Original Article

Effects of hypertonic saline preloading in sub arachnoid blockade for transurethral resection of prostate - A comparative study

Amirul Islam[1*], Md. Rafayet Ullah Siddique[2], Md. Mustafa Kamal[2], Debabrata Banik[3], AKM Akhtaruzzaman[3], Md. Abdul Hye[3]

[1] Medical Officer, Department of Anaesthesia, Intensive Care &Pain Medicine BSMMU,Shahbag, Dhaka-1000. [2]Assistant Professor, Department of Anaesthesia, Intensive Care &Pain Medicine BSMMU,Shahbag, Dhaka-1000. [3]Assoc. Professor, Department of Anaesthesia, Intensive Care &Pain Medicine BSMMU,Shahbag, Dhaka-1000.

***Corresponding author:** *Email*: <dramirul68@yahoo.com>

Abstract:

Background*: Hypertonic solution is used to combat hypotension in sub-arachnoid block during trans urethral resection of prostate.*

Aims and objectives*: To compare the effect of 3% sodium chloride solution with that of 0.9% sodium chloride solution, to combat sub-arachnoid block induced hypotension in trans urethral resection of prostate.*

Methods*: A total number of sixty patients ASA grade I & II were selected randomly in two groups , thirty in each group. Group A received 15ml/kg of 0.9% NaCl solution and group B 4ml/kg of 3% NaCl solution as a preload. Sub arachnoid block performed at the $L_{3/4}$ interspace in the sitting position. Heart rate, mean arterial pressure, amount of ephedrine, amount of used additional I/V normal saline, serum electrolytes and level of sensory block were observed.*

Results*: Mean arterial pressure was differed significantly at late hours ie, 50min, 60min(P<0.001). Incidence of hypotension was 43% in group A, 16% in group B and was significant(p<0.05). Less additional I/V fluid was required in groupB and difference was significant(P<0.05). Low doses of ephedrine was needed in groupB and was highly significant(P<0.001).*

Conclusion*: Preloading of hypertonic solution is superior to isotonic solution in trans urethral resection of prostate under sub arachnoid block.*

Key Words*: sub arachnoid block, hypertonic saline, trans urethral resection of prostate.*

(Journal of BSA, 2009; 22(2): 66-71)

Introduction:

Now a day's most of the urological operations including transurethral resection of prostate (TURP) are performed under sub-arachnoid block (SAB). SAB is gaining increase popularity and replacing general anaesthesia gradually. Advantages are virtual avoidance of risks of general anaesthesia, for example, gastric aspiration and difficult tracheal intubation and also TURP syndrome can not be diagnosed early, whereas SAB is very useful to diagnose early and potentially prevent the above mentioned problems. However, hypotension after SAB results from functional sympathetic devervation, not only of the arterial and arteriolar circulation but also of the large veins, venules. Venodilation can increase significantly venous capacitance with a consequent decrease in venous return and cardiac output. The rational of prehydration is to expand the plasma volume. However isotonic crystalloid solutions, in volume expansion commonly used, may not be effective, as about 70% of the solution diffusion occurs extra vascularly into the interstitial space. In contrast hypertonic saline is more effective as it can remain in the intravascular space, induce instantaneous mobilization of endogenous fluid also the osmotic gradient from the intracellular to the extracellular space[1].

Circulatory preloading is one of the mainstays in the preventing of the hypotension and a variety of crystalloid and colloid solutions have been used for this purpose[2]. Prophylaxis colloid fluid is not popular because it may produce anaphylactic reaction and interferes with blood grouping and cross matching and also interferes of blood coagulation[3].Despite this, a significant incidence of hypotension which necessitates the use of a vasopressor is still reported[4].

The usual practice is to use crystalloid solutions, these are mainly isotonic but its half life is short. So to require three to four times more than hypertonic crystalloid solutions, only 25% of fluid remains intravascularly.

Hypertonic saline (3% NaCl) has an osmolality of 1026mOsmol/L that about three times more of plasma[5]. The fluid shift and osmolar changes that occur with its infusion can be predicted. The hypertonic solution will also draw water out of the cells increasing extracellular fluid volume. But it has some warning that rapid correction of chronic hyponatremia and hypotension can be fatal or cause severe neurological injury[6]. So patients selection with serum elctrolytes will be within normal ranges and no chronic hypotension. Hypertonic solution(3%NaCl) is better in some points of views-less incidence of hypotension, it prevents hyponatremia during TURP because hyponatremia contributes TURP syndrome, it prevents water intoxication[7].

