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PERFUSION INDEX (PI) AS AN EARLY PREDICTOR OF NEURAXIAL BLOCKADE DURING SPINAL ANAESTHESIA IN CAESAREAN SECTION

Gynecology

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ABSTRACT

Background and Aims: The perfusion index (PI) which is the ratio of the pulsatile blood flow to the non-pulsatile or static blood in the peripheral tissue, represents a measure of peripheral perfusion obtained from pulse oximeter of Masimo SET(signal extraction technology) type. In spinal anaesthesia sympathetic blockade typically occurs before the onset of anaesthetic (sensory and motor) effects. Sympathetic blockade causes local vasodilatation leading to rise in PI in legs. So PI via toe can detect proper spinal anaesthesia.

Methods: Two probes placed one on index finger and other on 2nd toe, to measure the PI in 30 elective LSCS. Intrathecal 12.5mg hyperbaric bupivacaine was administered in sitting position then immediately patiens were made to lie supine with 15 degree left lateral tilt to avoid supine hypotension of pregnancy. PI via finger, toe and percentage changes over base line were calculated and analysed before and after spinal anaesthesia.

Results: PI via toe increased significantly($p<0.0001$) soon after administration and reached a plateau within 5 min, whereas PI finger did not change much. Median anaesthesia levels by cold test were T6 at 15 min. In 2 failed cases no change in baseline PI.

Conclusion: our results suggests that PI is early and non-invasive indicator of proper spinal anaesthesia onset. However final results will be shown at the time of presentation

KEYWORDS

Perfusion Index, Pulse Oximeter, Signal Extraction Technology, Supine Hypotension, Spinal Neuraxial Blockade, Vasodilatation, Sympathectomy.s

Introduction

Perfusion Index (PI) which is the ratio of the pulsatile blood flow to the non-pulsatile or static blood in the peripheral tissues. PI represents an indirect measure of peripheral perfusion that can be continuously and non-invasively obtained from the pulse oximeter of Masimo SET (signal extraction technology) . which works based on the differential absorption of infra red (940nm) rays by pulsatile and nonpulsatile or static blood in tissues. Normal range is from 0.02% (very feeble pulse strength) to 20% (very strong pulse strenght).

Early detection of proper onset of spinal that too objectively had been a dilemma for anaesthesiologists. Anaesthesiologists traditionally detect onset by checking for sensory loss by cold test or asking pt to raise limbs or by rise in temperature. As we all know spinal anaesthesia causes sensory, motor and sympathetic blockade. as sympathetic fibres are myelinated and small, so sympatholysis typically occurs before the anaesthetic effects(sensory & motor blockade). So immediately after the intrathecal administration of local anesthetic there will be lumber sympatholysis which will result in vasodilatation that in result will lead to increased tissue perfusion in the lower part of body below the level of neuraxial blockade. It will cause rise in PI value at toe(blocked) while there will be no change in the PI value at finger. Also there will be no rise in PI at toe in case of failure of blockade. This study was aimed at weather rise in PI at toe can be an early and objective predictor of onset of spinal blockade in LSCS cases.

METHODS

After the approval of the study from the institutional ethical committee (jhalawar medical college and hospital, jhalawar). Parturients undergoing elective caesarean section deliverywere included. A written informed consent was obtained from each parturient. The exclusion criteria were emergency cases, placenta preavia, preeclampsia, cardiovascular ds, cerebrovascular ds, morbid obesity (BMI≥30), gestational age <36 or >41 wks , and if any contraindication to spinal anesthesia. After exclusion and parturients who did not consent a total of 30 partureints between age group 20-35 years were included in our study.

