Original Research Article

To Assess IVC Collapsibility Index before Spinal Anaesthesia to Predict Fluid Responsiveness

Dr. Kumbha Gopi[1] senior resident, Dr. Tripti Vatsalya[2] (Associate Professor), Dr. Ayushi Soni[3] (Senior Resident), Dr. Neelesh Nema[4] (Assistant Professor), Dr. Saladi Venkata Akshay[5] (Senior Resident)

Dept. of Emergency Medicine, Gandhi Medical College Bhopal, M.P.[1]
Dept. Of Anaesthesiology, Gandhi Medical College, Bhopal, M.P.[2,3&4]
Dept. of Anaesthesiology, Atal Bihari Vajpayee Government Medical College Vidisha, M.P.[5]

Corresponding Author: Dr. Saladi Venkata Akshay

Abstract

Background & Methods: The aim of the study is to assess IVC diameter and IVC collapsibility index before spinal anaesthesia. Patient were divided into either of two study groups of minimum 40 patients each. All patients fasted for 6 hours before surgery, patients were shifted to operation theatre and base line parameters like Heart Rate (HR), Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), Respiratory Rate (RR), Peripheral Oxygen Saturation (SpO2) and electrocardiography (ECG) recorded and an intravenous access achieved (using 18G intracath) in all patients.

Results: Proportion of patients with episode of hypotension:- 0, 1 was significantly higher in group A as compared to group B. (0:- 42.50% vs 5% respectively, 1:- 57.50% vs 5% respectively). Proportion of patients with episode of hypotension:- 2, 3, 4 was significantly lower in group A as compared to group B. (2:- 0% vs 40% respectively, 3:- 0% vs 47.50% respectively, 4:- 0% vs 2.50% respectively). (p value <0.0001)

Conclusion: Our study suggested that, there was decreased intra-operative fluid administration and reduction in the administration of vasoactive drugs in IVCCI group when compared to IVCCI non-measured group which may be related to the lower incidence of hypotension after spinal surgery.

Keywords: IVC, collapsibility, index, spinal & anaesthesia.
Study Design: Hospital Observational Study.

1. Introduction

Spinal anaesthesia is one of the common methods of intraoperative analgesia in below umbilical surgeries and it is frequently used in daily clinical practice. This anaesthetic technique is important and widely used for operations on the lower abdomen, pelvis, perineum, and lower limbs. It has advantages such as the rapid onset of action, cost effective, ease of administration and relatively few side effects.

The most common side effects of spinal anaesthesia are hypotension and bradycardia [(1)]. Post spinal hypotension has an incidence of 15.3 to 33% that may result in organ hypoperfusion and ischemic events[(2)] . Hypotensive response is exaggerated in elderly patients where a negative influence on a relative higher resting sympathetic tone and decreased baroreceptor activity may explain the higher incidence of hypotension in response to spinal anaesthesia.

During spinal anaesthesia, sympathetic fibers are blocked and as a result, sympathetic denervation is caused which results in peripheral vasodilatation and hence redistribution of central blood volume which eventually decreases preload[3].

Patients susceptibility to intraoperative hypotension can also be influenced by the preoperative volume status. This volume status is affected by general physical condition, associated comorbidities, fasting status, or drugs taken by patients[4].

Post spinal hypotension due to spinal blockade is principally a consequence of either diminished systemic vascular resistance after blocked of preganglionic sympathetic fibers or decreased cardiac output or both. Many attempts have been tried to prevent post spinal hypotension, such as preventive empirical volume loading or prophylactic vasopressors, has been used to lower the incidence of hypotension following spinal anaesthesia.

However, intravenous volume preload carries the potential for volume overload, particularly in patients with cardiac disease[5]. Furthermore different definitions of hypotension and diverse patients populations, the effect of volume preload on prevention of hypotension is still controversial. Until recently, cardiac output measurement required invasive monitoring, which is unsuitable in awake patients having spinal anaesthesia for short procedures.

Hypotension after spinal anaesthesia may cause several adverse effects, such as coronary ischemia and delirium. Thus identifying a good, easy, reliable and noninvasive predictor for early diagnosis and treatment of post spinal hypotension is important[6].

2. Material and Methods

Department of Anaesthesiology, Gandhi Medical college and associated Hamidia Hospital, Bhopal. For this study, 80 patients of age 18-60 years of ASA grade I and II were assessed preoperatively after taking oral and written consent and ethical committee approval letter no. 26929/MC/IEC/2021 dated: 24-08-2021. The selected patients who satisfied with the below inclusion criteria were then registered, all history and clinical details were recorded in the history sheet as per the proforma. Patient were divided into either of two study groups of minimum 40 patients each. All patients fasted for 6 hours before surgery, patients were shifted to operation theatre and base line parameters like Heart Rate (HR), Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), Respiratory Rate (RR), Peripheral Oxygen Saturation (SpO2) and electrocardiography (ECG) recorded and an intravenous access achieved (using 18G intracath) in all patients.

