

SERUM SODIUM DYNAMICS AND ITS CLINICAL RELEVANCE IN TRANSURETHRAL RESECTION OF PROSTATE SURGICAL PATIENTS

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ABSTRACT

BACKGROUND

Many endourological procedures require the use of an irrigation fluid to dilate the operating field and to wash away debris and blood. A potential complication of such irrigation is systemic absorption of the fluid and serum electrolytes changes, particularly serum sodium to the extent that overt symptoms are produced.

The aim of this descriptive study is to analyse serum sodium changes and its clinical relevance in benign prostatic hyperplasia patients who underwent transurethral resection of prostate.

MATERIALS AND METHODS

This descriptive study was done among 100 benign hyperplasia prostate patients without any comorbid illness underwent TURP in Urology Department, Thanjavur Medical College Hospital, Thanjavur, Tamilnadu, in between period from February 2015 to January 2017. Preoperative and postoperative serum sodium levels correlated with signs and symptoms developed with various age groups, various prostate gland sizes, resection times and volume of irrigation fluids. Statistical tests used in this study are ANOVA followed by Tukey's HSD test.

RESULTS

Sodium level has fallen by 14 mEq/L, raised by 2 mEq/L, postoperatively. Major fluctuation in serum sodium seen in 71-80 years age group patients; in 51-75 Gms group patients, resection time more than 60 Mints group patients, in 25-29 Litres irrigant group patients and in moderate TURP syndrome group patients. Severe TURP syndrome was not observed in any patient. Age is directly proportional to the degree of hyponatraemia. Mean sodium decrease (9.22 mEq/L) was highest in moderate TURP syndrome group. Degree of hyponatraemia directly proportional to blood pressure elevation, inversely related with pulse rate.

CONCLUSION

In patients aged more than 80 years without comorbid medical condition, it is better to complete procedure as quick as with low volume irrigation, aged less than 80 years and without comorbid medical conditions, larger glands up to 78 Gms maybe safely resected with the limit of 60 minutes resection time. In perioperative blood pressure and pulse rate monitoring will help to pick up TUR syndrome early.

KEYWORDS

TURP Syndrome, Dilutional Hyponatraemia, Central Pontine Myelinolysis.

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BACKGROUND

Many endourological procedures require the use of an irrigation fluid to dilate the operating field and to wash away debris and blood.

A potential complication of such irrigation is systemic absorption of the fluid and serum electrolytes changes; particularly serum sodium to the extent that overt symptoms are produced. The consequences depend on the rate, volume and nature of the fluid absorbed. Other adverse effects due to fluid absorption soon became apparent. They arise in both the cardiovascular and nervous systems and in the late 1950s, became known as the 'Transurethral Resection (TUR) syndrome.'

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Since then, several hundred life-threatening and even fatal events have been reported. Severe events are associated with serum sodium level <115 mEq/L.

The reference interval for serum sodium is 135 to 145 mEq/L from infancy throughout life.

Hyponatraemia is defined as a decreased plasma sodium concentration <136 mEq/L hyponatraemia manifests itself clinically as generalised weakness and mental confusion at values <120 mEq/L, bulbar or pseudobulbar palsy at <110 mEq/L and severe mental impairment between 90 and 105 mEq/L.^(1,2)

Aim

The aim of this descriptive study is to analyse serum sodium changes and its clinical relevance in benign prostatic hyperplasia patients who underwent transurethral resection of prostate in Thanjavur Medical College Hospital from February 2015 to January 2017.

MATERIALS AND METHODS

Type of Study

Descriptive Study.

Area Selection

The study was conducted among Inpatients of Urology Department, Thanjavur Medical College hospital, Thanjavur, Tamilnadu.

Period Selection

The study was conducted in between period from February 2015 to January 2017.

Patient Selection

A total of 100 benign prostatic hyperplasia with bothersome symptomatic/acute urinary retention patients who underwent transurethral resection of prostate were selected.

Inclusion Criteria

Benign prostatic hyperplasia with bothersome symptomatic/acute urinary retention patients without comorbid medical illness.