Method:

60 patients of hypertrophy of prostate undergoing TURP were taken in this study. Every patient included in the study, allowed choosing a card. According to card number, patients grouped. Each group received either 0.9% NaCl solution or 3% NaCl solution for preloading through 18G intravenous cannula placed in the forearm.

Subarachnoid block performed at the level of L_{3-4} inter-space with the patient in the sitting position. All subjects received 10mg of 0.5% hyperbaric bupivacaine delivered through a 25 gauge Quincke needle to achieve uniform performance. All patients were getting O_2 through nasal prong at the rate of 2L/min throughout procedure. Blood pressure was measured with an automated blood pressure device and S_PO_2 continuously displayed on Datex-Ohmeda machine by using S_PO_2 probe and reading recorded in time to time.

Hypotension is defined as a systolic blood pressure less than 20% of the base line blood pressure. Base line blood pressure was determined by calculating the mean of three blood pressure measurement in the pre operative period before fluid loading commenced. Hypotension treated with a bolus of 5mg ephedrine intravenously and rapid infusion of running fluid to both groups. Variables were recorded including the maximum height of block as assessment by pin prick 15 minutes following subarachnoid block, other drugs used and their doses, and the amount of intravenous fluid was given throughout the procedure.

Study parameters:

Mean arterial Pressure, mean heart rate, amount of ephedrine used, Amount of used additional intravenous (I/V) fluid, Serum electrolytes were taken during procedure.

Data collected in a specially designed 'Data sheet'. It was collated and analyzed for statistical significance by student's t-test and chi square (χ^2) as appropriate. Values regarded as significant if $P<0.05$, (CL95%).

Results:

Patient's demographics were similar and comparable in both groups and differences were statistically not significant.

Table-I

Demographic data

Variable	Group A n=30	Group B n=30	p-value
Age (year)	65.94±1.90	66.74±1.76	0.759
Weight (kg)	57.41±1.08	59.27±1.73	0.362
Height (cm)	166.24±0.94	167.67±1.18	0.347

Data are presented as mean ± SEM. Unpaired t-test was performed. The studied groups became statistically matched for age (p=0.759), weight (p=0.362), and height (p=0.347). Values are regarded as significant if $p<0.05$.

Table II

Changes of heart rate

Groups	Before Preload	Before SAB	After SAB	5min	10mins	15mins	30mins	40mins	50mins	60mins
GroupA	78.27± 1.64	81.37± 1.82	77.84± 3.15	76.77± 2.23	76.66± 2.34	74± 2.58	72.77± 2.85	72.11± 2.51	71.14± 3.34	73.41± 2.43
GroupB	81.24± 1.8	82.51± 1.49	80.81± 1.8	79.14± 1.93	75.07± 2.1	69.37± 2.02	67.51± 1.94	68.74± 1.95	68.21± 2.14	69.67± 2
P value	0.234	0.952	0.415	0.424	0.614	0.161	0.130	0.283	0.466	0.241

Data are presented as mean±SEM . Unpaired t-test was performed. There was no significant difference between the two groups.

Table -III

Changes of mean arterial pressure.

Groups	Base line	After pre-load	Just after block	3mins	10mins	20mins	30mins	40mins	50mins	60mins
Group-A	101± 1.87	02.4± 11.93	100± 1.80	92.17± 1.37	85.24± 2.07	81.17± 2.38	76.67± 3.15	77± 2.91	75.24± 2.59	74.74± 2.61
Group-B	101.7± 2.02	104.1± 1.99	97.67± 2.27	92.3± 2.37	88 ± 2.25	86.24± 2.60	81.77± 2.63	83.87± 2.58	86.24± 2.32	86.61± 2.29
P value	0.86	0.559	0.36	0.81	0.368	0.111	0.218	0.081	0.0006	0.0009

Data are presented as mean±SEM. Unpaired t-test was performed. Values are regarded as insignificant that was up to 40 minutes from onset of sub arachnoid block. But at 50 mins and 60 mins after SAB mean arterial pressure difference were highly significant ie, p =0.0006 and p=0.0009 respectively.