Study Protocols- each parturient was given an infusion of 500ml RL for prehydration before spinal . after that also RL was infused until the end of surgery. Standard monitoring with ECG,NIBP, HR and SpO2 with PI by pulse oximeter of Masimo type was done. Two pulse oximetry probes were placed both one on index finger and other on 2nd toe to measure the PI before and after the SAB. After recording the baseline PI values at toe and finger attending anaesthesiologist performed spinal anesthesia in usuall manner using 12.5 mg hyperbaric bupivacaine in sitting position. Immediately after that patient were made to lie in supine position with a 15 degree left lateral tilt to prevent supine hypotension syndrome of pregnancy. Attandinding anaesthesiologist who was not allowed to see the PI via toe, checked maximum cephalad anesthetic level by cold sensory test (using spirit swab)at 5min, 10min and 15 minafter the spinal anesthesia given. If there was failure of spinal onset then also it was declared at 15 min. He was allowed to treat hypotension(defined as decrease in SAP≥30% from the baseline) by 50mcg phenylephrine iv bolus and bradycardia(HR<55 bpm) by atropine 0.5mg iv bolus as a rescue medication. Al vital and PI at toe and figer was recorded at at fixed time interval until the end of surgery.

Results/statistical analysis

Patients characteristics and obstetrics characteristic data are presented as mean (range) in the table given below(n=30)

Age(years)	26(20-35)
Height(cm)	148(142-154)
Weight(kg)	52(48-64)
Gravidity	2(0-4)
Parity	1(0-3)
Gestational age(weeks)	38(36-41)
Indication for CS(n) Repeat/twin/primi breech/others	18/1/2/9
Neonatal Wt(Kg)	2.4(2.2-3.5)

PI values before and changes in PI value over the time after spinal anesthesia at toe and finger with median range of sensory block (by cold test) and motor block(Bromage score) for level of anesthesia (n=28)

Time	Mean(±1SD) PI Values		Level of anaesthesia	
	Finger	Toe	Median (range) Level of sensory block	Mean (±1SD) Bromage score
Base line	6.21(±1.78)	2.96(±1.46)	0	0
SAB	6.21(±1.78)	2.96(±1.46)	0	0
5min	4.83(±1.94)	8.43(±2.61)	T10(T8-T11)	1.6

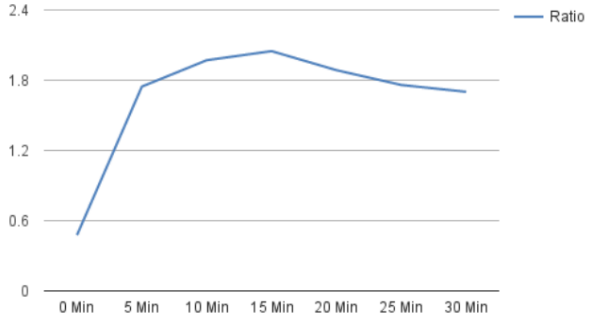
10min	5.47(±2.98)	10.78(±4.03)	T6(T6-T9)	2.9
15min	5.57(±2.62)	11.40(±3.99)	T6(T4-T6)	3
20min	6.30(±2.95)	11.88(±4.64)	T6	3
25min	6.77(±3.39)	11.90(±4.84)	T6	3
30min	7.02(±3.49)	11.93(±5.01)	T6	3

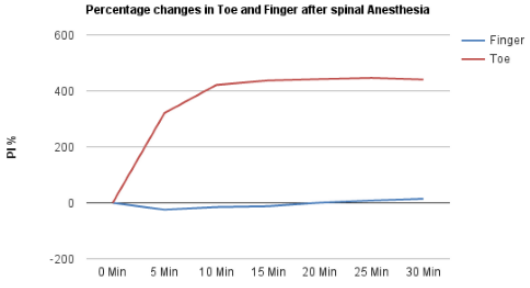
Percentage change in PI value from base line mean(±1SD) after the spinal anesthesia over the time (n=28)