Exclusion Criteria

1. Bladder neck hypertrophy.
2. Carcinoma of bladder.
3. Carcinoma of prostate.
4. Benign hyperplasia of prostate with bladder stones.
5. Benign hyperplasia of prostate with carcinoma bladder.
6. Recurrent benign hyperplasia of prostate.
7. Residual benign hyperplasia of prostate.
8. Benign prostatic hyperplasia patients who underwent TUR of prostate and died of other than TUR syndrome.
9. Patients with benign hyperplasia of prostate with any comorbid illnesses like diabetes mellitus, coronary artery disease, chronic kidney disease, chronic pulmonary disease and chronic liver diseases.

A total of 100 bothersome symptomatic benign prostatic hyperplasia patients those who underwent TURP were studied during this period between the age groups of 48-95 years, the average age being 71.5 yrs.

All the above patients were evaluated for benign prostatic hyperplasia.

The Following Evaluations were done on these Patients Preoperatively-

- Symptoms assessment (IPSS score).
- Urine culture and sensitivity.
- Haemogram.
- Blood urea, sugar, creatinine and electrolytes.
- Ultrasonogram of kidney, ureter, bladder and prostate with post void residual urine volume.
- Uroflowmetry.
- Office urethroscopy.
- Cardiac evaluation.
- Pulmonary evaluation if needed.

Constants in Study

- Spinal anaesthesia.
- Sterile water as irrigant.
- Placing the irrigating fluid drum at 60 cm above the operating table.
- 22-Fr. irrigant rubber tube.
- 24-Fr. non-continuous irrigation resectoscope sheath.

- Resection without SPC.
- Done by equally skilled surgeons.

Variables Observed in Study

- Patient age.
- Gland size.
- Immediate preoperative serum sodium value.
- Immediate preoperative pulse rate.
- Immediate preoperative blood pressure.
- Resection time.
- Irrigant volume.
- Blood pressure immediately completing the procedure.
- Pulse rate immediately completing the procedure.
- Immediate postoperative serum sodium value.
- Symptoms and signs in perioperative periods.

Gland Size Measurement

Gland size is measured by conventional ultrasound. The volume in cubic centimetres of prostate is comparable to weight in grams due to its specific gravity, which is 1.050.⁽³⁾

Serum Sodium Measurement

Blood samples 5 cc in amount collected immediate pre and postoperative periods. Serum sodium is measured in our hospital laboratory by flame emission spectrophotometry.⁽⁴⁾

Resection Time

Resection time is the period in minutes between times of initiation of resection to the time at which last activation diathermy is done.

Irrigant Volume

Irrigation volume is volume of sterile water in litres, which is irrigated during the period of resection time.

Symptoms and Signs in Perioperative Period

Clinical signs and symptoms observed in perioperative period were categorised as mild, moderate and severe.^(5,6,7,8)

Mild

Nausea, vomiting, headache, restlessness, bradycardia up to 30 beats variation per minute, hypertension up to 60 mmHg variation of systolic pressure, up to 30 mmHg variation of diastolic pressure. In perioperative blood pressure and pulse rate monitoring will help to pick up TUR syndrome early.⁽⁹⁾

Moderate

Confusion, abdominal pain, abdominal distension, visual disturbances, bradycardia more than 30 beats variation per minute, hypertension more than 60 mmHg variation of systolic pressure, more than 30 mmHg variation of diastolic pressure.

Severe

Convulsion, cerebral oedema, coma, pulmonary oedema. Disseminated intravascular coagulation.

Statistical Analytical Methods

Standard deviation, 'p' values, 'f' values were calculated by Tukey HSD test, ANOVA test and p value <0.05 was taken as significant. All statistical tests were interpreted at 5% level of significance.

RESULTS

Age Distribution

		No. of Patients (N)	Percentage (%)
Age Group (Yrs.)	<=50	4	4
	51-60	32	32
	61-70	41	41
	71-80	19	19
	>80	4	4

Table 1. Age Distribution in the Study Population (n=100)

100 patients in the age range of 48-95 yrs. were observed, the average age being 71.5 yrs., observed patients were divided into 5 age groups (Table 1).

Majority of patients (41%) have come under 61-70 group.