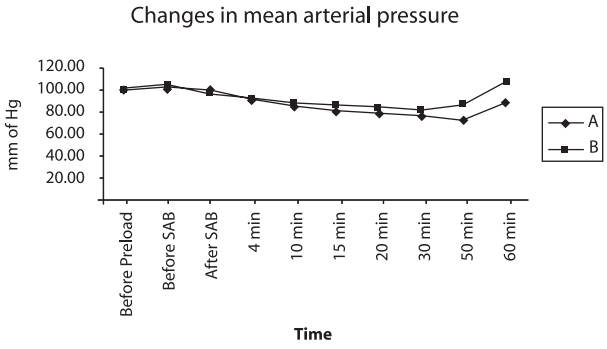

Fig.-1: *Changes in mean arterial pressure.*

Table-IV

Incidence of hypotension.

Groups	Hypotension	P value
Group A (n=30)	13 (43.33%)	0.042
Group B (n=30)	5 (16.66%)	

Data are presented as mean±SEM. Unpaired t-test was performed. Overall incidence of hypotension in group A was 13 (43.33%) and in group B was 5 (16.66%) after SAB. The incidence of hypotension in two groups were found significant.

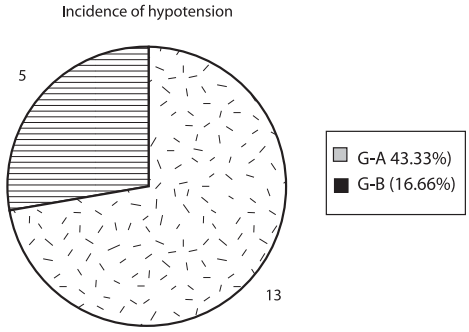

Fig.-2: *Incidence of hypotension .*

Table -V
Treatment of hypotension

Group	Additional I/V fluid (ml)	Ephedrine	
		Number of pt.	mean dose (mg)
Group A	213.33±	10	2.34±
(n=30)	46.92	(33.34%)	0.37
Group B	93.34±	3	0.833±
(n=30)	35.54	(10%)	0.49
P value	0.02		0.001

Data are presented as mean±SEM. Unpaired t-test was performed. Treatment of hypotension with I/V normal saline and ephedrine. It was found that use of additional I/V normal saline significantly differed between two groups and also the use of ephedrine was significant. Mean dose of ephedrine used in group B was significantly less then group A.

Table- VI
Maximum level of analgesia

Groups	T_4	T_6	T_8	T_{10}	P-value
Group-A n=30	1	3	14	12	0.467
Group-B-n=30	0	3	15	12	

Data are presented in number, sensory block achieved. Chi square test was performed.

Maximum level of sensory analgesia included in this range from $T_4 - T_{10}$. Desired level of sensory block is the T8 in both groups.One patient had sensory level at T_4, six patients had sensory level at T_6, twenty nine patients had sensory level at T_8 and twenty four patients had sensory level at T_{10}. This is not significant difference in achieving sensory blocked in both groups.

Table- VII
Serum electrolytes

	Groups	Preoperativem Eq/L	Postoperativem Eq/L	Significant level
Na+	A	139.33± 0.474	138.3± 0.58	0.062
	B	139.39± 4.00	141.19± 0.39	0.001
K+	A	4.31± 0.099	4.53± 0.08	0.104
	B	4.46± 0.087	4.64± 0.08	0.241
Cl-	A	103.04± 2.15	102.06± 3.16	0.067
	B	104.62± 3.11	105.15± 2.67	0.042

Data are presented as mean ± SEM; Analysis was done by student's t-test. Serum electrolytes of two groups were done preoperative and postoperative respectively. All compare were insignificant except sodium ion in group B (p 0.001)& chloride ion in group B (p 0.042)which were significant.