Group A: Inferior vena cava ultrasonography (IVCUS) was performed before spinal anaesthesia.

Group B: Spinal anaesthesia was performed without taking inferior vena cava measurements.

INCLUSION CRITERIA

- Age 18 – 60 years.
- American society of Anaesthesiologist physical Grade I & II
- Hemodynamically stable patients.
- Elective surgeries.
- Both sexes.

EXCLUSION CRITERIA

- Patient’ s refusal
- H/O allergy to local anaesthetics
- ASA class III & IV
- Patients with airway problem suggesting Difficult intubation

- Patients with a history of significant coexisting diseases like heart diseases, impaired renal function and severe liver disease.
- Any contraindication to regional anaesthesia
- Patients with spine deformity
- Morbidly obese patients.
- Pregnant and lactating mothers.
- Emergency surgeries.

3. Result

Table 1:-Comparison of age(years) between group A and B.

Age(years)	Group A(n=40)	Group B(n=40)	Total	P value
18-20	2 (5%)	3 (7.50%)	5 (6.25%)	0.778*
21-30	9 (22.50%)	10 (25%)	19 (23.75%)	
31-40	11 (27.50%)	13 (32.50%)	24 (30%)	
41-50	11 (27.50%)	6 (15%)	17 (21.25%)	
51-60	7 (17.50%)	8 (20%)	15 (18.75%)	
Mean ± SD	38.2 ± 11.87	37.1 ± 12.27	37.65 ± 12.01	0.685‡
Median(25th-75th percentile)	37.5(26.75-45.25)	35(27-46.5)	36(27-46)	
Range	18-60	18-59	18-60	

Distribution of age(years) was comparable between group A and B. (18-20 years:- 5% vs 7.50% respectively, 21-30 years:- 22.50% vs 25% respectively, 31-40 years:- 27.50% vs 32.50% respectively, 41-50 years:- 27.50% vs 15% respectively, 51-60 years:- 17.50% vs 20% respectively) (p value=0.778).

Table 2:-Comparison of ASA status between group A and B.

ASA status	Group A(n=40)	Group B(n=40)	Total	P value
1	12 (30%)	12 (30%)	24 (30%)	1†
2	28 (70%)	28 (70%)	56 (70%)	
Total	40 (100%)	40 (100%)	80 (100%)	

Distribution of ASA status was comparable between group A and B. (1:- 30% vs 30% respectively, 2:- 70% vs 70% respectively) (p value=1).

Table 3:-Comparison of episode of hypotension between group A and B.

Episode of hypotension	Group A(n=40)	Group B(n=40)	Total	P value
0	17 (42.50%)	2 (5%)	19 (23.75%)	<.0001*
1	23 (57.50%)	2 (5%)	25 (31.25%)	
2	0 (0%)	16 (40%)	16 (20%)	
3	0 (0%)	19 (47.50%)	19 (23.75%)	
4	0 (0%)	1 (2.50%)	1 (1.25%)	
Mean ± SD	0.57 ± 0.5	2.38 ± 0.84	1.48 ± 1.14	<.0001§
Median(25th-75th percentile)	1(0-1)	2.5(2-3)	1(1-2.25)	
Range	0-1	0-4	0-4	

Comparison of episode of hypotension between group A and B.
Proportion of patients with episode of hypotension:- 0, 1 was significantly higher in group A as compared to group B. (0:- 42.50% vs 5% respectively, 1:- 57.50% vs 5% respectively). Proportion of patients with episode of hypotension:- 2, 3, 4 was significantly lower in group A as compared to group B. (2:- 0% vs 40% respectively, 3:- 0% vs 47.50% respectively, 4:- 0% vs 2.50% respectively). (p value <0.0001)

Table 4:-Comparison of total fluid infused (mL) between group A and B.

Total fluid infused (mL)	Group A(n=40)	Group B(n=40)	Total	P value
Mean ± SD	1077.5 ± 168.69	1840 ± 269.66	1458.75 ± 444	<.0001‡
Median(25th-75th percentile)	1100(1000-1200)	1800(1700-1900)	1400(1100-1800)	
Range	700-1400	1400-2500	700-2500	

Comparison of total fluid infused (mL) between group A and B.
Mean ± SD of total fluid infused (mL) in group B was 1840 ± 269.66 which was significantly higher as compared to group A (1077.5 ± 168.69).(p value <.0001)