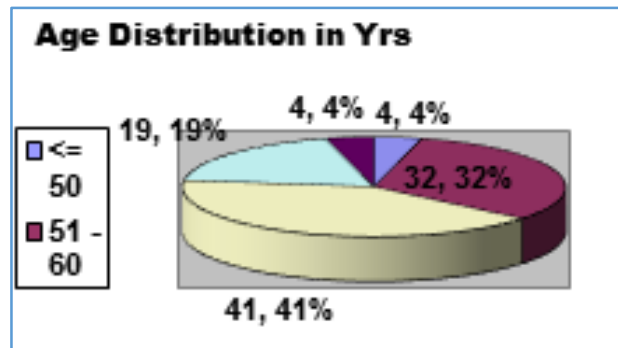


Figure 1. Age Distribution in the Study Population (n=100)

Degree of sodium change among this various age group of patients analysed statistically by ANOVA followed by Tukey HSD test.

Descriptive Na+ Difference in Relation with Age Group									
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum*	Maximum*	
					Lower Bound	Upper Bound			
<=50	4	1.00 ^a	2.944	1.472	-3.68	5.68	-2	4	
51-60	32	4.25 ^{ab}	3.312	0.585	3.06	5.44	-1	11	
61-70	41	4.56 ^{ab}	1.817	0.284	3.99	5.13	1	10	
71-80	19	5.00 ^b	3.197	0.733	3.46	6.54	2	14	
>80	4	6.75 ^b	2.630	1.315	2.57	10.93	3	9	
Total	100	4.49	2.805	0.281	3.93	5.05	-2	14	

Table 2

F = 2.573; P = 0.043.

Different alphabet between age groups denote significant risk at 5% level.

*Values with negative symbol (-) denoted sodium value more in postoperative than preoperative sample.

*Values with positive side denoted sodium value less in postoperative than preoperative sample.

Sodium level has fallen by 14 mEq/L and raised by 2 mEq/L postoperatively. Major fluctuation in serum sodium (2-14 mEq/L) seen in 71-80 years age group patients. But, mean sodium decrease (6.75 mEq/L) was highest in >80 years age group. This observation was significant. F value was 2.573, P value was 0.043, which is statistically significant.

Gland Size

In this study, largest gland resected was 108 Gms, smallest resected gland was 23 Gms in size. Majority of patients (50%) have come under 26-50 Gms group.

		No. of Patients (N)	Percentage (%)
Gland size in g	<=25	9	9
	26-50	50	50
	51-75	27	27
	76-100	10	10
	>100	4	4

Table 3. Prostate Gland Sizes of the Study Population (n=100)

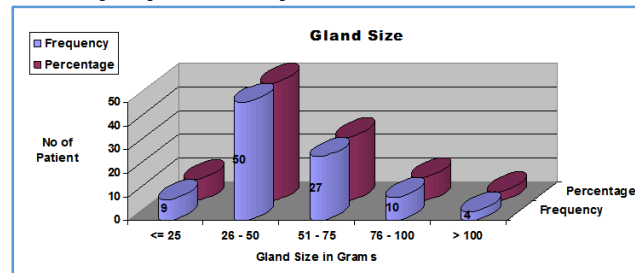


Figure 2. Prostate Gland Sizes of the Study Population (n=100)

Degree of sodium change among this various age group of patients analysed statistically by ANOVA followed by Tukey HSD test.

Descriptive Sodium Difference in Relation with Gland Size									
Gland Size in Gms	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum*	Maximum*	
					Lower Bound	Upper Bound			
<=25	9	1.89 ^a	1.833	0.611	0.48	3.30	-1	4	
26-50	50	3.22 ^{ab}	1.694	0.240	2.74	3.70	-2	6	
51-75	27	5.67 ^{bc}	2.587	0.498	4.64	6.69	2	14	
76-100	10	8.00 ^{cd}	1.826	0.577	6.69	9.31	4	10	
>100	4	9.50 ^d	1.291	0.645	7.45	11.55	8	11	
Total	100	4.49	2.805	0.281	3.93	5.05	-2	14	

Table 4

F = 25.394; P = 0.001.

Different alphabet between age groups denotes significant risk at 5% level.

*Values with negative symbol (-) denoted, sodium value more in postoperative than preoperative sample.

*Values with positive side denoted, sodium value less in postoperative than preoperative sample.

Sodium level has fallen by 14 mEq/L and raised by 2 mEq/L postoperatively. Major fluctuation in serum sodium (2-14 mEq/L) seen in 51-75 Gms group patients. But, mean hyponatraemia (9.50 mEq/L) was highest in >100 Gms group. This observation was significant. F value was 25.394, P value was 0.001, which is statistically significant.