Discussion:

Arterial hypotension after sub aracnhoid block (SAB) is more or less common. Now a day's most of the urological operations including trans urethral resection of prostate (TURP) are performed under sub arachnoid block(SAB). SAB is also useful in trans urethral resection of prostate (TURP) because TURP syndrome can be early diagnosed by this method[5] . Spinal anaesthesia induced hypotension results from functional sympathetic denervation not only of the arterial and arteriolar circulation, but also of the large veins & venules. Venodilation can increase significantly venous capacitance with a consequent decrease in venous return and cardiac output. The rationale use of pre-hydration is to expand the plasma volume. However, isotonic crystalloid solution is the fluid commonly used to expand the plasma volume, may not be effective as about 75% of the solution diffuses extravascularly into the interstitial space within short time. In contrast, hypertonic saline is more effective as it can remain in the vascular system more time than crystalloid solution, it can induce instantaneous mobilization of endogenous fluid along the osmotic gradient from the intracellular to the extracellular space. In addition, hypertonic saline (3%NaCl) may result in direct myocardial stimulation and venoconstriction[1].

Small volume resuscitation (3-5ml/kg) of hypertonic saline is effective for hemorrhagic shock[5]. Resuscitation using hypertonic saline (3-7.5% NaCl) association of rapid improvement in organ perfusion in anaesthetized person subjected to burn injury. In comparison to isotonic saline (0.9% NaCl) greater increase in blood flows to the heart, kidney, liver and testis observed with hypertonic saline. The results suggested that significant improvement in blood flow distribution can achieved hypertonic saline by using one fourth volume in that of normal saline. The apparent improvement of the left ventricular systolic function in response to hypertonic saline is caused mainly by the combined effect of increased left ventricular preload and reduced left ventricular after load[10].

Although hemodynamic effects induced by the spinal anaesthesia are usually tolerated well in healthy young patient, prevention of hypotension is commonly achieved using fluid preloading. Anaphylactic reaction may occur after the administration of colloids, this risk is rare, but may not be acceptable for prophylaxis. Ringer's lactate solution is the solution, used most commonly for fluid preloading even though its Na+ concentration (130mmol/l) is less than that in 0.9% NaCl solution (155mmol/l)[8] .

Hypertonic saline (3%NaCl) has an osmolality of 1026mosmol/L that about three times of plasma.The Na^+ content of this fluid limits the distribution of the fluid to the extra cellular fluid. The hypertonic saline will also draw water out of the cells decreasing intracellular fluid volume. Glycine solution is used randomly as an irrigation fluid. It has an osmolarity of 200mosmol/l. Glycine is metabolized in the liver to ammonia may lead to visual impairment. High ammonia levels may result in neurological distrubance[9]. There is a more chance of water intoxication in TURP because to use of isotonic solution in excess amount to prevent hypotension and also absorption of irrigation solution due to prolong use. Water intoxication (restlessness, frothing, retching, tremor and twitching of muscles) was described by another auther[7]. Patient undergoing TURP may develop this syndrome from dilutional hyponatremia secondary to systemic absorption of the irrigation fluid, the degree of bleeding type, volume and pressure of the irigation fluid and also prolong duration of operation . So, to prevent TURP syndrome, some strategies should be maintained-i.e.-hydrostatic bag pressure will be less than 60cm of H_2O, Short operating time i.e., less than 90 min, Minimize intra vesicle pressure by frequent emptying, Adequate hemostasis, Limit the position of the irrigarion bag to maximum 60cm above the surgical field, Maintain adequate blood pressure and therefore normal periprostatic venous pressure in order to avoid increased absorption through open venous sinuses. Necessary to observe neurological status (possible in patient with regional anaesthesia), temperature and laboratory measurement frequently.

Hypo-osmolality and hyponatremia appear to be the principal culprit's contributing to the neurological changes seen in TURP syndrome[9]. In our study, we have not found such type of emergency crisis, it may not be due to such preventive measures that was against contributing factors.

Kien et.al.[1] also suggested that hypertonic saline required fifth times less than isotonic saline for the initial treatment of burn shock.

We found that 4ml/kg of 3%NaCl solution was as effective as 15ml/kg of NaCl solution in the prophylaxis of hemodynamic changes in ASA II patient in TURP under spinal anaesthesia.

Mouren S.et al[11], found that hypertonic saline increase myocardial contraction and vasoconstriction. This effect of hypertonic solution probably explains improved cardiac output. Because of plasma osmolarity is the driving force for volume distribution. Our observation found that 10% ephedrine needed in group B and 33% in group A, to keep Mean Arterial Pressure (MAP) greater than the acceptable limit. Ueyama H[12] found that initial fluid administration might provide a protection against undesired cardiovascular side effects but not all, our studies had shown this the augmentation of blood volume with initial fluid administration, regardless of the fluid used, must be large enough to result in a significant increase in cardiac output for effective prevention of hypotension.

