Original Research Paper

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Anesthesiology

PERFUSION INDEX AS A PREDICTOR OF HYPOTENSION FOLLOWING SPINAL ANESTHESIA IN LSCS PATIENTS

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KEYWORDS :

INTRODUCTION

Spinal anaesthesia induced hypotension during caesarean delivery is the result of decreased vascular resistance due to sympathetic blockade and decreased cardiac output due to pooling of blood in the blocked areas of the body. Although baseline volume status is known to affect the degree of hypotension, baseline peripheral vascular tone may also have influence. Peripheral vascular tone has been shown to be decreased in parturients at term, especially those who are multiparous.

Decreased peripheral vascular tone results in blood volume being trapped m the extremities even before administering spinal anaesthesia , and the sympathetic blockade with spinal anaesthesia would further increase the blood pooling. Therefore, parturients with low baseline vascular tone may be at an increased risk of developing hypotension after spinal anaesthesia .

Pregnant women are more sensitive to local anaesthetics, less responsive to Va SOpreSSOrS and have a low mean arterial pressure (map) at term nelirax -ial R blockade for lscs.

Perfusion index(pi) is defined as the ratio of pulsatile blood flow to non-pulsatile blood flow in the peripheral vascular tissue, measured using a pulse oximeter (co oximeter) masimo radical based on the amount of infra red light absorbed non invasively. Pi can be used to assess the perfusion dynamics due to changes in peripheral vascular tone as non invasive method to detect the likelihood of development of hypotension following subarachnoid block . This study was aimed to examine whether baseline pi in parturients correlated with the degree of hypotension during spinal anaesthesia for caesarean delivery and whether baseline pi could predict hypotension.

AIM OF THE STUDY

Primary Aim:

Patients undergo lower segment caesarean section under sub arachnoid block, this study aims to investigate the correlation between baseline perfu sion index(non invasive dynamic monitoring) and the incidence of hypoten sion following sub arachnoid block in lscs patients .

Secondary Aim:

To prevent complications due to sub arachnoid block like hypotension, bradycardia leading onto cardiac arrest.; To prevent hypotension induced nausea and vomiting.

PRINCIPLE OF PERFUSION INDEX

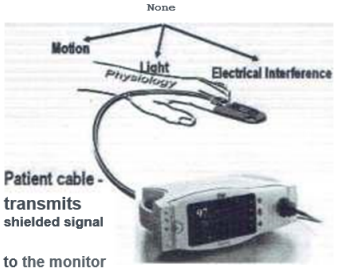
Perfusion index is a relative assessment of the pulse strength at the monitoring site. Pi displays ranges from 0.02 %(weak pulse strength) to 20% (very strong pulse strength). It is a numerical value that indicates the strength of infrared signal returning from monitoring site.pi is a relative number and varies between monitoring sites from patient to patient, as physiological conditions vary, changes in the sympathetic nervous tone affect smooth muscle tone, thereby altering the levels of perfusion.

Perfusion index is defined as the ratio of ac (pulsatile) to de (non pulsatile) components of the infrared signal correspond to pulsatile and non pulsatile amounts of blood. As the pulsatile (arterial) flow is the only portion affected with vasoconstriction and vasodilatation, peripher a l pi has been considered as a numerical non invasive measure of peripheral perfusion . Ppi decreases in states of hypo perfusion due to decreased pulsatile component of blood flow. A ppi of <1.4 is a marker of hypo perfusion.

In our study masimo set* (signal extraction technology) pulse oximetry was used as it is a new and fundamentally distinct method of acquiring , processing and reporting arterial oxygen saturation and pulse rate. It enables the power of adaptive filters to be applied to real time physiologic monitoring by utilizing properietary techniques to accurately establish a noise reference in the detected physiologic signal, thus enabling the direct calculation of a,rterial oxygen saturation and pulse rate.

Because it is not bound by the red over infrared ratio approach, the masimo set system eliminates the problems of :motion artefact, low pp& most low signal to noise situations. This greatly extends the utility of spo2 in high motion, low signal and noise intensive environments .

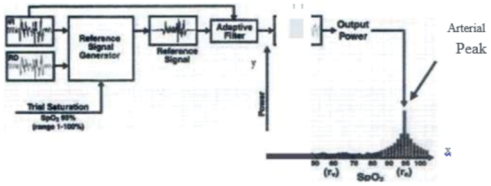
Masimo sets most powerful algorithm 1s discrete saturation transformation.



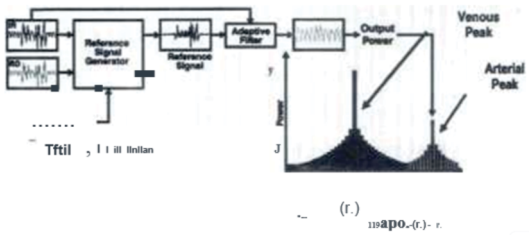
Sensors .. improved design shields noise from light and and electrical absorbs interference noise from motion.

Signal Processing • uses adaptive filters to distinguish between noise signals and arterial signals; and reads 10X smaHer pulse amplitudes.

All algorithms are based on assumptions. More assumptions make the algorithm weaker. Dst makes only one assumption that the arterial blood has a higher oxygenation than venous making it the most powerful pulse oximeter.



The Discrete Saturation Transform (DST) without motion



OST makes only one assumpUon :- that arterial blood has a higher oxygenation than venous - mak:Jng it the most powetful pulse oxfmeby algomhm.

The discrete saturation transform algirithm allows one to separate and, consequently calculate the optical density ratios that correspond to both the arterial oxygen saturation (r a) and an estimate to the venous oxygen saturation ® v). These optical densities are not known beforehand but are required to obtain the appropriate reference signals for adaptive noise cancellation. Every optical density ratio, corresponding to the patients physiological range (spo2 1% to 100%) must be considered. Therefore the dst algorithm not only uses a noise reference signal, but a whole family of reference signals.each reference signal is used in the adaptive noise cancellation process and each yields

information the oxygen saturation content of the physiological signals.

