52
Cerebral Perfusion pressure	47 [40, 61]	52 [48, 62]	-0.44

ASA = American Society of Anesthesiologists; STD = standardized difference; BMI = body mass index; FVm = cerebral blood flow velocity; STN = subthalamic nucleus; VIM = ventrointermediate nucleus of thalamus

**Table 2. Effect of dexmedetomidine versus propofol on primary outcomes of mean cerebral blood flow velocity and brain oxygenation using one-sided noninferiority tests.**

Primary outcome*	Dexmedetomidine	Propofol	Ratio of geometric means (90% CI)	
			(Dexmedetomidine vs. Propofol)	P
Mean cerebral blood flow velocity, cm/sec	40 [32, 47]	45 [37, 48]	0.94 (0.84, 1.05)	0.011
Brain oxygenation, %	73 [70, 75]	74 [70, 77]	0.99 (0.96, 1.02)	<0.001

\*Both primary outcomes followed a log-normal distribution, so a log transformation was implemented. The corresponding effect size was thus specified as ratio of geometric means.

**Table 3. Perioperative measurements for dexmedetomidine and propofol patients (N=44)**

Variable	Dexmedetomidine (N = 23)	Propofol (N = 21)	STD
<b>Mean cerebral blood flow, cm/sec</b>			
Preoperative	47.9 ± 9.3 <sup>b</sup>	49.1 ± 11.1 <sup>a</sup>	-0.12
First peak dose	40.5 ± 7.9 <sup>e</sup>	45.4 ± 17.0	-0.37
Lowest dose	40.7 ± 7.7 <sup>b</sup>	43.1 ± 10.7 <sup>b</sup>	-0.25
Second peak dose	44.3 ± 13.8 <sup>e</sup>	48.2 ± 13.9 <sup>b</sup>	-0.28
PACU	46.7 ± 10.5	55.0 ± 18.1 <sup>b</sup>	-0.56
<b>Mean arterial pressure, mmHg</b>			
Preoperative	89.7 ± 16.1 <sup>d</sup>	99.5 ± 11.3 <sup>b</sup>	-0.70
First peak dose	89.8 ± 12.4 <sup>a</sup>	80.9 ± 12.6	0.71
Lowest dose	83.5 ± 9.8 <sup>a</sup>	89.0 ± 10.0 <sup>b</sup>	-0.56
Second peak dose	82.5 ± 8.9 <sup>e</sup>	79.9 ± 13.0 <sup>b</sup>	0.23
PACU	79.4 ± 11.6 <sup>e</sup>	87.1 ± 15.2 <sup>e</sup>	-0.57
<b>Systolic blood pressure, mmHg</b>			
Preoperative	133.7 ± 21.5 <sup>d</sup>	133.7 ± 33.0 <sup>b</sup>	0.00
First peak dose	122.0 ± 15.4 <sup>a</sup>	107.7 ± 27.3	0.65
Lowest dose	113.3 ± 13.0 <sup>a</sup>	124.6 ± 15.7 <sup>b</sup>	-0.78
Second peak dose	115.0 ± 12.9 <sup>e</sup>	110.2 ± 14.7 <sup>b</sup>	0.35
PACU	113.4 ± 14.9 <sup>e</sup>	120.7 ± 17.5 <sup>e</sup>	-0.45

Standardized difference (STD): the difference in means or proportions divided by the pooled standard deviation.

N missing values: superscripts a=1, b=2, c=3, d=4, e=6, f=9.