Time	PI Values Mean(±1SD)		% Change in PI values from BL Mean (±1SD)		Median (range) Level of sensory block	Mean (±1SD) Bromage score
	Finger	Toe	Finger	Toe		
Base Line	6.21 (±1.78)	2.96 (±1.46)	0	0	0	0
SAB	6.21 (±1.78)	2.96 (±1.46)	0	0	0	0
5 Min	4.83 (±1.94)	8.43 (±2.61)	23.72 (±22.28)	321.20 (±364.88)	T10 (T8-T11)	1.6
10 Min	5.47 (±2.98)	10.78 (±4.03)	14.56 (±22.26)	421.39 (±433.75)	T6 (T6-T9)	2.9
15 Min	5.57 (±2.62)	11.40 (±3.99)	11.67 (±22.37)	437.00 (±422.53)	T6 (T4-T6)	3
20 Min	6.30 (±2.95)	11.88 (±4.64)	0.64 (±30.55)	442.00 (±406.14)	T6	3
25 Min	6.77 (±3.39)	11.90 (±4.84)	8.94 (±40.34)	447.00 (±411.10)	T6	3
30 Min	7.02 (±3.49)	11.93 (±5.01)	15.11 (±52.39)	444.00 (±397.64)	T6	3

changes in ratio(toe/finger) of PI value mean(±1SD) before and after spinal anesthesia over the time

Time	Toe/Finger Ratio (±1SD)	Median (range) Level of sensory block	Mean (±1SD) Bromage Score
Base Line	0.47(±19.37)	0	0
SAB	0.47(±19.37)	0	0
5 Min	3.46(±25.76)	T10(T8-T11)	1.6
10 Min	18.56(±18.31)	T6(T6-T9)	2.9
15 Min	28.09(±30.09)	T6(T4-T6)	3
20 Min	18.66(±39.90)	T6	3
25 Min	19.59(±55.13)	T6	3
30 Min	16.45(±39.86)	T6	3





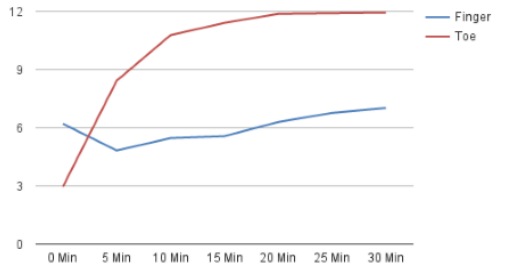


Table : Distribution of Heart Rate in different time Periods

	N	Mean	Std. Deviation	F value	P value
Baseline	30	91.9667	10.42042	2.958	0.035(S)
5 Min	30	93.8000	15.40354		
10 Min	30	101.6000	12.97106		
15 Min	30	94.0000	15.03788		
Total	120	95.3417	13.93532		

Table : Distribution of PI Finger and Toe in different time Periods

Descriptives						
		N	Mean	Std. Deviation	F Value	P value
PI Finger	Baseline	30	6.3500	1.75593	1.808	0.150 (NS)
	5 Min	30	4.9200	1.96001		
	10 Min	30	5.6300	2.99277		
	15 Min	30	5.7200	2.62000		
	Total	120	5.6550	2.40880		
PI Toe	Baseline	30	2.9400	1.49149	44.806	<0.0001 (S)
	5 Min	30	8.6100	2.59726		
	10 Min	30	11.0000	4.01798		
	15 Min	30	11.5500	4.04677		
	Total	120	8.5250	4.67202		

Table : Distribution of SBP & DBP in different time Periods

		N	Mean	Std. Deviation	F Value	P value
SBP	Baseline	30	127.6000	13.68513	3.869	0.011 (S)
	5 Min	30	116.6000	16.18556		
	10 Min	30	117.8000	14.47566		
	15 Min	30	121.3000	9.86163		
	Total	120	120.8250	14.23669		
DBP	Baseline	30	79.0000	9.14255	6.741	<0.0001 (S)
	5 Min	30	70.4000	15.02550		
	10 Min	30	66.6000	12.23224		
	15 Min	30	76.5000	10.49384		
	Total	120	73.1250	12.76192		

