ASIAN JOURNAL OF PHARMACEUTICAL AND CLINICAL RESEARCH

INNOVARE ACADEMIC SCIENCES
Knowledge to Innovation

Vol 17, Issue 2, 2024

Online - 2455-3891
Print - 0974-2441

Research Article

AN OBSERVATIONAL STUDY TO COMPARE SPINAL ANESTHESIA-INDUCED HEMODYNAMIC CHANGES IN NORMOTENSIVE AND HYPERTENSIVE PATIENTS ON ANTIHYPERTENSIVE MEDICATIONS

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Received: 04 December 2023, Revised and Accepted: 19 January 2024

ABSTRACT

Objectives: Spinal anesthesia is a popular and widely used anesthetic technique for lower abdominal, pelvic, and lower limb surgery. It has proven to be a convenient, economical, and easily motivated technique that provides excellent anesthesia and post-operative analgesia. Hypotension and bradycardia occur frequently following spinal anesthesia due to blockade of sympathetic outflow. Antihypertensive agents decrease this effect by controlling blood pressure. There are conflicting reports on the continuation of antihypertensive drugs on the day of surgery in patients undergoing spinal anesthesia. Sudden hypotension could have detrimental effect on the organ systems. This study was undertaken to compare the spinal anesthesia-induced hemodynamic changes in normotensive and in hypertensive patients on antihypertensive therapy.

Methods: The study was conducted in the Department of Anesthesiology, Gandhi Medical College, and associated Hamidia Hospital Bhopal during January 2019–July 2020. It was an observational study conducted on 100 patients of ASA Grade 2 and Grade 3 in the age group between 35 and 60 years. Undergoing lower limb surgery under spinal anesthesia, patients were allocated into two groups: Group N (n=50) normotensive and Group H (n=50) hypertensive patients receiving antihypertensive medication.

Results: Incidence of hypotension was significantly higher in Group II patients. Single episode of hypotension was seen in 12 (24.0%) patients in Group I and 33 (66.0%) in Group II patients respectively. Three episodes of hypotension were seen in 3 (6.0%) Group I and 4 (8.0%) Group II patients, respectively**.** The frequency of administration of mephentermine was 2 times more significant in Group II who required treatment with mephentermine more than twice as compared to Group I (p=0.001). There was statistically no significant difference found in mean Heart rate between Group I (normotensive) and Group II (hypertensive), respectively (p>0.05).

Conclusion: Antihypertensive medications decreased the incidence of hypotension by controlling blood pressure but their varying effects on the cardiovascular system might alter the hemodynamics during the initial phase of subarachnoid block. We found that patients on antihypertensive therapy (calcium channel blockers) had increased incidence of intraoperative hypotension after SAB and when compared to normotensive patients required vasopressors more often to maintain normal blood pressure.

Keywords: Hypotension, Bradycardia, Spinal anesthesia, Antihypertensive medications.

 DOI: http://dx.doi.org/10.22159/ajpcr.2024v17i2.50384. Journal homepage: https://innovareacademics.in/journals/index.php/ajpcr

INTRODUCTION

Spinal anesthesia is a popular and widely used anesthetic technique for lower abdominal, pelvic, and lower limb surgery. It has proven to be convenient, economical, and easily motivated technique that provides excellent anesthesia and post-operative analgesia [1]. The most common complication encountered with spinal anesthesia is hypotension with an abrupt decrease in arterial pressure resulting from the rapid onset and high-level blockade which is due to sympathetic nervous system blockade [2,3]. As a result, decreased systemic vascular resistance and peripheral pooling of blood occur which decreases cardiac output. In some cases, these cardiovascular effects can manifest as profound hypotension and bradycardia in some instances. Even a mild drop in blood pressure is significant in high-risk patients such as the elderly and in those with underlying organ dysfunction in whom the autoregulatory mechanism may be abnormal [4]. Hemodynamic instability is more likely to occur in patients with hypertension [5]. Severe hypertension and hypotension may occur in the hypertensive patient during the perioperative period [6]. Much of the abnormal hemodynamic responses seen. The intraoperative responses reflect the reaction to antihypertensive drugs and the cardiovascular response to anesthetic drugs. Risk of adverse events related to hypertension occurring during surgery can be reduced by good pre-operative control of the blood pressure, and continuation of pre-operative antihypertensive therapy [7]. Hypertensive patients can develop wide swings in blood pressure following subarachnoid block intraoperatively, which increases the risk of post-operative cardiac and renal complications such as myocardial ischemia, cerebrovascular accidents, and acute renal failure, independent risk factors were identified [8,9] which are necessary for the prevention of perioperative cardiac events causing both morbidity and mortality than normotensive patients with similar degree of sympathetic blockade [10].