Resection Time

In this study, resection time observed in the range of 17-90 minutes. Majority of patients (39%) have come under 41-60 minutes group.

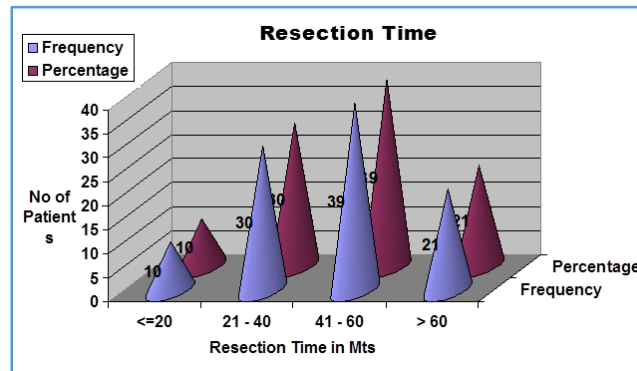


Figure 3. Resection Time Taken in the Study Population (n=100)

Degree of sodium change among this various age group of patients analysed statistically by ANOVA followed by Tukey HSD test.

		No. of Patients (N)	(%)
Resection Time in mts.	<=20	10	10
	21-40	30	30
	41-60	39	39
	>60	21	21
Total		100	100

Table 5. Resection Time Taken in the Study Population (n=100)

Descriptive Sodium Difference in Relation with Resection Time								
Resection Time in mts.	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
<=20	10	2.20 ^a	1.814	0.573	0.90	3.50	-1	4
21-40	30	3.43 ^a	1.633	0.298	2.82	4.04	-2	6
41-60	39	3.82 ^a	2.138	0.342	3.13	4.51	-1	11
>60	21	8.33 ^b	2.058	0.449	7.40	9.27	5	14
Total	100	4.49	2.805	0.281	3.93	5.05	-2	14

Table 6

F = 36.225; P = 0.001.

Different alphabet between age groups denote significant risk at 5% level.

*Values with negative symbol (-) denoted, sodium value more in postoperative than preoperative sample.

*Values with positive side denoted, sodium value less in postoperative than preoperative sample.

Sodium level has fallen by 14 mEq/L and raised by 2 mEq/L postoperatively. Major fluctuation in serum sodium (5-14 mEq/L) seen in resection time more than 60 Mints. group patients. Mean sodium decrease (8.33 mEq/L) was also highest in resection time more than 60 Mints. group. This observation was significant. F value was 36.225, P value was 0.001, which is statistically significant.

Irrigant Volume

In this study, irrigant volume observed was in the range of 10-32 litres. Majority of patients (32%) have come under irrigant volume 20-24 litres group.

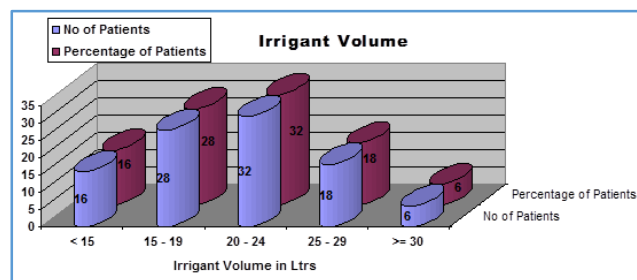


Figure 4. Irrigant Volume Used in the Study Population (n=100)

Descriptive Sodium Difference in Relation with Irrigant Volume								
Irrigant Volume in Ltrs.	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum*	Maximum*
					Lower Bound	Upper Bound		
<15	16	2.75 ^a	1.571	0.393	1.91	3.59	0	6
15-19	28	3.36 ^a	2.112	0.399	2.54	4.18	-2	7
20-24	32	4.22 ^a	2.282	0.403	3.40	5.04	-1	11
25-29	18	6.67 ^b	2.910	0.686	5.22	8.11	2	14
>=30	6	9.33 ^c	0.816	0.333	8.48	10.19	9	11
Total	100	4.49	2.805	0.281	3.93	5.05	-2	14

Table 7. Irrigant Volume Used in the Study Population (n=100)

		No. of Patients (N)	(%)
Irrigant Volume in Ltrs.	<15	16	16
	15-19	28	28
	20-24	32	32
	25-29	18	18
	>=30	6	6
Total		100	100

Table 8

F = 15.932; P = 0.001.