4. Discussion

Spinal anaesthesia is one of the common methods of intraoperative analgesia during below umbilical surgeries.
During spinal anaesthesia, local anaesthetic blocks somatic, motor, sensory and preganglionic sympathetic fibers. The sympathetic fibers consists of preganglionic fibers from T1 to L2-L3 segments. An adequate tissue perfusion during surgery is crucial to prevent the adverse outcomes(7).
Hypotension is one of the most frequent side effect of spinal anaesthesia. Safe intraoperative management includes prevention of undesirable hypotensive episodes. Post spinal hypotension development is multifactorial with fluid optimisation being the important modifiable factor, but empirical fluid loading is of little or no value in a fluid non-responsive patient and may even worsen the patient outcome(8). So evaluation of hemodynamic status is important in the optimisation of the fluid therapy.
Ultrasonographic assessment of the inferior vena cava collapsibility index (IVCCI) is easy to perform, non-invasive, time efficient and readily available tool to predict fluid responsiveness and to evaluate hemodynamic status in different patient populations, predominantly in critically ill patients. Preoperative IVCCI is a reliable predictor of hypotension after induction of general anaesthesia with high specificity(9). In various randomised trail, fluid therapy guided by IVC parameters before spinal anaesthesia was found to have a significant reduction of PSH.
In the present study, we have chosen IVCCI cut-off value ≥36% as fluid responders and performed fluid optimisation prior to spinal anaesthesia. This cut-off value was taken from the previous study done by Zhang et al.(10) in a systematic review where a total of eight studies involving 235 patients were analysed. The cut-off value varied across studies ranging from 12 to 40%. The sensitivity and specificity in the overall population of IVCCI from Zhang et al.(10) were 0.76(95%CI: 0.61-0.86) and 0.86 (95%CI:0.69-0.95) respectively. Similarly studies by Ayyanagouda et al.(11) also took cut-off value of IVVCI as 36% got the same results in decreased incidence of hypotension and reduced requirement of vasopressors

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE1, 2024

in IVCCI measured group. From this we came to know that IVCCI was of great value in predicting volume responsiveness.

5. Conclusion

Our study suggested that, there was decreased intra-operative fluid administration and reduction in the administration of vasoactive drugs in IVCCI group when compared to IVCCI non-measured group which may be related to the lower incidence of hypotension after spinal surgery.

6. References

1. Hartmann B, Junger A, Klasen J, Benson M, Jost A, Banzhaf A, Hempelmann G. The incidence and risk factors for hypotension after spinal anesthesia induction: an analysis with automated data collection. Anesthesia & Analgesia. 2002 Jun 1;94(6):1521-9.
2. Carpenter RL, Caplan RA, Brown DL, Stephenson C, Wu R. Incidence and risk factors for side effects of spinal anesthesia. Anesthesiology. 1992 Jun 1;76(6):906-16.
3. Stienstra R. Mechanisms behind and treatment of sudden, unexpected circulatory collapse during central neuraxis blockade. Acta anaesthesiologica scandinavica. 2000 Sep 1;44(8):965-71.
4. Zhang J, Critchley LA. Inferior vena cava ultrasonography before general anesthesia can predict hypotension after induction. Anesthesiology. 2016 Mar;124(3):580-9.
5. Ceruti S, Anselmi L, Minotti B, Franceschini D, Aguirre J, Borgeat A, Saporito A. Prevention of arterial hypotension after spinal anaesthesia using vena cava ultrasound to guide fluid management. British Journal of Anaesthesia. 2018 Jan 1;120(1):101-8.
6. Laborda A, Sierre S, Malvè M, De Blas I, Ioakeim I, Kuo WT, De Gregorio MA. Influence of breathing movements and Valsalva maneuver on vena caval dynamics. World journal of radiology. 2014 Oct 10;6(10):833.
7. Khan MU, Memon AS, Ishaq M, Aqil M. Preload versus coload and vasopressor requirement for the prevention of spinal anesthesia induced hypotension in nonobstetric patients. J Coll Physicians Surg Pak. 2015 Dec 1;25(12):851-5.
8. Ilyas A, Ishtiaq W, Assad S, Ghazanfar H, Mansoor S, Haris M, Qadeer A, Akhtar A. Correlation of IVC diameter and collapsibility index with central venous pressure in the assessment of intravascular volume in critically ill patients. Cureus. 2017 Feb 12;9(2).
9. Dodhy AA. Inferior vena cava collapsibility index and central venous pressure for fluid assessment in the critically ill patient. Age (mean±SD). 2021 Nov 1;42:10-4.
10. Zhang Z, Xu X, Ye S, Xu L. Ultrasonographic measurement of the respiratory variation in the inferior vena cava diameter is predictive of fluid responsiveness in critically ill patients: systematic review and meta-analysis. Ultrasound in medicine & biology. 2014 May 1;40(5):845-53.
11. Ayyanagouda B, Ajay BC, Joshi C, Hulakund SY, Ganeshnavar A, Archana E. Role of ultrasonographic inferior venacaval assessment in averting spinal anaesthesia-induced hypotension for hernia and hydrocele surgeries-A prospective randomised controlled study. Indian Journal of Anaesthesia. 2020 Oct;64(10):849.