The structural changes in arteriolar walls play a major role in hemodynamic response to anesthesia and explain greater changes in systemic vascular resistance and arterial pressure in hypertensive patients. The incidence of hypotension and bradycardia in hypertensive patients on regular medication depends on standardized doses of calcium channel blocker. Verapamil and nifedipine represent two types of calcium-channel blockers, each having a different mechanism of action. This present study observes the variation in hemodynamics in control and hypertensive patients taking antihypertensive medication, (calcium channel blocker) undergoing surgery in spinal anesthesia.

METHODS

This study was conducted in the Department of Anaesthesiology, Gandhi Medical College, and associated Hamidia Hospital during period from January 2019 to July 2020. It was an observational study conducted on 100 patients of ASA Grade 2 and Grade 3 in the age group between 35 and 60 years. Undergoing lower limb surgery under spinal anesthesia. After taking a written and informed consent, these patients were divided into two groups with 50 patients in each Group I and Group II. We evaluated the comparison of spinal anesthesia-induced hemodynamic changes in normotensive and hypertensive patients on antihypertensive medications.

Inclusion criteria

The following criteria were included in the study:

1. Age 35–60 years
2. ASA Grade 2 and 3
3. Essential hypertension receiving antihypertensive medication (calcium channel blocker)

Exclusion criteria

The following criteria were excluded from the study:

1. Age <35 years and >60 years.
2. ASA grades 1, 4, and more
3. BMI >35/kg2
4. Patients receiving Calcium channel blockers <1 month, >10 years.
5. Intraoperative massive blood loss.
6. Patient refusal
7. History of MI Stroke and CAD or CRF, history of diabetes mellitus, peripheral neuropathy serious pulmonary, hepatic, renal, coronary artery, or spine disease, History of local anesthetic drug allergies, Patient with h/o drug abuse, alcoholism, Patients having a history of significant neurological, psychiatric, or neuromuscular disorders, Local skin site infections and Bleeding diathesis or Anemia

All the patients were subjected to detailed pre-anesthetic evaluation with clinical history and systemic examination. Special consideration was given to elicit hypertension, breathlessness, pain, cough, wheezing, previous anesthesia, and drug sensitivity. The nutritional status, airway assessment, and spine examination were also done on the previous day of surgery. Routine investigations such as hemogram, random blood sugar, renal profile, urine examination, X-ray chest, and ECG were done. Patients on antihypertensive medication were advised to take morning dose of antihypertensive medication with sip of water on the day of surgery. All patients were advised kept NBM for 6 h Tab. Ranitidine 150 mg was given in previous night orally. All patients were informed about the procedure and written consent was taken.

At the pre-anesthetic clinic, patients were assessed, explained about the procedure, anesthesia, and consent were obtained. Inside the OT electrocardiography, peripheral saturation of oxygen (SpO_2) and non-invasive blood pressure monitor was attached and after stabilization period of 10–15 min, all the basal parameters were recorded. An IV access with 20 gauge cannula was secured, and all patients were preloaded with Ringer lactate solution 10–15 mL/kg body weight over 10 min. Standard monitoring included continuous ECG, pulse rate, SpO_2, and automated noninvasive blood pressure (systolic blood pressur [SBP], diastolic blood pressure [DBP], and mean arterial pressure [MAP]) was carried out. Baseline values were taken as the reading during rest period after infusion of fluids. Sensory blockade was assessed using pinprick method bilaterally. Motor block was assessed using a Modified Bromage Scale. Motor block duration was defined as the total time taken to return to Modified Bromage Scale 0. The highest sensory block level and recovery time of both sensory and motor block were recorded.

Sensory block grading

Grade	Sensory block
0	Sharp pin feel
1	Analgesia, dull sensation felt
2	Anesthesia, no sensation felt

Degree of motor block

This was assessed by patient's movements of leg and feet till no further change was observed. This was classified into four grades: Bromage PR and Coworkers in 1962.

