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Preoperative Stellate-ganglion Blockade to Prevent Hypertension Following Coronary-artery Operations

ARUN V. BIDWAI, M.D.,* CHARLES R. ROGERS, M.D.,† MAUNSEL PEARCE, M.D.,‡ THEODORE H. STANLEY, M.D.§

Postoperative hypertension following aorto-coronary-artery–saphenous-vein bypass procedures is a serious problem, which frequently necessitates vigorous vasodilator therapy.[1,2] The cause of this complication is unknown, but might be related to sympathetic nervous system activation.[1,2] Tarazi and co-workers[3] have demonstrated that right or left unilateral stellate ganglion blockade is an effective treatment for the complication in most patients, but there have been few reported attempts to prevent postoperative hypertension. In this study we evaluated preoperative right-stellate-ganglion blockade as a method of preventing postoperative hypertension after coronary-artery operations in a series of 45 patients.

METHODS

The study was approved by the Human Experimentation Committee of the Holy Cross Hospital. Written informed consent to perform the study was obtained from every patient at the time of the preoperative visit. All patients were similarly premedicated with diazepam (0.1 mg/kg), morphine (0.1 mg/kg), and atropine (0.1 mg/15 kg), im, 90 min before the scheduled time of operation. Two intravenous transfusions were started in upper extremity veins, a central-venous-pressure catheter was implanted into the right atrium via an antecubital vein, and a catheter was placed in the radial artery. Heart rate was obtained from a precordial stethoscope before endotracheal intubation and from an esophageal stethoscope after intubation. Intraoperative blood and fluid management schedules, as well as bypass management techniques, have been described.[4]

Anesthesia was induced with a sleep dose of thiopental (2–4 mg/kg) and maintained with halothane (0.5–1.5 per cent) and nitrous oxide, 50 per cent in oxygen. An endotracheal tube was placed in the trachea 1 min after succinylcholine (1.5 mg/kg) was administered and respiration was then controlled to keep Pa_{CO_2} 32–36 torr as measured in arterial blood every 30 min. All patients were given halothane (0.25–0.75 per cent) via the oxygenator during bypass and halothane (0.2–0.8 per cent) plus nitrous oxide (40 per cent) after bypass. No other anesthetic or anesthetic adjuvant was used during operation or for the first six hours postoperatively. Patients were randomly allocated to one of three groups (allocation was accomplished at the time of the preoperative visit). Patients in Group I received a right-stellate-ganglion injection (via the anterior paratracheal approach) of 10 ml of bupivacaine (0.25 per cent) 5 min after endotracheal intubation. Patients in Group II received a right-stellate-ganglion injection of 10 ml of physiologic-saline solution 5 min after intubation, and those in Group III received no further drug. The quality of the stellate-ganglion block was not evaluated at any time during the study.

Systolic and diastolic arterial and mean central venous blood pressures and heart rates were measured every 5 min. Data were recorded immediately before performance of the stellate-ganglion injection (or, in

* Assistant Clinical Professor of Anesthesiology, University of Utah Medical Center; Staff Anesthesiologist, The Holy Cross Hospital.
† Staff Anesthesiologist, The Holy Cross Hospital.
‡ Staff Cardiothoracic Surgeon, The Holy Cross Hospital.
§ Professor of Anesthesiology/Surgery, University of Utah Medical Center.
Received from the Departments of Anesthesiology, The University of Utah Medical Center and Holy Cross Hospital, Salt Lake City, Utah 84132. Accepted for publication March 2, 1979.
Address reprint requests to Dr. Bidwai.

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TABLE 1. Intraoperative Data (Mean = SD)

	Number of Coronary Arteries Grafted	Duration of Cardiopulmonary Bypass Min)	Halothane Concentration (Per Cent)	
			During Bypass	After Bypass
Group I	2.2 = 0.8	75 = 12	0.2 = .1	0.5 = 0.1
Group II	2.1 = 0.8	74 = 11	0.2 = .1	0.6 = 0.1
Group III	2.2 = 0.8	80 = 9	0.3 = .1	0.7 = 0.1

Group III, at the time the injection would have been performed); 15 min after stellate-ganglion injection; immediately before cardiopulmonary bypass; after 30 min of bypass; every 15 min after bypass during the duration of the operative procedure; every 15 min during the first six hours postoperatively. Post-bypass and post-operative recordings were averaged for each patient. No patient in the study received a vasopressor or cardiac stimulant during the study period.¶ All patients were mechanically ventilated with 60 per cent oxygen for the first six hours postoperatively, so that Pa_{CO_2} was maintained at 32–36 torr.

Data were evaluated for statistical significance utilizing Student *t* tests for paired and unpaired data.

