Deliberate Hypotension for the Management of Threatening Hemorrhage

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The successful management of reactionary hemorrhage by reinduction of deliberate hypotension led us to investigate the application of this technique as a therapeutic tool in the treatment of threatening hemorrhage. In three cases, where hemorrhage occurred or was pending, hypotension was induced and was found to be of significant value in stopping and preventing hemorrhage.

Case Reports

Case 1. A 59-year-old man who had syphilitic aortic valve disease underwent aortic valve replacement. Preoperatively, blood pressure was between 160 and 180 mm. Hg systolic and 65–10 mm. Hg diastolic. Induction was achieved with 200 mg. pentothal sodium, followed by 80 mg. succinylcholine to facilitate intubation. Anesthesia was maintained with nitrous oxide, oxygen, 0.1 per cent methoxyflurane and intermittent doses of d-tubocurarine. Under cardiopulmonary bypass, a Starr-Edwards valve was placed. After the incision in the aorta was sutured, the patient was put on partial bypass and a blood pressure of 120/70 mm. Hg was obtained. The ascending aorta gradually became distended and started to tear. Excessive bleeding at the suture line occurred and the patient was returned to complete bypass. Attempts to take the patient off complete bypass failed because of the recurrence of bleeding and tearing along the suture line. A total of 10 mg. of pentolinium (Ansolysen) was given intravenously in increments of 2 mg. each. A drop in systolic blood pressure to 80 mm. Hg was achieved. This produced a remarkable cessation of bleeding and a less distended aorta. Further suturing of the aorta was performed with ease. The systolic blood pressure returned gradually to 100 mm. Hg at the end of an hour. The chest was closed. Postoperative course was satisfactory. The patient was discharged from the hospital in fair condition.

Case 2. A 46-year-old man who had severe aortic regurgitation underwent aortic valve replacement during cardiopulmonary bypass. Anesthesia was induced with 180 mg. pentothal sodium and intubation was performed after 100 mg. succinylcholine had been given intravenously. Anesthesia was maintained with nitrous oxide, 40 per cent oxygen and intermittent doses of d-tubocurarine. After a Starr-Edwards valve was inserted and the incision in the aorta was sutured, the patient was put on partial cardiopulmonary bypass. The aorta became distended within a few seconds and tearing of its wall was seen. Excessive bleeding occurred at the suture line and the wall of the aorta became thin. Pentolinium, 15 mg., injected intravenously, accompanied by a slight foot-down tilt, resulted in a drop in systolic blood pressure from 150 to 85 mm. Hg. Marked reduction in the size of the aorta was noted; it became easily compressible. Bleeding from the suture line stopped immediately. Further suturing of the aorta was accomplished easily. Blood pressure was allowed to rise gradually to 110 mm. Hg systolic after 45 minutes, with no noticeable bleeding from the aorta. The procedure was tolerated and postoperative course was uneventful.

Case 3. A 39-year-old woman whose chief complaint was acute abdominal pain was scheduled for emergency abdominal exploration. She had a history of hypertension and had been receiving various medications, including reserpine and guanethidine. A sleep dose of sodium pentothal was injected and intubation was facilitated with succinylcholine. Anesthesia was maintained with nitrous oxide, 35 per cent oxygen, 0.3 per cent halothane and intermittent doses of d-tubocurarine. Blood pressure of 220/120 mm. Hg was well maintained throughout the initial part of the procedure. When the peritoneum was opened, 400 mL of blood were found in the peritoneal cavity and the diagnosis of acute hemorrhagic pancreatitis was established. Five hundred mL of blood were administered to replace the lost blood, but persistent oozing from the tail of the pancreas and spleen could not be controlled surgically. At this time it was learned that no more cross-matched blood was available for transfusion. Hypotension was instituted deliberately, using pentolinium in incremental doses totalling 24 mg. until the systolic blood pressure had fallen to 100 mm. Hg. This was followed by complete cessation of bleed-
ing from the pancreas and spleen. Splenectomy and a drainage procedure were performed with ease. Additional doses of pentolinium (10 mg.) were given to keep the systolic blood pressure at 100 to 120 mm. Hg to the end of the procedure and in the early postoperative period. The patient was kept on artificial respiration overnight. There was no evidence of further bleeding. She was made to ambulate on the second postoperative day.

**COMMENT**

Bleeding during surgery is due to the surgical intervention itself or to previously-existing pathology. Anesthetic factors may also influence bleeding during surgery. These include: anesthesics producing vasodilatation without concomitant reduction in blood pressure; drugs such as d-tubocurarine and local anesthetics; increased mean intrapulmonary pressures producing venous congestion; carbon dioxide retention; and incompatible blood transfusion. Obviously these factors must be considered whenever excessive oozing during surgery is observed.

The advantage of the use of ganglionic blocking agents in the management of hemorrhagic shock was observed as early as 1953. The presence of adequate blood volume before ganglionic blockade is produced has been emphasized. The present case reports illustrate the value of deliberate hypotension in circumstances where hemorrhage has occurred or is pending. In one previously-reported case, where reactionary hemorrhage was precipitated by straining after deliberate hypotension, its reinduction resulted in complete cessation of bleeding. Although the intraperitoneal bleeding in Case 3 was not due to reactionary hemorrhage, it responded similarly to induced hypotension.

Deliberate hypotension in Cases 1 and 2 appeared to play a major role not only in reducing bleeding but also in facilitating suturing of the aorta. The resulting decrease in distention and the reduction in size of the aorta during induced hypotension presumably halted the progressive thinning of the aortic wall and its subsequent tearing. By keeping the aorta soft and by preventing excessive stretching of its wall, subsequent suturing was made easier. Glenn et al., reported similar observations during operation for ligation and division of patent ductus arteriosus. The use of hypotensive drugs also has been found to be of great help for resection of the aortic bifurcation during the time of application of the proximal aortic clamp. This has reduced the forcefulness of the pulse pounding against the clamp, minimized trauma to the diseased vessel, and prevented slipping of the clamp. In the critical period immediately following cardiopulmonary bypass for operations on the aorta, the control of leaks and the prevention of aortic distention can be obtained by the judicious use of ganglionic blocking agents.

**REFERENCES**