Modified bromage score

Score	Criteria
0	Full movement
1	Inability to raise extended leg, can bend knee
2	Inability to bend knee, can flex ankle
3	No movement

After the satisfactory level of analgesia was achieved, surgeons were asked to start the operation.

Statistical analysis was done using Statistical Package of the Social Science (SPSS Version 20; Chicago Inc., USA). Data comparison was done by applying specific statistical tests to find out the statistical significance of the comparisons. Quantitative variables were compared using mean values and qualitative variables using proportions. Significance level was fixed at $p<0.05$. The Chi-square test was used to evaluate the statistical significance of differences in frequencies between subgroups. Comparison between two groups was done using unpaired "t" test for quantitative data and Chi-square test for qualitative data.

RESULTS

A total of 100 patients fulfilling inclusion criteria were enrolled and were allocated into two groups of 50 in each group. The demographic characteristics of both the groups were comparable as shown in Table 1. The mean age was 54.14±5.9 years. There was no significant difference between the groups with respect to age, sex, ASA Grade, mean heart rate, onset, and duration of sensory blockade or motor block ($p>0.05$). However, in Group II, the incidence of hypotension and bradycardia was statistically highly significant compared to Group I ($p<0.001$). Mean SBP at baseline was significantly higher in Group II patients (137.88±5.36 mmHg) compared to Group I (118.40±8.45 mmHg). The difference was statistically significant. After spinal anesthesia, there was a gradual fall in SBP with maximum fall at 20 min. (12.16% in Group I and 28% in Group II).

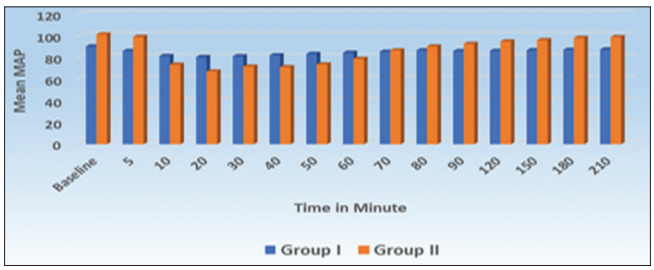

Fig. 1: Comparative evaluation of changes in MAP between Group I and Group II patients at different time intervals

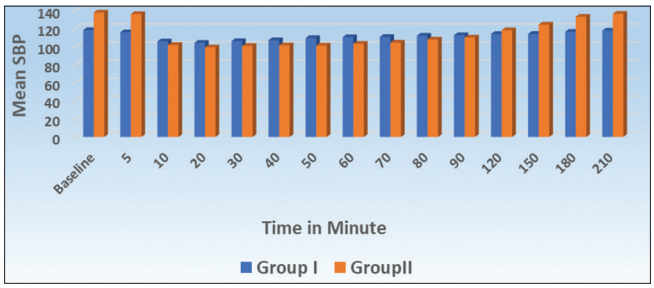

Fig. 2: Comparative evaluation of changes in SBP between Group I and Group II patients at different time intervals

Table 1: Demographic distribution of study subject

Gender	Group I (Normotensive)	Group II (Hypertensive)	Total	Chi-square value	p-value
Male	44 (88.0%)	42 (84.0%)	86 (86.0%)	0.332	0.564(NS)
Female	6 (12.0%)	08 (16.0%)	14 (14.0%)		
ASA grade					
Grade II	40 (80.0%)	36 (72.0%)	76 (76.0%)	0.877	0.349(NS)
Grade III	10 (20.0%)	14 (28.0%)	24 (24.0%)		
Total	50	50	100	Student 't' test value	p-value
Mean age (year)	47.74±7.8 year	54.14±5.9 year		1.354	0.350(NS)

Table 2: Comparative evaluation of changes in heart rate between Group I and Group II hypertensive patients at different time intervals