In our observation, mean arterial blood pressure changes was insignificant in two groups except 50 min and 60 min after SAB(Table-III) which was very significant. This supports the study by Arndt J.O[13], where he found that administration of preloading fluids reduces the incidence of early cardiac events, but a vasopressor was needed for prevention of the late events. This is probably due to shifting of I/V fluids to the extra-vascular spaces.

Hypertonic saline administration causes a rapid increase in serum sodium concentration and osmolarity related to the sodium dose. This has been associated with central pontine myelinolysis in chronically debilitated patients with a prolonged period of hyper osmolarity or hypernatremia[6]. There for it is very important to keep in mind while using 3% NaCl saline.

In our study, preoperative and post operative serum electrolytes were within normal limits in both

groups.. But in case of group B, post operative serum sodium and chloride concentration slightly increased and statistically significant($p<0.001$) & ($p<0.05$) respectively.

Conclusion:

The preloading of hypertonic solution is superior to isotonic solution in trans urethral resection of prostate under sub arachnoid blockade in patients of benign hypertrophy of prostate.

Reference:

1. Kien, Nguyen D, Antognini, Joseph F, Reilly, et al:Resuscitation using small volume of hypertonic saline is effective for haemorrhagic shock.Br J Anaesth 1996; 83:137-40.
2. Crawford JS, Davis P, Lewis M.Some aspect of epidural block provided for elective caesarean section. Anaesthesia 1986; 41:1039-46.
3. Ring J, Messmer K. Incidence and severity of anaphylactoid reactions to colloid volume substitutes. Lancet 1977; 1:466-70.
4. Mc Care AF & Wildsmith JAW. Prevention and treatment of hypotension during central neural block. Br J Anaesth 1993;70:672-74.
5. Nguyen D, Antognini, Kien .Resuscitation using small volume of hypertonic saline is effective for haemorrhagic shock. Br J Anaesth 1996; 83:4.
6. Mc Kee AC, Winkelman MD, Banker BQ. Control pontine myelinolysis in severely bumed patient's relationship to serum hyperosmolarity. Neurology 1988; 38:1211-7.
7. Wier . The TURP syndrome. Canadian Journal of Anaesthesia 1922; 38:90-97
8. Veroli P, Benhamou D. Comparison of hypertonic saline isotonic saline and Ringer's lactate solution for fluid preloading before lumber extradural anaesthesia. Br J Anaesth1992; 69:461-64.
9. Imiak S, Weavind I, Dabney T, Wenker O.Interactive case report in Anaesthesia and Critical Care. The Internet Journal of Anaesthesiology 1999; 3: 1.
10. Goertz, Axel W, MD.Mehl, Tobies, MD Linder, Karl H.MD. A positive ionotropic effect of hypertonic saline has been demonstrated in isolated cardiac tissues.Br J Anaesh 1995; 82:1389-95.
11. Mouren S, Delayance S, Mion G. Mechanism of Myocardial contractility with hypertonic saline in isolated blood-perfusied rabit hearts, Anesth Analg 1995; 81:77-82.
12. Ueyama H, Heyanling, Tanigami H. Effect of crystalloid and colloid preload on blood volume in the parturient undergoing spinal anaesthesia for Elective cesarean section. Anesthesiology 1999; 91:1571-76.
13. Arndt J.O, Walter B, Joachim K. Incidence and time course of cardiovascular side effects during spinal anaesthesia after prophylactic use of intravenous fluid or vasoconstriction, Anaesth Analg 1998; 84:347-54.
14. Deutsch, S-As a refresher course in Anaesthetics-1992. New Orleans surgical 4 anesthetic consideration in Turp-Hatch, PD-A/C,15: 203-11.
15. Wang BW, Chiou YH, Chen WB. Intravenous pretreatment of hypertonic saline can prevent systemic hypotension induced by spinal anaesthesia. Acta Anaesthesiol Sin 1997;35:85-90.
16. Stern RH . Severe hypernatremia: the case for conservative management. Critical Care Med 1992; 20: 534-9.