If : i rd =s rd+n rd
then: $=n_{rd}-n_{ir}\, r_a$
i ir= S ir+n ir
i rd - (I ir*r a)= S rd +nrd]-[Si fa +nir fa]
r a =srd/sir
substituting Sir ra for Srd ,we get:
s rd= r a*s ir
Srd -ra *sir=N' (noise reference)

A family of reference signals n®, is generated similar to that o f a noise reference signal .the reference signal, as discussed earlier is the difference between the physiologic signal due to red light (ird) and the product of an arbitrary optical density ratio (r) and physiologic signal due to infrared light (ird), although there is a family of reference signals, based on the selection optical density ratio, there are only three distinct cases to consider.

If one selects an optical density ratio that does not correspond to either arterial or venous oxygen saturation (easel), the reference signal consist of a desired signal portion and undesired signal portion. In the adaptive noise cancellation process, such a signal will not only remove undesired signal portion of the physiologic signal, but also remove the desired signal portions .

When an optical density ratio that corresponds to the venous oxygen saturation is selected (case 2) the reference signal only contain signal portion. Therefore the output of the adaptive noise canceller will consist of the undesired signal portion only, similarly, when an optical density ratio that corresponds to the arterial oxygen saturation is selected (case3) the reference signal only contain noise portions. Therefore the output of adaptive noise canceller will consist of the desired signal portion only

$$i_{rd}=s_{rd}+n_{rd}\ ,i_{ir}=s_{ir}+n_{ir}$$

$$s_{rd}=r_a\, s_{ir} \qquad n_{rd}=r_v\, n_{ir}$$

Reference signal n'(r)=irct-r iir

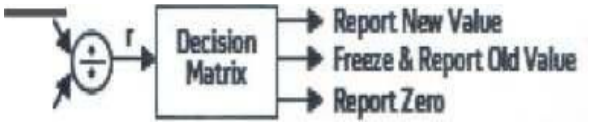
Case 1: $r=r_a,r_v$ n'(r)=(ra_r)sir+(rv- r) nir r:optical density ratio

Ra: arterial optical density ratio
Rv=venous optical density ratio

Case2:r=rv $n'(r_v)=(r_a-r_v)s_{ir}$

Case 3:r=ra $n(r_a)=(r_v-r_a)n_{ir}$

for each selected value of the optical density ratio, the corresponding reference signal is calculated and subsequently processed through an adaptive noise canceller.



The attempt to treat the "symptom "rather than the "core problem "does not provide clinicians with continuous real-time information and can be unreliable in critical medical situation.

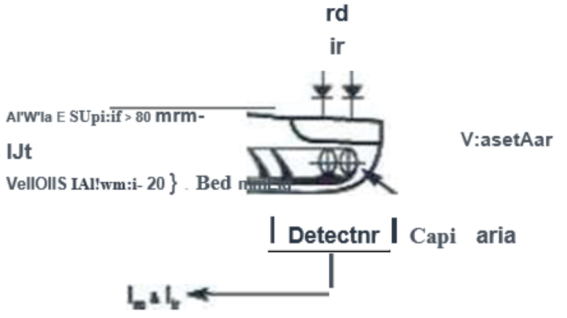
MASIMO SET PULSE OXIMETRY

Radical-7 Pulse CO-Oximeter

Masimo signal extraction technology rejects the conventional wisdom and begins with an understanding that during patient motions the venoms blood. Being at a relatively low pressure is quite susceptible to the local effects of perturbation during motion.

Considering the finger for example, the venous blood in the vascular bed will be of interest .in addition, the venous blood is a strong absorber of light. Hence, it can represent a significant contributor to the total optical density during motion episodes.Futhermore, the venous blood saturation is normally lower than the arterial blood saturation. This explains why saturation values tend to drop in conventional pulse oximeter systems during episodes of patient motion.

During routine patient motions (shivering, wavmg, tapping, etc) the resulting noise can be quite substantial and can easily overwhelm a conventional ratio based oximetry system. Having identified the venous blood as a significant contributor to noise during motion, it follows that if the noise reference corresponds to the venous components could be measured, then an adaptive noise canceller might be utilized to cancel its contribution.



In summary,the procedure for determining the arterial oxygen saturation utilizing masimo set processing is as follows:

1) Sweep all optical density ratios that correspond to oxygen saturation of 1% to 100%.
2) Compute the reference signal for each optical density ratio.
3) Measure the output power of the adaptive noise canceller for each reference signal.
4) Identify the appropriate peak in the dst transform that corresponds to the arterial oxygen saturation. (Largest spo2 value).

REVEIW OF LITERATURE

Historically the use of perfusion index as a predictor of tissue perfu sion I hypotension dates back to 2002 in a study done by lima ap/bakker .j.et.al. Lima ap/bakker.j. et.al did a study on the use of perfu sion index derived from the pulse oximetry signal as a non invasive indicator of perfusion.

The capillary refill time, peripheral perfusion index and arterial oxygen saturation were measured in one group. Capillary refill time, peripheral perfusion index, arterial oxygen saturation, central to toe temperature difference and haemodynamic variables were measured in another group. The authors concluded that the peripheral perfusion index distribution is skewed and can be used to monitor perfusion in critically ill patients.

Toyama, matsuoka et.al did a prospective study, where the perfusion index derived from a pulse oximeter can predict the incidence of

hypotension during spinal anaesthesia for caesarean delivery. Parturients undergoing elective lscs were enrolled. The correlation between perfusion index and degree of hypotension, and also the predictability of spinal anaesthesia induced hypotension during caesarean delivery by pi was investigated. The authors concluded that higher baseline pi was associated with profound hypotension and baseline pi could predict spinal induced Hypotension during caesarean delivery.