Hear rate (Beat Per Minute) at different time interval	Group I (Normotensive)		Group II (Hypertensive)		Student t-test Value	Sig. P value
Minute	Mean	SD	Mean	SD		
Baseline	80.88	9.445	82.44	4.390	1.738	0.085(NS)
5 min	77.10	6.887	79.94	6.696	1.355	0.178(NS)
10 min	76.20	4.868	78.16	8.723	0.283	0.977(NS)
20 min	72.68	8.054	70.60	9.756	1.163	0.247(NS)
30 min	78.32	9.759	79.76	8.778	0.776	0.439(NS)
40 min	75.20	8.593	76.16	9.121	0.541	0.589(NS)
50 min	74.80	9.071	75.56	10.881	0.379	0.705(NS)
60 min	74.84	7.341	75.00	7.908	0.104	0.916(NS)
70 min	74.94	8.257	75.60	8.070	0.404	0.686(NS)
80 min	75.56	5.422	77.40	10.734	1.082	0.281(NS)
90 min	76.00	6.490	78.52	9.413	1.558	0.122(NS)
120 min	76.28	7.212	78.56	6.312	1.563	0.1624(NS)
150 min	76.98	8.660	79.66	5.553	1.842	0.068(NS)
180 min	77.20	6.252	80.16	4.342	1.582	0.078(NS)
210 min	77.56	8.324	80.36	5.531	1.265	0.810(NS)

Table 3: Incidence of Hypotension between Group I and Group II patients

Incidence of Hypotension	Group I (Normotensive)	Group II (Hypertensive)	Total	Chi-square value	Sig. P value
1 Episode	12 (24.0%)	33 (66.0%)	45 (45.0%)	44.074	0.001(HS)
2 Episode	3 (6.0%)	13 (26.0%)	16 (16.0%)		
3 Episode	3 (6.0%)	4 (8.0%)	7 (7.0%)		

Table 4: Comparison of onset and duration of sensory blockade

	Group I (Normotensive)		Group II (Hypertensive)		Student t-test value	Sig. P value
	Mean	SD	Mean	SD		
Onset of Sensory Blockade (min)	4.596	0.937	4.452	0.658	0.889	0.376(NS)
Duration of (min) Sensory Blockade	176.36	9.483	173.72	11.597	1.246	0.215(NS)

The 67 difference in fall of SBP was statistically significant (Fig. 2). Mean DBP at baseline was significantly higher in Group II patients (83.56±4.37 mmHg) compared to Group I (76.08±9.25 mmHg). The difference was statistically significant. After spinal anesthesia, there was a gradual fall in DBP with maximum fall at 20 min. (10.52% in Group I and 33% in Group II). The difference in fall of DBP was statistically significant (Fig. 3). Mean MAP at baseline was significantly higher in Group II patients (101.42±3.28 mmHg) compared to Group I (90.40±10.78 mmHg). The difference was statistically significant. After spinal anesthesia, there was a gradual fall in MAP with maximum fall at 20 min. (11.11% in Group I and 30% in Group II). The difference in fall of MAP was statistically significant (Fig. 1).

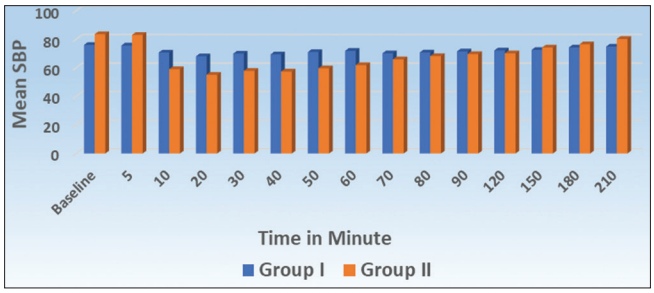

Fig. 3: Comparative evaluation of changes in DBP between Group I and Group II patients at different time intervals

DISCUSSION

Spinal anesthesia is widely used for infraumbilical and lower limb surgeries. It is an easy convenient and economical technique which provides excellent anesthesia and post-operative analgesia. Hypotension and bradycardia occur frequently following spinal anesthesia due to blockade of sympathetic outflow. These side effects can be prevented and treated by effective prophylaxis and timely therapeutic intervention, for example, preloading, vasopressors, and ionotropic drugs to decrease morbidity and mortality [11]. In this study, we compared the incidence of hemodynamic changes in hypertensive

Table 5: Comparison of onset and duration of motor blockade

	Group I (Normotensive)		Group II (Hypertensive)		Student t-test value	Sig. P value
	Mean	SD	Mean	SD		
Onset of motor blockade (min)	6.56	1.065	6.25	1.043	1.443	0.144(NS)
Duration of motor blockade (min)	150.46	11.374	151.04	12.730	0.240	0.810(NS)