RESULTS

There were 16 patients in Group I, 14 in group II, and 15 in Group III. All groups had similar average severities of coronary-artery disease, were subjected to similar operations of approximately equal average durations and were anesthetically and surgically treated in exactly the same fashion, with the exception of the stellate-ganglion injections (table 1). Systolic and diastolic arterial and central venous blood pressures and heart rates were similar in the three groups before satellate-ganglion injection and remained unchanged after injection and before bypass (table 2). Mean arterial blood pressures were similar in the three groups during cardiopulmonary bypass.

Systolic and diastolic blood pressures and heart rates in patients in Group II and Group III were significantly higher after bypass and postoperatively than before stellate-ganglion injection (control)

¶ A total of 30 patients was entered into the study; however, five were excluded because of the use of one or more vasopressor or cardiac stimulants during the early post-bypass period.

TABLE 2. Heart Rate and Systolic Arterial and Central Venous Blood Pressures Prior to and after Stellate-ganglion Injections (Mean = SD)

	Arterial Pressure (torr)		Central Venous Pressure (torr)	Heart Rate (Beats/Min)
	Systolic	Diastolic		
Pre-stellate-ganglion injection				
Group I	132 = 11	90 = 8	8 = 2	76 = 7
Group II	130 = 10	87 = 9	8 = 1	74 = 8
Group III	129 = 8	88 = 9	7 = 2	74 = 8
15 minutes after stellate-ganglion injection				
Group I	126 = 9	88 = 9	7 = 1	70 = 8
Group II	132 = 10	89 = 10	8 = 1	75 = 8
Group III	131 = 10	88 = 9	8 = 1	73 = 9
Pre-bypass				
Group I	129 = 8	86 = 10	7 = 1	71 = 8
Group II	138 = 12	93 = 12	8 = 1	78 = 9
Group III	135 = 11	92 = 11	8 = 1	76 = 9
After 30 min of bypass				
Group I	61 = 8*		—	—
Group II	64 = 6*		—	—
Group III	63 = 10*			
Post-bypass				
Group I	125 = 11	84 = 9	9 = 2	75 = 7
Group II	150 = 14†¶	105 = 10†¶	11 = 3	86 = 7†§
Group III	151 = 16†¶	107 = 12†¶	12 = 4	88 = 8†§
Postoperatively				
Group I	124 = 11	= 86 = 10	10 = 2	72 = 8
Group II	154 = 15‡¶	= 103 = 11†¶	11 = 3	84 = 9†§
Group III	157 = 16‡¶	= 108 = 10†¶	11 = 3	83 = 9†§

* Mean arterial pressure.

† $P < 0.05$; ‡ $P < 0.025$. Student *t* test for unpaired data, compared with Group I values during the same period.

§ $P < 0.05$; ¶ $P < 0.025$. Student *t* test for paired data, compared with pre-stellate-ganglion-injection values.

values, and also significantly higher than post-bypass and postoperative values in Group I (table 2). Five patients in Group II and six in Group III experienced systolic arterial blood pressures of more than 170 torr for two hours or more during the first six hours postoperatively and needed anti hypertensive treatment with sodium nitroprusside. Seven of the above-mentioned patients had heart rates of more than 100 beats/min during the hypertensive episodes. No patient in Group I sustained a systolic arterial blood pressure of more than 145 torr or a heart rate of more than 100 beats/min during the same period.

Discussion

Hypertension after cardiopulmonary bypass and other surgical procedures has been reported to occur in approximately 30 per cent of patients after coronary-artery revascularization procedures.[1,2,5] Patients with this complication have a markedly increased systemic vascular resistance and an unchanged or increased heart rate, but no appreciable alternation in right or left atrial pressure or cardiac output.[2] Postoperative hypertension following coronary-artery surgery is not caused by hypovolemia and is not associated with the presence of preoperative hypertension, apparent renal dysfunction, use of vasopressor drugs, or a specific anesthetic technique.[1-3,5] Observations made by Estafanous and co-workers[6] and others,[7] indicate that postoperative hypertension also occurs after valvular open-heart surgery, albeit less frequently.

Although a number of regimens, including use of intravenously administered nitroglycerin, sodium nitroprusside, phentolamine, and promazine, as well as right or left stellate-ganglion block with lidocaine, have been effective in treating postoperative hypertension,[1-3] we reasonsed that prevention of this complication, if it were unassociated with significant problems, would be more desirable than treatment after hypertension occurred.

The results of this study do not demonstrate a mechanism, but do indicate that hypertension after bypass and postoperatively following coronary-artery surgery can be prevented by preoperative right stellate-ganglion blockade with bupivacaine. In addition, stellate-ganglion blockade with 10 ml bupivacaine (0.25 per cent) resulted in post-bypass and postoperative systolic arterial blood pressures and heart rates that were significantly lower than those in the other two groups, but were not associated with hypotension, bradycardia or any other complication at any time during or after this study. These findings provide additional data to support the concept that postoperative hypertension is caused by increased sympathetic activity, and suggest that the increases in activity may begin before the postoperative period.

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