Devika rani dungappa,mps lokesh et al. Did a prospective study based on perfusion index as a predictor of hypotension following spinal anaesthesia in lscs patients. The author divided the parturients undergoing lscs under subarachnoid block based on baseline perfusion index into 2 groups.group 1 with a pi <3.5 and group 2 with a pi >3.5. A total of126 parturients were included in the study. The author concluded that the baseline pi of >3.5 is associated with high incidence of hypotension than the group with pi< 3.5.

Hauss r,bein b et al did the study on heart rate variability predicts severe hypotension after spinal anaesthesia for elective caesarean delivery. In this study a total_ of 100 parturients were studied. Retrospectively 30 patients heart rate variability was analysed based on lowest systolic blood pressure after sub arachnoid block .70 patients were studied prospectively, assigned into one of the 2 groups by their low to high frequency ratio (lf/hf) before sub arachnoid block.sensitivity and specificity of lh/hf for prediction of decrease of systolic blood pressure greater than 20% of baseline were tested. The author concluded that the heart rate variability analysis before spinal anaesthesia may predict hypotension after sub arachnoid block with high sensitivity and specificity .this indicates that the predictive value of If/hf is superior to established predictors.

Yakose m, mihae et al studied the predictive ability of non invasive hemodynamic parameters for hypotension during caesarean section.

Hypotension was predicted by pulse oximetry parameters, such as perfusion index and pleth variability index, heart rate and ratio of If/hf component of heart rate variability .logistic regression revealed heart rate to be the only independent predictor of hypotension associated with spinal anaesthesia.

Ginosar .y. Weiniger et al studied about pulse oximeter perfusion index as an early indicator of sympathectomy after epidural anaesthesia. The author hypothesised that pulse oximeter pi provides an earlier and clearer indication of sympathectomy following epidural anaesthesia than skin temperature and arterial pressure. A total of 40 patients received lumbar epidural catheters. Each patient received lOml of 0.5% or 0.25% bupivacaine . Pi in the toe, mean arterial pressure, and toe temperature were assessed at baseline, 5,10,15,20 minutes following epidural anaesthesia. Clinically evident sympathectomy criteria was defined as 100% increase in perfusion index , 15% decrease in mean arterial pressure, 1 degree increase in toe temperature . The authors concluded that perfusion index was an earlier and clearer, more sensitive indicator of sympathectomy.

Frohlich md et al studied on baseline heart ratemaypredict hypotension after spinal anaesthesia in prehydrated obstetrics patients. In this prospective study blood pressure and heart rate were recorded with the patient in lateral supine position and after standing up. After bupivacaine spinal anaesthetic, blood pressure was obtained every two minutes for 30 min .

Hemodynamic parameters were correlated with epehdrine requests. The authors' concluded that the baseline hr may be a predictor of obstetric spinal hypotension.

Higher baseline heart rate, possibly reflecting a higher sympathetic tone, may be a useful parameter to predict post spinal hypotension.

Kinsella s m ,e t al studied about the advance predictors of hypotension at caesarean delivery under sub arachnoid block . Cardio vascular system response to supine ivc compression might predict hypotension risk during elective caesarean delivery under subarachnoid block .27 women were investigated before lscs by taking blood pressure and heart rate measurement for 5 minutes in left lateral position , 5 minutes in supine position and one further reading in left lateral position and . Sitting position. A pre op supine stress test, combining an increase in maternal heart rate of greater than 10 beats /min or leg flexion movements while supine was analysed. A positive sst was more frequent in those with severe systolic hypotension .the positive test was associated with twice as much vasopressin use.

Mowafl ha et al did a study on the efficacy of perfusion index asan indicator for intravascular injection of epinephrine containing epidural test dose in propofol anaesthetised adults. Fourty patients scheduled for elective general surgeryunder total intravenous anaesthesia were randomised to receive either 3ml of lidocaine 15mg/ml with epinephrine 5mic/ml or 3ml of saline iv (n=20 each). Heart rate/sbp/pi were monitored for 5 min after injection of the test dose resulted in average maximum pi decrease of 65%. Maximal increase in heart rate was 19+-8 bpm ans sbp were 17+-7mm of hg .they concluded that pi is a reliable alternative to conventional hemodynamic criteria for detection of intravascular injection of epidural test dose in propofol anaesthetised adult patients.

Park ge et al. Did a study on the effects of varymg volumes of crystalloid administration before caesarean delivery on maternal hemodynamics and colloid osmotic pressure. The dose response effect of varying amounts of crystalloid volume prior to spinal anaesthesia were studied. They measured maternal hemodynamic variables and maternal and fetal colloid osmotic pressure in 3 groups of healthy parturients receiving spinal anaesthesia. Fifty five parturients were randomised to receive 10,20,30ml/kg of crystalloid volumes prior to induction of sab.they measured mean arterial blood pressure (map), cardiac index (ci) and systemic vascular resistance index (svri). Using thorasic impedence monitoring until delivery.maternal and neonatal • colloid osmotic pressurewere measured. All groups showed decline in map&svri from baseline at 5 minutes after spinal anaesthesia. The 20ml,30ml/kg group showed a larger decline in cop than 1Oml/kg group. They concluded that the 30ml/kg group had no significant maternal hemodynamic alterations/ ephedrine requirement after spinal anaesthesia and had no added benefit.

Ajne et al did a study on the contribution of endogenous endothelin - 1 to basal vascular tone during normal pregnancy and pre eclampsia.three groups were studied. Healthy non pregnant women,normal pregnant women and women with preeclampsia . Forearm blood flow was measured by venous occlusion plethysmography during intraarterial infusion of phosphoramid on, an endothelin converting enzyme for 60 minutes, followed by co infusion with endothelin - 1 for 30 minutes.the vascular senstivity to endothelin -1 is not altered during normal pregnancy in contrast to pre eclamptic pregnancy, where no effect of endothelin-1 was seen. Reduced endothelin dependance during pregnancy might be one mechanism behind decrase in pherpheral vascular resistance.