Different alphabet between age groups denotes significant risk at 5% level.

*Values with negative symbol (-) denoted, sodium value more in postoperative than preoperative sample.

*Values with positive side denoted, sodium value less in postoperative than preoperative sample.

Sodium level has fallen by 14 mEq/L and raised by 2 mEq/L postoperatively. Major fluctuation in serum sodium (2-14 mEq/L) seen in 25-29 litres. irrigant group patients. But, mean sodium decrease (9.33 mEq/L) was highest in irrigant volume more than 30 litres group. This observation was significant. F value was 15.932, P value was 0.001, which is statistically significant.

Symptomatic vs. Asymptomatic Patients

	No. of Patients (N)	(%)
Asymptomatic	70	70
Mild form TURP syndrome	21	21
Moderate form TURP syndrome	9	9
Total	100	100

Table 9

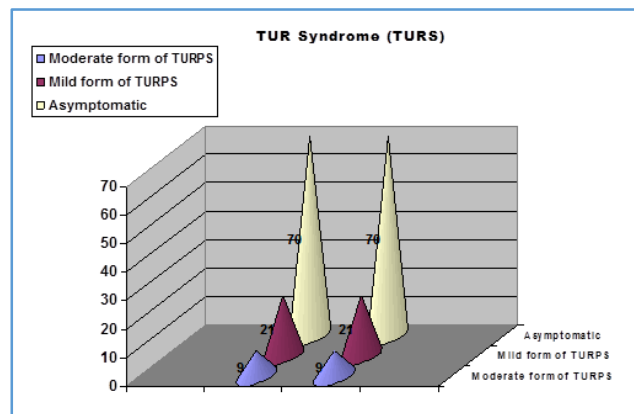


Figure 5. Asymptomatic, Symptomatic Patients in the Study Population (n=100)

Degree of sodium change among this various age group of patients analysed statistically by ANOVA followed by Tukey HSD test.

Descriptive Sodium Differences in Relation with TURP Syndrome									
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum*	Maximum*	
					Lower Bound	Upper Bound			
Asymptomatic	70	3.27	1.760	0.210	2.85	3.69	-2	8	
Mild	21	6.52	2.400	0.524	5.43	7.62	2	11	
Moderate	9	9.22	2.682	0.894	7.16	11.28	4	14	
Total	100	4.49	2.805	0.281	3.93	5.05	-2	14	

Table 10

F = 49.2171; P = 0.001.

Different alphabet between age groups denote significant risk at 5% level.

*Values with negative symbol (-) denoted, sodium value more in postoperative than preoperative sample.

*Values with positive side denoted, sodium value less in postoperative than preoperative sample.

Sodium level has fallen by 14 mEq/L and raised by 2 mEq/L postoperatively. Major fluctuation in serum sodium (4-14 mEq/L) seen in moderate TURP syndrome group patients. Mean sodium decrease (9.22 mEq/L) was also highest in moderate TURP syndrome group. This observation was significant. F value was 49.2171, P value was 0.001, which is statistically significant. In asymptomatic patients, mean sodium decrease was 3.27 mEq/L postoperatively. Severe TURP syndrome was not observed in any patient.

DISCUSSION

Age and Sodium Dynamics

In my study, age is a significant factor, which affects sodium changes in TURP patients. This study shows age is directly proportional to the degree of hyponatraemia. Richard H. Harrison III et al has shown in his study that age is a risk factor for development of TURP syndrome.⁽⁵⁾ Bosch et al has shown in his study in elderly patient, extracellular volume

deficit slightly over a litre with electrolyte deficit. Glomerular filtration rate and renal blood flow decrease by about 1% per annum after the age of 30 years in normal person. Degree of dilutional hyponatraemia more in elderly.⁽⁵⁾ Logan and Holtgrewe et al have concluded that there appears a profound increase in mortality and morbidity rate after the seventh decade of life.

Gland Size and Sodium Dynamics

In my study, mean sodium decrease was increased when gland size was increased. This observation was statistically significant. When gland size increases, resection time naturally increases. Chance of fluid absorption will be more. In my study, patients did not develop TUR syndrome even with large glands (<=78 gms), but all they had their resection time was within 60 minutes. AUA cooperative study by Mebust et al 1989 has concluded that risk of TUR syndrome is more, if the gland is more than 45 Gms in size.⁽¹⁰⁾ Agius AM

and Cutajar CL et al has concluded that serum sodium change was high with large gland size.