Table : Distribution of Mean Level of Anesthesia in different time Periods

		Group				Total	Chi Sq	P value
		Baseline	5 Min	10 Min	15 Min			
Mean Level of Anisthisia	T0	30	0	0	0	30	264.545	<0.0001 (S)
		100.0%	0.0%	0.0%	0.0%	25.0%		
	T10	0	9	0	0	9		
		0.0%	30.0%	0.0%	0.0%	7.5%		
	T11	0	6	0	0	6		
		0.0%	20.0%	0.0%	0.0%	5.0%		
	T12	0	3	0	0	3		
		0.0%	10.0%	0.0%	0.0%	2.5%		
	T4	0	0	0	3	3		
		0.0%	0.0%	0.0%	10.0%	2.5%		
	T5	0	0	0	9	9		
		0.0%	0.0%	0.0%	30.0%	7.5%		
	T6	0	0	15	18	33		
		0.0%	0.0%	50.0%	60.0%	27.5%		
	T7	0	0	9	0	9		
		0.0%	0.0%	30.0%	0.0%	7.5%		
	T8	0	3	3	0	6		
		0.0%	10.0%	10.0%	0.0%	5.0%		
	T9	0	9	3	0	12		
		0.0%	30.0%	10.0%	0.0%	10.0%		
Total		30	30	30	30	120		
		100.0%	100.0%	100.0%	100.0%	100.0%		

Results

Time	Mean(± 1SD)PI value		Mean(± 1SD)% Change in PI value from BL		Toe / Finger Ratio
	Finger	Toe	Finger	Toe	
Base Line	6.21 (±1.78)	2.96 (±1.46)	0	0	0.47 (±19.37)
SAB	6.21 (±1.78)	2.96 (±1.46)	0	0	0.47 (±19.37)
5 Min	4.83 (±1.94)	8.43 (±2.61)	23.72 (±22.28)	321.20 (±364.88)	3.46 (±25.76)
10 Min	5.47 (±2.98)	10.78 (±4.03)	14.56 (±22.26)	421.39 (±433.75)	18.56 (±18.31)
15 Min	5.57 (±2.62)	11.40 (±3.99)	11.67 (±22.37)	437.00 (±422.53)	28.09 (±30.09)
20 Min	6.30 (±2.95)	11.88 (±4.64)	0.64 (±30.55)	442.00 (±406.14)	18.66 (±39.90)
25 Min	6.77 (±3.39)	11.90 (±4.84)	8.94 (±40.34)	447.00 (±411.10)	19.59 (±55.13)
30 Min	7.02 (±3.49)	11.93 (±5.01)	15.11 (±52.39)	444.00 (±397.64)	16.45 (±39.86)

Mean(± 1SD) Heart Rate	Mean (± 1SD) MAP	Median (Range) Level of Sensory block	Mean (± 1SD) Bromage Score
89.81(±8.38)	91.54(±10.39)	0	0
89.81(±8.38)	91.54(±10.39)	0	0
84.81(±8.38)	92.45(±15.78)	T10(T8-T11)	1.6
81.45(±11.94)	100.45(±3.30)	T6(T6-T9)	2.9
82.27(±7.51)	93.27(±15.08)	T6(T4-T6)	3
80.00(±9.72)	98.63(±15.46)	T6	3
78.72(±5.76)	104.09(±13.88)	T6	3
79.54(±7.50)	100.36(±17.57)	T6	3

In all the cases of successful onset PI via the toe increased significantly ($P<0.0001$) soon after the induction of spinal anaesthesia and reached a plateau within 5 min, while on the other hand there was no or little change in PI via the finger. [fig. 1]

As a result toe to finger PI ratio increased significantly [fig. 2]

In 2 cases of failed spinal (at 15 min) blockade out of 30 there was no change in PI values at finger or toe.

The median anaesthetic level checked by cold test at 5min, 10min and 15minafter spinal were T10(rangeT8-T11), T6(rangeT6-T9) and T6 (rangeT4-T6) respectively.

There was significant (approx 300%) increase in percentage change over the base line values of PI via toe within 5min after spinal. [fig. 3]

Conclusion

Spinal anaesthesia produces differential distribution of blood flow to blocked and/or unblocked areas. PI at toe increases in response to vasodilatation after spinal anaesthesia which typically occurs before and more quickly than the development of anaesthetic effects

So it will be useful/valuable to put one probe at toe to detect early onset of spinal blockade objectively and non-invasively that too with good sensitivity.

Detection of a spike in PI is an indicator of proper onset while no change is an early warning of anaesthetic failure.

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