Sakai et al did a comparative study on venous distensibility during normal pregnancy and pre eclampsia.twenty one women with normal pregnancy, twelve women with severe pre-eclampsia, eight women with mild pre -eclampsia were studied during the 3rd trimester/ 6 weeks post delivery. Teh non pregnant women were also studied.venous distensibility was measured using the venous pressure-volume relation in the forearm with a water filled plethesmograph . Venous distensibiltity was greater in normal pregnant women and decreased in pre eclampsia during pregnancy than post partum. These venous abnormalities may contribute to impaired control of hemodynamics in pre-eclampsia during pregnancy .

Hales jr/stephens et al.made observation on a new non- invasive monitor of skin blood flow. A tissue perfusion monitor (tpm) to provide an index of skin blood flow has been developed. This employs photo electric plethesmographic principles to measure changes in the net flux of red blood cells in superficial micro vasculature.the tissue perfusion index (tpi)varies in proportion to skin blood flow.provided local haemoglobin concentration does not change significantly.they concluded that tpi is a reliable index of changes in skin blood flow,but tpm is a more precise monitor, less sensitive to motion artifact.can be used in evaluation of regional nerve blockade/circulatory resusitation after reconstructive surgery and in clinical tsts of neurovascular function.

METHODOLOGY

A study titled as baseline perfusion index as a predictor of hypotension following spinal anaesthesia in lower segment caesarean section was done in institute of obstetrics and gynaecology, madras medical college, Chennai during the period January 20 18 to August 2018.this

study was done after getting; institutional ethical committee clearance and informed written consent from all the patients participated in •this study. Based on previous studies, the study sample for our study was determined as below,

SAMPLE SIZE

n =z2*2*sn*(l-sn)/p*d2
Where, n = sample size, • z=alpha error for two tailed probability at

95%, = 1.96
Sn= 81%=0.81 (ref bja article 111(2):235-41(2013)
D =precision for sn =12%= 0.12
P= prevalence of hypotension =60%=0 .6
n = (1.96)2*2*0.81*(100-81)/0.6*(0.12)2
= 68.4 = 69

70 patients of age group 18 to 35 years belonging to asa1&2 posted for elective lscs participated in this study.

INCLUSION CRITERIA

As a physical status 1 & 2 patients .
Age 18 to 35 years
Elective lower segment caesarean section Who have given valid consent?

EXCLUSION CRITERIA

Not satisfying inclusion criteria.
Patients admitted with advanced cardiac and respiratory insufficiency.
Allergy to local anaesthetics .
Skin infection in lumbar area.
General anaesthesia cases
Eclampsia
Contraindication to spinal anaesthesia
Patient refusal
Lack of written informed consent.

STUDY DURATION

8 months.(December 2017-july2018)

MATERIALS:

Standard monitor to measure HR/SP02/NIBP/TEMPERATURE/ECG.
Masimo monitor for perfusion index .
25g quincke needle

DRUGS:

Inj.Ranitidine 50mg
Inj.Metoclopromide lOmg
Inj.Bupivacaine 0.5%
Inj.Fentanyl
Inj.Epehdrine
Inj.Oxytocin
All the emergency drugs were kept ready.

INTRAVENOUS FLUIDS

Normal saline(n s)
Ringer lactate(rl)

Routine pre operative assessment of all patients was done on the previous day of surgery.all patients were premedicated with inj.ranitidine 50mg and inj.

Metoclopromide lOmg iv one hour prior to elective surgery. Starvation guidelines included npo from night 12.00 am.

After shifting the patients to the operative room on the day of surgery they were randomly allocated into one of the two groups based on their baseline perfusion index in supine position. We hypothsised that parturients with higher baseline perfusion index would have a higher incidence . of hypotension.anticipating equal distribution of baseline pi on either side of cut off point of 3.5 as suggested in a study by toyama.et al. Patients where divided into 2 groups

Group 1 - baseline pi >3.5
Group 2 - baseline pi
=/<3.5 .

Baseline parameters heart rate/nibp/spo2/ecg/temperature/baseline p1 were recorded in supine position by an anaesthesiologist who was not involved in the further intraoperative monitoring of the patient.

Iv access was established in the left upper limb using a 18g cannula.each parturient was prehydrated with 500 ml of ringer lactate over 20 minutes.after prehydration , the baseline values were recorded. Pi was recorded after using masimo radical monitor in the left index finger. While administering central neuraxial blockade , the masimo pulse oximeter was disconnected to prevent observer bias,and spo2 was recorded using a different pulse oximeter. Spinal anaesthesia was performed by the anaesthesiologist blinded to baseline pi. Using quinkes 25g spinal needle in right lateral decubitus position using lOmg of 0.5% hyperbaric bupivacaine with 25 mies of inj fentanyl at 13-14 or 12-3 interspace.

The parturient was returned to supine position with a left lateral tilt of 15degrees to facilitate left uterine displacement. The masimo pulse oximeter was reconnected to monitor the patient till the end of surgery. Oxygen was -given through face mask @41/min. Ringer lactate was administered at lOOml/10 minutes. The level of sensory block was checked 5 minutes after spinal injection with a cold swab.if a t6 sensory block level was not achieved , the parturients were excluded from the study.maximum cephalad spread was checked 20 min after sab.

NIBP/HR/RR/SP02/PI/TEMP were recorded at 2 minute intervals for 20 minutes &then at 5 minute intervals till the end of surgery.adverse effects were noted and treated accordingly.

Hypotension was defined as decrease in mean arterial pressure <65mm of hg, and was treated with lOOml of ringer lactate and a 6mg bolus dose of inj.

Epedrine . The first 60 minutes following spinal anaesthesia was considered for anaesthesia induced hypotension.

Bradycardia was defined as heart rate of <55 beats/min and was treated with inj.atropine 0.6mgiv bolus.apgar scores were recorded at 1st and 5th minute by paediatrician. Inj.oxytocin 10 units was given as uterotonic following baby extraction via infusion.patients reqmnng additional oxytocin/surgical intervention were excluded from the study. Incidence of nausea , vomiting if observed was recorded.