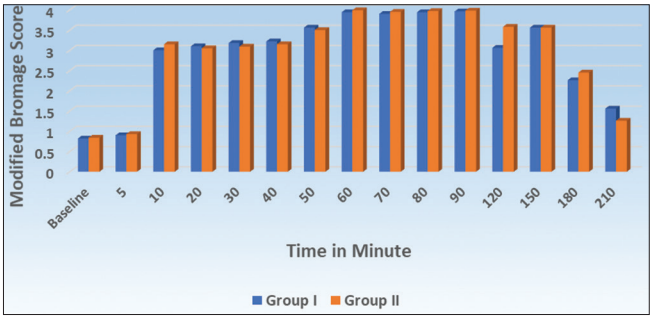

Fig. 4: Comparative evaluation of modified Bromage Score between Group I and Group II patients at different time intervals

patients on calcium channel blockers with that in normotensive patients following spinal anesthesia. Antihypertensive medications decreased the incidence of hypotension by controlling blood pressure but their varying effects on the cardiovascular system might alter the hemodynamics during the initial phase of subarachnoid block.

In our study, the mean age in Group I was 47.74 7.8 years and 54.14 5.9 years in Group II, respectively. The difference of age in both groups was found to be statistically not significant (p>0.05). This corresponds with the study done by Acar *et al*. [14]. 3 mL of 0.5% hyperbaric bupivacaine was used for spinal anesthesia in Group I and Group II. This dose selection is made in accordance with the following study Kaimar *et al*. [12], Kavyashree *et al*. [13] 3 mL of hyperbaric bupivacaine was administered over 10 s periods. The number of patients with ASA grade II was 40 (80%) and 36 (72.0%), respectively, in Group I and Group II. The number of patients in ASA Grade III was 10 (20%) and 14 (28%), respectively, in Group I and Group II, respectively. There was statistically no significant difference in ASA Grade II and III grade among the two groups.

In our study, we did not observe a significant fall in heart rate after SAB. This can be explained on the basis of the differential block, according to which autonomic block is two segments higher than sensory block. The maximum sensory level achieved in our study was T8 and so the autonomic block level might have been T6 which explains our findings. Similarly, Kavyashree et al. [8] (2016) observed a significant fall in heart rate in patients receiving beta blocker compared to those on calcium channel blockers. The mean heart rate was 80.88±9.44 beat per minute and 82.44±4.39 beats per minute in Group I and II, respectively. The mean heart rate showed a transient fall at around 20 min after SAB in both the groups but there was no statistically significant difference between the groups. Thereafter, heart rate was comparable and stabilized throughout the observation period. Our findings correlate with Kaimar et al. [12] who noted significant bradycardia in beta blocker treated group and no changes in heart rate in calcium channel blocker group. Our findings are consistent with Kavyashree et al. [8] (2016) who also observed statistically significant fall in SBP, DBP, and MAP up to 20 min of spinal anesthesia. On comparing, the present study observed 28% fall in SBP as compared to 23% fall in SBP from baseline mentioned in her study. Our findings correlated well with this study which also showed that hypotension is more common in patients treated with calcium channel blockers than those on beta blockers. This effect could be explained due to peripheral vasodilatation already existing in patients on calcium channel blockers and could have been exaggerated by decreased vascular resistance after spinal anesthesia.

In our study, incidence of hypotension between normotensive and hypertensive patients was significantly higher in Group II patients as compared to Group I. Single episode of hypotension was seen in 12 (24%) patients of Group I and 33 (66%) in Group II, respectively. Three episodes of hypotension were seen in 3 (6%) patients in Group I and 4 (8%) of Group II patients, respectively. There was statistically highly significant difference found in incidence of hypotension in Group II patients compared to Group I (p=0.001). The similar findings were observed in a cross-sectional study by Yousaf *et al*. [1], who noted hypotension in (62%) of hypertensive patients compared to (34%) of normotensives.

CONCLUSION

In our study, we found that patients on antihypertensive therapy (calcium channel blockers) had increased incidence of intraoperative hypotension after SAB and when compared to normotensive patients required vasopressors more often to maintain normal blood pressure. Antihypertensive medication when continued till the morning of the day of surgery decreases the incidence of hypotension, but their varying effects on the cardiovascular system can alter the hemodynamics during the initial phase of SAB. Hence, to present detrimental effects following SAB, Hypertensive patients should have MAP within acceptable range and take antihypertensive therapy regularly and in the morning of surgery.