Resection Time and Sodium Dynamics

In my study, mean sodium decrease was increased when resection was increased. This observation was significant. Mean sodium decrease (8.33 mEq/L) was also highest in resection time more than 60 Mints. group. Major fluctuation in serum sodium (5-14 mEq/L) seen in resection time more than 60 Mints. group patients. Desmond J et al reported that dangerous fluid absorption during TURP is prevented by keeping the operating time below 60 Minutes.⁽¹¹⁾ Nesbid reported that the resection time should be limited to 60 Minutes.^(12,13) Richard H. Harrison III et al limited their resection time approximately to 60 minutes to prevent high degree of dilutional hyponatraemia and TUR syndrome.⁽⁵⁾ Hagstorm in his studies on fluid absorption, correlated resection time with fluid absorption and found that from 10-30 cc of fluid are absorbed for each minute of resection time.⁽¹⁴⁾

Irrigant Volume and Sodium Dynamics

In my study, mean sodium decrease was increased when irrigant volume was increased. This observation was significant. Significant amounts of fluid maybe absorbed during a TURP, especially if venous sinuses are opened.⁽¹⁵⁾ Hahn RG, Ekengren J have concluded that major fluid absorption rarely stops once initiated and often coincides with a decrease in arterial pressure.⁽¹⁶⁾ Madsen and Naber⁽¹⁷⁾ irrigation rate of 300 mL/min. was necessary to maintain good visualisation and that this rate cannot be adequately maintained if the fluid height is less than 60 cm. Due to poor visibility, if irrigation rate was increased by raising the height of the fluid from 60 cm to 70 cm doubled the irrigation fluid pressure. Madsen and Naber⁽¹⁷⁾ found that fluid absorption was directly related to irrigation fluid pressure. If more fluid absorbed, more degree of dilutional hyponatraemia.

TUR Syndrome and Sodium Dynamics

In my study, sodium level has fallen up to 14 mEq/L. Mean sodium decrease (9.22 mEq/L) was also highest in moderate TURP syndrome group. This observation was significant. All patients with mild TUR syndrome had the serum sodium level ≤ 130 mEq/L postoperatively. All patients with moderate TUR syndrome had the serum sodium level ≤ 125 mEq/L postoperatively. The clinician should be aware of a mild TUR syndrome, which is easily overlooked. This presents with nausea and often a sudden reduction in arterial pressure 30-45 mins. after the operation. Serum sodium is lowered 5-10 mEq/litre.⁽³⁾ Hyponatraemia (<120 mEq/litre) may cause muscle weakness, muscular twitches, epileptic seizures and shock.⁽¹⁸⁾ In my study, lowest postoperative value of sodium found was 122 mEq/liter that patient had moderate TUR syndrome.

In my study, 21% had mild TUR syndrome, which can be easily overlooked. Absorption of small amounts of fluid (1-2 litre) occurs in 5-10% of patients undergoing transurethral prostatic resection and results in an easily overlooked mild Transurethral Resection (TUR) syndrome.⁽¹⁹⁾

Sodium Dynamics in Relation with BP and PR Changes

In my study, degree of hyponatraemia directly proportional to blood pressure elevation, inversely related with pulse rate, both are proved significant by statistics. These finding correlates with intracranial pressure rise. N.S.R Maluf, J.S. Boren and G.E. Brandes has concluded in their study that intracranial pressure tended to rise during resection. The change averaged +79 mm of CSF to the maximum of +198 mm of CSF showed the greatest gain in weight and became hypertensive.⁽²⁰⁾

CONCLUSION

- In patients aged more than 80 years without comorbid medical condition, it is better to complete procedure as quick as with low volume irrigation.
- Patients aged less than 80 years and without comorbid medical conditions, larger glands up to 78 Gms, maybe safely resected, with the limit of 60 minutes resection time.
- Absorption of small amounts of fluid occurs in 21% of patients undergoing transurethral prostatic resection and results in an easily overlooked mild Transurethral Resection (TUR) syndrome.
- In perioperative blood pressure and pulse rate monitoring will help to pick up TUR syndrome early.

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