STATISTICAL ANALYSIS:

All data obtained during the study were entered in excel 2009 and statistical analysis was performed using statistical software (spss 21.0). Statistical analysis was performed using chi-square test, independent sample t-test.regression analysis with spearmans correlation co-efficient was done to assess the corellation between baseline perfusion index and hypotension .

Receiver operating characteristic (roe) curve Was plotted for perfusion index and occurance of hypotension.results were defined as statistically significant when the p value was less than 0.05.

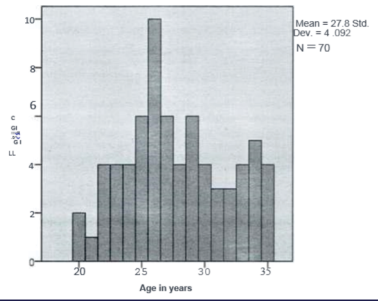
OBSERVATION AND RESULTS

A total of 70 patients were included in the study. The parturients who had an inadequate level of spinal anaesthesia or who underwent rescue measures were excluded from the study.

1. 33 patients were in group I ,
2. 37 patients were in group II for final analysis.

The demographic parameters such as age, weight and height were comparable in two groups. Duration . of surgery was comparable in both the groups.

Distribution of age of the subjects



Age	Group	N	Mean ·	Std. Deviati	P value by 't' test
	< 3.5	33	26.88	4.37	
	> 3.5	37	28.62	3.69	0.075

The median level of cephalad spread of spinal anaesthesia was t4-t6.
baseline perfusion index values in both groups were compared.
The skewed distribution was observed around a pi value of 3.45.
The lowest pi value recorded in our study was 1.4.
The highest pi value in our study was 7.7.

Toyoma et al, found a senstlvity of 81% and specificity of 86% with a baseline cut off perfusion index of 3.5. In our study the baseline was found to be 3.45 and the sensitivity and specificity were 81%&47.9% respectively.

Heart rate was compared between the two groups:
There were no significant changes in heart rate in the 1st 18 minutes of surgery.

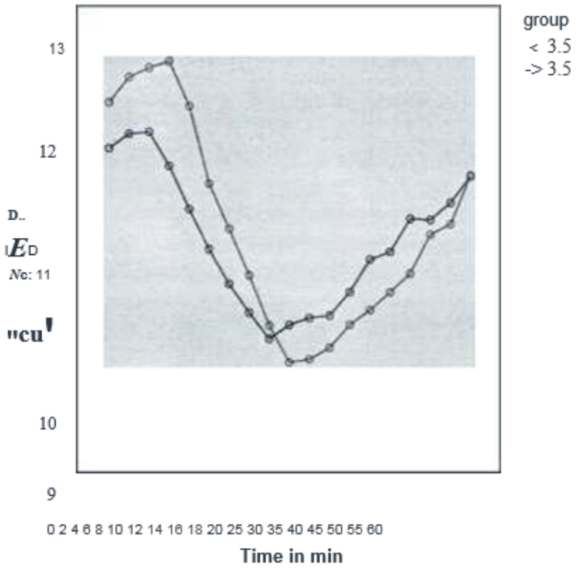
Significant heart rate changes were noted from the 20th min of surgery to the 45th min of surgery in both the groups. More so in the group with baseline pi >3.5.

	Group	N	Mean	Std. Deviation	P value by 't' test
HrO	< 3.5	33	92.61	9.33	0.606
	> 3.5	37	93.73	8.81	
Hr2	< 3.5	33	95.73	10.52	0.973
	> 3.5	37	95.65	8.64	
Hr4	< 3.5	33	97.24	10.09	0.796
	> 3.5	37	97.81	8.22	
Hr6	< 3.5	33	99.48	9.01	0.605
	> 3.5	37	100.59	8.81	
Hr8	< 3.5	33	102.42	8.43	0.254
	> 3.5	37	104.95	9.75	
HrlO	< 3.5	33	106.24	11.28	0.758
	> 3.5	37	107.08	11.31	
Hr12	< 3.5	33	108.42	14.07	0.613
	> 3.5	37	110.05	12.76	
Hr14	< 3.5	33	109.94	14.76	0.538
	> 3.5	37	112.08	14.20	
Hr16	< 3.5	33	109.12	15.17	0.165
	> 3.5	37	114.16	14.87	
Hr18	< 3.5	33	106.42	14.75	0.027*
	> 3.5	37	114.49	15.07	
	Group	**N**	**Mean**	**Std. Deviation**	**P value by 't' test**
Hr20	< 3.5	33	102.61	14.21	0.003*
	> 3.5	37	113.51	15.40	
Hr25	< 3.5	33	100.36	12.74	0.010*
	> 3.5	37	109.35	15.35	
Hr30	< 3.5	33	97.85	11.14	0.009*
	> 3.5	37	105.73	13.30	
Hr35	< 3.5	33	94.97	10.51	0.007*
	> 3.5	37	102.08	10.97	
Hr40	< 3.5	33	92.67	9.53	0.010*
	> 3.5	37	99.11	10.56	
Hr45	< 3.5	33	91.42	8.53	0.038*
	> 3.5	37	96.22	10.21	
HrSO	< 3.5	33	90.79	8.90	0.367
	> 3.5	37	92.62	7.99	
HrSS	< 3.5	33	89.97	9.18	0.7 16
	> 3.5	37	8.84	8.84	
Hr60	< 3.5	33	90.00	8.29	0.967
	> 3.5	37	89.92	8.20	

Systolic blood pressure comparison:

	Group	N	Mean	Std. Deviation	P value by 't' test
SbpO	< 3.5	32	118.66	11.44	0.088
	> 3.5	36	123.06	9.48	
Sbp2	< 3.5	33	119.91	12.47	0.044*
	> 3.5	37	125.35	9.12	
Sbp4	< 3.5	33	119;85	11.48	0.009*
	> 3.5	37	126.30	8.59	
Sbp6	< 3.5	33	116.58	12.98	<0.001 *
	> 3.5	37	127.00	10.86	
Sbp8	< 3.5	33	112.61	14.13	0.002*
	> 3.5	37	122.76	12.01	
Sbp10	< 3.5	33	108.79	12.57	0.038*
	> 3.5	37	114.95	11.81	
Sbp12	< 3.5	33	105.55	10.83	0.035*
	> 3.5	37	110.89	10.00	
Sbp14	< 3.5	33	102.88	11.05	0.138
	> 3.5	37	106.62	9.81	
Sbp16	< 3.5	33	100.12	10.72	0.425
	> 3.5	37	102.03	9.13	
Sbp18	< 3.5	33	101.21	10.06	0.219
	> 3.5	37	98.41	8.86	
	Group	**N**	**Mean**	**Std. Deviation**	**P value by 't' test**
Sbp20	< 3.5	33	102.03	9.21	0.131
	> 3.5	37	98.51	9.93	
Sbp25	< 3.5	33	102.33	8.62	0.223
	> 3.5	37	99.46	10.67	
Sbp30	< 3.5	33	104.67	8.46	0.203
	> 3.5	37	101.57	11.31	
Sbp35	< 3.5	33	108.09	9.49	0.040*
	> 3.5	37	103.24	9.82	
Sbp40	< 3.5	33	108.91	10.07	0.109
	> 3.5	37	104.89	10.54	
Sbp45	< 3.5	33	112.09	11.01	0.038*
	> 3.5	37	106.78	9.96	
SbpSO	< 3.5	33	112.06	11.73	0.557
	> 3.5	37	110.51	10.21	
Sbp55	< 3.5	33	113.76	10.91	0.485
	> 3.5	37	111.68	13.56	
Sbp60	< 3.5	33	116.42	10.24	0.944
	> 3.5	37	116.24	11.20	

Comparison of systolic blood pressure in the 2 groups intraoperatively:



The companson of systolic blood pressure/ diastolic blood pressure/mean arterial pressure between the two groups was done. The differences were significant in the first 45 minutes of the procedure.

Systolic blood pressure differences were more significant in the 2nct, 4th, 6th, 8th, 10th, 12th, 14th, 35th, 45th minutes in the group with baseline pi of >3.5.

Diastolic blood pressure comparison:

	Group	N	Mean	Std. Deviation	P value by 't' test
DbpO	< 3.5	33	73.48	7.19	0.021*
	> 3.5	36	77.58	7.21	
Dbp2	< 3.5	33	72.36	8.13	0.003*
	> 3.5	37	77.81	6.41	
Dbp4	< 3.5	33	73.58	7.74	0.003*
	> 3.5	37	78.68	6.29	
Dbp6	< 3.5	33	72.09	8.87	0.002*
	> 3.5	37	78.16	7.23	

Dbp8	< 3.5	33	68.70	9.03	0.007*
	> 3.5	37	74.19	7.63	
Dbp10	< 3.5	33	64.88	9.15	0.036*
	> 3.5	37	69.27	8.06	
Dbp12	< 3.5	33	63.21	10.36	0.128
	> 3.5	37	66.86	9.45	
Dbp14	< 3.5	33	61.58	9.86	0.958
	> 3.5	37	61.70	10.24	
Dbp16	< 3.5	33	58.91	9.74	0.650
	> 3.5	37	57.78	10.78	
Dbp18	< 3.5	33	58.39	10.55	0.150
	> 3.5	37	54.35	12.45	
Dbp20	< 3.5	33	59.24	10.23	0.055
	> 3.5	37	54.19	11.27	
Dbp25	< 3.5	33	60.88	9.95	0.001*
	> 3.5	37	52.19	11.35	
Dbp30	< 3.5	33	62.64	10.84	0.002*
	> 3.5	37	53.86	11.71	
Dbp35	< 3.5	33	64.88	10.48	0.005*
	> 3.5	37	56.89	12.25	
Dbp40	< 3.5	33	65.82	11.30	0.022*
	> 3.5	37	59.27	11.96	
Dbp45	< 3.5	33	65.91	11.47	0.182
	> 3.5	37	62.27	11.12	
DbpSO	< 3.5	33	67.39	11.88	0.200
	> 3.5	37	64.08	9.49	
Dbp55	< 3.5	33	69.33	9.20	0.343
	> 3.5	37	67.35	8.16	
Dbp60	< 3.5	33	71.30	7.82	0.878
	> 3.5	37	71.62	9.29	

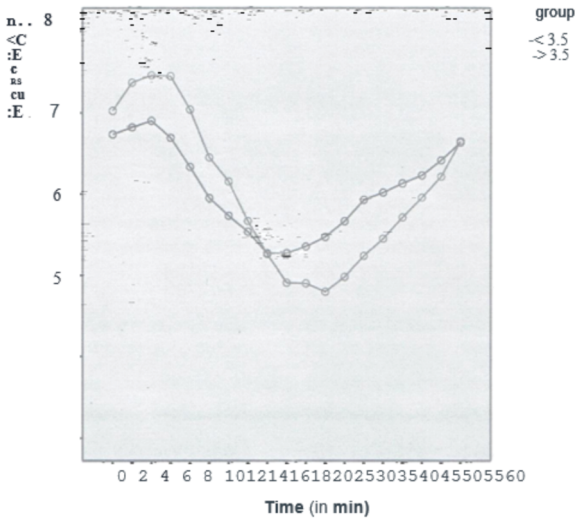
Diastolic blood pressure differences were significant in the 2nd, 4th, 6th, 8th, 10th, 25th, 30th, 35th, 40th minutes in both the groups.