ETHICAL APPROVAL

The study was approved by the Institutional Ethics Committee, GMC Bhopal.

ACKNOWLEDGMENT

The authors would like to thank all study participants for their valuable time. Authors would like to extend their gratitude to the staffs of the Department of Anesthesia, Gandhi Medical College, Bhopal, MP for their contributions and technical supports.

CONFLICTS OF INTEREST

None declared.

FUNDING

No funding sources.

REFERENCES

1. Yousaf M, Rabbani MW, Ahmad MS. Comparison of spinal anaesthesia induced fall in blood pressure in normotensive and hypertensive patients. Br J Anaesth 2014:.
2. Brown DL. Spinal, epidural and caudal anaesthesia. In: Miller RD, editor. Anesthesia. 5th ed. Philadelphia: Churchill Livingstone; 2000. p. 1496-506.
3. Cousins MJ, Bridenbaugh PO, editors. Neural Blockade. Philadelphia. J. B. Lippincott Publishers; 1980. p. 146.
4. Bhagat H, Malohtra K, Ghildyal SK, Srivastava PC. Evaluation of preloading and vasoconstrictors as a combined prophylaxis for hypotension during subarachnoid anaesthesia. Indian J Anaesth 2004;48:299-303.
5. Skarvan K. Introduction to arterial hypertension and anaesthesia: A look beyond the numbers. Baillieres Clin Anaesthesiol 1997;11:521-29. doi: 10.1016/S0950-3501(97)80040-2
6. Howell SJ, Sear JW, Foëx P. Hypertension, hypertensive heart disease and perioperative cardiac risk. Br J Anaesth 2004;92:570-83.

doi: 10.1093/bja/aeh091, PMID 15013960

7. Estafanous FG. Preoperative hypertension. In: Anaesthesia and the Heart Patient. Boston: Butterworths; 1988. p. 215-27.
8. Singla D, Kathuria S, Singh A, Kaul TK, Gupta S, Narang M. Risk factors for development of early hypotension during spinal anaesthesia. J Anaesthesiol Clin Pharmacol 2006;22:387.
9. Hartmann B, Junger A, Klasen J, Benson M, Jost A, Banzhaf A, *et al*. The incidence and risk factors for hypotension after spinal anesthesia induction: An analysis with automated data collection. Anesth Analg 2002;94:1521-9.
10. Rooke GA, Freund PR, Jacobson AF. Hemodynamic response and change in organ blood volume during spinal anesthesia in elderly men with cardiac disease. Anesth Analg 1997;85:99-105. doi: 10.1097/00000539-199707000-00018, PMID 9212130
11. Kleinman W, Mikhail M. Regional anaesthesia and pain management. In: Morgan GE, Mikhail MS, Murray MJ, editors. Clinical Anaesthesiology. New York: Lange Medical Books/McGraw-Hill; 2006. p. 289-323.
12. Kaimar P, Sanji N, Upadya M, Mohammed KR. A comparison of hypotension and bradycardia following spinal anesthesia in patients on calcium channel blockers and β-blockers. Indian J Pharmacol 2012;44:193-6. doi: 10.4103/0253-7613.93847, PMID 22529474
13. Kavyashree NG, Patel MD, Girish CN. Comparison of haemodynamic profile after spinal anaesthesia in patients on regular treatment with calcium channel blockers and β blockers. J Evol Med Dent Sci 2016;5:1922-8. doi: 10.14260/jemds/2016/455
14. Acar NS, Uzman S, Toptas M, Vahapoglu A, Akkoc I, Dinc SC. Spinal anesthesia with hyperbaric bupivacaine: A comparison of hypertensive and normotensive patients. Med Sci Monit 2013;19:1109-13. doi: 10.12659/MSM.889412, PMID 24304744
15. Sharma SK, Gajraj NM, Sidawi JE. Prevention of hypotension during spinal anesthesia: A comparison of intravascular administration of hetastarch versus lactated Ringer's solution. Anesth Analg 1997;84:111-4. doi: 10.1097/00000539-199701000-00021, PMID 8989010