Mean arterial pressure comparison in two groups:

	Group	N	Mean	Std. Deviation	P value by 't' test
MapO	< 3.5	33	87.34	9.90	0.389
	> 3.5	37	90.23	16.73	
Map2	< 3.5	33	88.21	8.25	0.003*
	> 3.5	37	93.66	6.69	
Map4	< 3.5	33	89.00	7.92	0.001*
	> 3.5	37	94.55	5.84	
Map6	< 3.5	33	86.92	9.18	0.00
	> 3.5	37	94.44	7.29	
Maps	< 3.5	33	83.33	9.33	< 0.001*
	> 3.5	37	90.38	7.93	
MaplO	< 3.5	33	79.52	9.27	0.022*
	> 3.5	37	84.50	8.51	
Map12	< 3.5	33	77.32	9.51	0.055
	> 3.5	37	81.54	8.59	
Map14	< 3.5	33	75.34	9.33	0.545
	> 3.5	37	76.68	8.97	
Map16	< 3.5	33	72.65	9.24	0.959
	> 3.5	37	72.53	9.38	
Map18	< 3.5	33	72.67	9.64	0. 137
	> 3.5	37	69.04	10.46	
Map20	< 3.5	33	73.51	9.04	0.051
	> 3.5	37	68.96	9.97	
Map25	< 3.5	33	74.70	8.56	0.004*
	> 3.5	37	67.95	10.42	
Map30	< 3.5	33	76.65	9.45	0.007*
	> 3.5	37	69.77	11.01	
Map35	< 3.5	33	79.28	9.64	0.007*
	> 3.5	37	72.34	10.90	
Map40	< 3.5	33	80.18	10.47	0.028*
	> 3.5	37	74.48	10.78	
Map45	< 3.5	33	81.30	10.56	0.092
	> 3.5	37	77. 11	9.98	
M apSO	< 3.5	33	82.28	10.80	0.256
	> 3.5	37	79.56	9.08	
M apSS	< 3.5	33	84. 14	8.76	0.346
	> 3.5	37	82. 13	8.97	
M ap60	< 3.5	33	86.34	7.38	0.939
	> 3.5	37	86.50	9.06	

Mean arterial pressure was significant in the 25th, 30th, 35th, 40th minutes.

Comparison of mean arterial pressure between the 2 groups intraoperatively:



Temperature comparison in both groups:

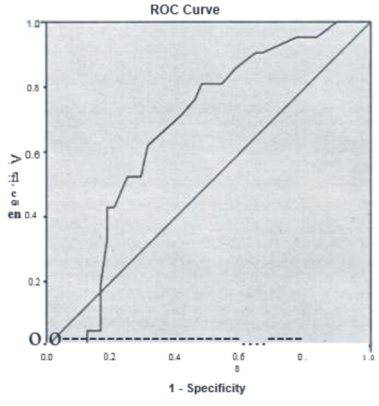
	Group	N	Mean	Std. Deviation	P value by 't' test
Tempo	< 3.5	33	98.56	0.23	0.110
	> 3.5	37	98.49	0. 15	
Temp2	< 3.5	33	98.46	0.15	0.831
	> 3.5	37	98.46	0.11	
Temp4	< 3.5	33	98.48	0.15	0.734
	> 3.5	37	98.46	0.12	
Temp6	< 3.5	33	98.48	0.15	0.681
	> 3.5	37	98.46	0.13	
Temp8	< 3.5	33	98.47	0.15	0.819
	> 3.5	37	98.46	0.13	
TemplO	< 3.5	33	98.48	0.14	0.483
	> 3.5	37	98.46	0.13	
Temp12	< 3.5	33	98.48	0.16	0.612
	> 3.5	37	98.50	0.15	
Temp14	< 3.5	33	98.48	0. 16	0.525
	> 3.5	37	98.51	0.15	
Temp16	< 3.5	33	98.48	0. 15	0.295
	> 3.5	37	98.52	0. 14	
Temp18	< 3.5	33	98.49	0. 13	0.155
	> 3.5	37	98.54	0. 14	
Temp20	< 3.5	33	98.50	0.11	0.161
	> 3.5	37	98.54	0.14	
Temp25	< 3.5	33	98.50	0.11	0.161
	> 3.5	37	98.54	0.14	
Temp30	< 3.5	33	98.48	0.22	0.158
	> 3.5	37	98.54	0.14	
Temp35	< 3.5	33	98.48	0.17	0.104
	> 3.5	37	98.54	0.14	
Temp40	< 3.5	33	98.49	0.17	0.181
	> 3.5	37	98.54	0.14	
Temp45	< 3.5	33	98.49	0.17	0.207
	> 3.5	37	98.54	0.14	
TempSO	< 3.5	33	98.48	0.21	0.145
	> 3.5	37	98.54	0.14	
Temp55	< 3.5	33	98.49	0.14	0.171
	> 3.5	37	98.54	0.14	
Temp60	< 3.5	33	98.50	0.14	0.175
	> 3.5	37	98.55	0.14	

Since the duration of surgery in group I (n=33) was 45+_ 11 minutes and group II (n=37) was 47+_ 13 minutes there was no significant changes in the temperature noted. Spo2 , respiratory rate, apgar scores were comparable and no significant differences were observed.

Roe curve depicting perfusion index against incidence of hypotension:

		Group				P value by chi sq test
		< 3.5		> 3.5		
		Frequency	%	Frequency	%	
Hypo_O	Yes	1	50.0%	1	50.0%	0.506
	No	32	47.1%	36	52.9%	
Hypo_2	Yes	0	0.0%	0	0.0%	1.00
	No	33	47.1%	37	52.9%	
Hypo_4	Yes	0	0.0%	0	0.0%	1.00
	No	33	47.1%	37	52.9%	
Hypo_6	Yes	1	100.0%	0	0.0%	0.471
	No	32	46.4%	37	53.6%	
Hypo_S	Yes	1	100.0%	0	0.0%	0.471
	No	32	46.4%	37	53.6%	
Hypo_ lO	Yes	2	100.0%	0	0.0%	0.219
	No	31	45.6%	37	54.4%	
Hypo_ 12	Yes	2	50.0%	2	50.0%	0.384
	No	31	47.0%	35	53.0%	
Hypo_ 14	Yes	5	45.5%	6	54.5%	0.903
	No	28	47.5%	31	52.5%	
Hypo_ 16	Yes	8	44.4%	10	55.6%	0.79
	No	25	48.1%	27	51.9%	
Hypo_ 18	Yes	8	33.3%	16	66.7%	0.095
	No	25	54.3%	21	45.7%	
Hypo_20	Yes	7	30.4%	16	69.6%	0.05
	No	26	55.3%	21	44.7 %	
Hypo_)S	Yes	5	21.7%	18	78.3%	0.003*
	No	28	59.6%	19	40.4%	
Hypo_30	Yes	4	18.2%	18	81.8%	0.001*
	No	29	60.4%	19	39.6%	
Hypo_35	Yes	3	17.6%	14	82.4%	0.005*
	No	30	56.6%	23	43.4%	
Hypo_40	Yes	4	36.4%	7	63.6%	0.435
	No	29	49.2%	30	50.8%	
Hypo_45	Yes	1	14.3%	6	85.7%	0.064
	No	32	50.8%	31	49.2%	
Hypo_SO	Yes	2	40.0%	3	60.0%	0.339
	No	31	47.7%	34	52.3%	
Hypo_SS	Yes	1	33.3%	2	66.7%	0.41
	No	32	47.8%	35	52.2%	
Hypo_60	Yes	0	0.0%	1	100.0%	0.529
	No	33	47.8%	36	52.2%	

Aue - 0.667 (0.537 - 0.798), p value = 0.028
Cut off value = 3.45 ; sensitivity - 81%, specificity - 47.9%



The roe curve yielded 3.45 as the most appropriate cut off point in baseline pi with a senstivity of 81% and a specificity of 47.9% .

Binary logistic regression for predicting hypotension:

	B	S.e.	Wald	Df	P value	Adj odds
Pi > 3.5	1.927	.627	9.456	1	0.002	6.868
Pi < 3.5	(reference)					
Constant	-3.908	1.116	12.256	1	< 0.001	.020

The incidence of hypotension in group I(n=33, pi >3.5)was found to be more compared to than group 2 (n=37,pi <3.5).this was clinically and statistically highly significant.

DISCUSSION

Our study was aimed at the reduction in the severity of hypotension and its consequences in parturients undergoing elective lower segment caesarean section under subarachnoid block. Though there are many parameters which can predict hypotension like age, baseline blood pressure, baseline heart rate, maternal body mass index, height of the patient. Still there is no definite indicator for hypotension in patients undergoing lscs.hence this study used perfusion index (baseline) as .a predictor of hypotension, to prevent its after effects like bradycardia, nausea,vomiting leading on to cardiac arrest.

DG BISHOP ET AL. developed a pram scoring system involving pre operative pulse rate, pre-operative baseline mean arterial pressure and age. This score was used in both elective and emergency caesarean delivery.

In this prospective observational study, the incidence and severity of hypotension in parturients who underwent lscs under subarachnoid block whose baseline perfusion index was more than 3.5.. The roe curve yielded a new baseline value of 3.45. As the cut off point for predicting hypotension in lscs under sab.

Hypotension following administration of sab for casarean section IS common. There IS no definite monitoring system which can predict the incidence and severity of hypotension so that additional precautions may be taken.

Pregnancy is associated with a decrease in systemic vascular resistance, increased total blood volume and cardiac output. The decrease in svr may vary in parturients.This decrease in peripheral vascular tone corresponds to higher perfusion index due to mcrease m pulsatile component causmg vasodilatation.central neuraxial blockade induces sympathectomycausing blood pooling in the blocked areas decreasing the cardiac output and map.the degree of hypotension depends on volume status, sympathetic activity of the individual, maternal bmi etc. Women around 30 weeks have more volume of blood trapped in lower extremities due to decreased vascular tone hence they are preloaded with crystalloids. Ephedrine is used for hypotension .

Yokose et al demonstrated that perfusion index had no predictive value for hypotension in lscs. This was significantly due to methodological differences.

Toyama.et al in his study the baseline pi >3.5 was associated with significant hypotension following sab.his test had a senstivity of 81% and specificity of 86%.where as in our study it was 78% and 47% respectively.

Ginosar et al demonstrated that an increase in perfusion index following epidural anaesthesia was a reliable indicator of sympathectomy.

In our study ever episode of hypotension in both groups was treated with 100 of iv fluids and 6mg of epedrine. Phenyleprine was not used .in patients were uretrotonics like carboprost and methergine were used those patients were excluded from the study.

One study uses thigh sleeves to prevent hypotension to increase central bllod volume. The degree of vascular tone changes depends on the number ofpregnancies and hormonal factors.

LIMITATIONS OF THE STUDY:

-);;;- Patient movement and any stimulus increasing sympathetic activity like anxiety could change pi values.
-);;;- Hemodynamic parameters such as cardiac output, systemic vascular resistance were not measured , however arterial and central lines are not appropriate for uncomplicated elective caesarean delivery.
-);;;- Photoplethysmographic analysis is sensitive to patient movement hence change in pi values due to peripheral vasoconstriction.
-);;;- Baseline values of pi and hemodynamic parameters were obtained in supine position , wheareas a 15 degree tilt was applied after spinal injection to prevent aorto caval compression.

CONCLUSION:

In parturients undergoing elective lower segment caesarean section a baseline perfusion index of >3.5 was associated with higher incidence of hypotension than the group with a pi value of <3.5. And the new cut

off value of perfusion index according to our study was 3.45. Since there are not many predictors of hypotension in patients undergoing lscs under sab,perfusion index can be used to predict hypotension in parturients.

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