The Supine Hypotension Syndrome in a Young Boy

GREG M. SCHROEDER, M.D.* AND PETER J. JEBSON, F.F.A.R.C.S.†

The supine hypotension syndrome, defined as hypotension occurring secondary to occlusion of the aorta and inferior vena cava when the patient assumes a supine position, occurs in approximately 10–15% of normal term pregnancies.1 Reports of the supine hypotension syndrome in men and nonpregnant women are rare. Epstein and Panter2 reported this complication secondary to a giant ovarian cyst, and Kim et al.3 reported supine hypotension in a 24-yr-old woman with an intraabdominal mass. With the advent of newer imaging techniques to identify the extent of aortocaval compression, this unusual but potentially serious problem may be anticipated and appropriate treatment undertaken.

We describe the anesthetic management of a young boy with a large intraabdominal mass where the possibility of supine hypotension syndrome was anticipated and the measures that were taken to minimize the effects of aortocaval compression.

REPORT OF A CASE

A 17-yr-old, 67-kg boy was admitted for resection of a large intraabdominal mass arising from the anterior abdominal wall. Although this mass was soft, nontender swelling that had been present for 7 to 8 months, it had rapidly expanded over the last 2 to 3 months. By needle biopsy the tumor was found to be a sarcoma.

The patient was otherwise healthy and denied any nausea, diaphoresis, ankle edema, scrotal swelling, or any other symptoms while in the supine position. Preoperative computerized tomography (CT) confirmed a large mass in the anterior abdominal wall (fig. 1). As can be seen from the CT at the level of the third lumbar vertebra, occlusion of the inferior vena cava (arrow) was threatened. The aorta was less compromised by the tumor.

Examination of the abdomen prior to operation confirmed that the tumor was an approximately 21 × 21 cm mass occupying the entire hypogastrum and extending into the epigastrium. Pneumographic evaluation was normal apart from the abdominal findings. The heart rate was 82 beats/min and arterial blood pressure 130/88 mmHg in the supine position with no change in the lateral position. There were no signs of inferior vena cava obstruction. Examination of the respiratory system was also negative. The hemoglobin, hematocrit, and serum electrolytes were all normal.

The anesthetic management for operative removal of the tumor was planned with two particular problems in mind. The earliest anticipated problem was cardiovascular embarrassment if the patient were anesthetized in the supine position or while being moved into the supine position for surgery. The second major anticipated problem was intraoperative blood loss with removal of the tumor of unknown vascularity.

An 18-gauge peripheral iv infusion was started the night prior to the operation, and 1½ of 5% dextrose in lactated Ringer's solution was infused over 12 h. Preoperative medication consisted of 10 mg of morphine sulfate and 0.2 mg glycopyrrolate im 45 min prior to leaving the ward.

On arrival in the operating room, with the patient in the supine position, a catheter was inserted into the left radial artery for monitoring blood pressure, which was 118/65 mmHg prior to induction of anesthesia. A right internal jugular cannulation was performed with a 7-French Edwards® triple-lumen catheter for the purpose of administration of iv fluids and measurement of right atrial pressure. After placement of the right atrial catheter, 530 ml of lactated Ringer's solution was infused via the two iv catheters. Because right atrial pressure was 12 mmHg, we felt that intravascular volume was adequate. The heart was in sinus rhythm at a rate of 88 beats/min, and the peripheral veins were well filled.

After oxygen was administered in the left lateral decubitus position, anesthesia was induced with thiopental 6.5 mg/kg iv (2.5% solution) in divided doses. After confirmation of a clear airway, 1 mg of pancuronium was given followed by succinylcholine (1.5 mg/kg). The trachea was intubated with an 8.0 mm endotracheal tube. Fentanyl 3.7 µg/kg was given in iv increments and ventilation was controlled with nitrous oxide/oxygen mixture (70%/30%) using a semiclosed circle system. Cardiovascular stability was well maintained and on return of spontaneous respiration, arterial blood pressure was 120/65 mmHg with a sinus heart rate of 80 beats/min. At this time, pancuronium 0.07 mg/kg was administered iv without significant increase in the heart rate, while arterial blood pressure remained at the previous level. Ventilation was controlled at tidal volumes of 10 ml/kg and a rate of 10 breaths/min. The time from induction of anesthesia to this point was approximately 14 min.

The patient was then slowly turned from a left lateral to a supine position. Several events then followed in rapid sequence. Arterial blood pressure decreased to a systolic pressure of 58 mmHg within 1 min after turning, and right atrial pressure decreased to between 0 and 2 mmHg. The diagnosis of supine hypotension was made, and rapid infusion of crystalloid into a peripheral iv and the right atrial catheter was begun. The patient was also placed in the Trendelenburg position and with 15° of left lateral tilt. These maneuvers, together with 900 ml of crystalloid infused over 5 min, restored the arterial blood pressure to a level of 115/55 mmHg. Right atrial pressure returned to 8–10 mmHg. No abnormality of cardiac rhythm occurred, and the heart rate was 65 beats/min.

The operation was carried out through a vertical midline incision and lasted approximately 5½ hours. Anesthesia was continued with fentanyl (3.0 µg/kg), nitrous oxide, oxygen (70%/30%), pancuronium (0.65 mg/kg), and small amounts of isoflurane. Though left lateral tilt was maintained until removal of the tumor, twice during the operation the patient became hypotensive to a systolic level of 75–80 mmHg, which improved dramatically when surgeons retracted the tumor anteriorly. Blood loss did not prove to be a major problem.

Due to the fact that resection of approximately 60% of his anterior...
abdominal wall was required, along with the tumor, the patient was admitted to the Intensive Care Unit for 24 h for monitoring of postoperative ventilation. The patient had an uneventful postoperative recovery and left the hospital 10 days after his surgery.

**DISCUSSION**

In those patients in whom supine hypotension does not present until anesthesia, two mechanisms may contribute to the sudden decrease in arterial blood pressure. These are changes in vasomotor tone with the vasodilatation that accompanies the use of many drugs in general anesthesia, coupled with mechanical obstruction of venous return from the lower half of the body. General anesthesia, independent of muscle relaxants, may well cause muscle and ligament relaxation that permits a mass to fall back on the large vessels, compressing them against the anterior vertebral column. Since the inferior vena cava contributes more than 65% of the venous return to the right atrium, occlusion of the inferior vena cava results in reduction in the degree of diastolic filling of the ventricles. The result will be a reduction in cardiac output. Assumption of the supine recumbent position in late pregnancy has been shown to reduce maternal cardiac output by approximately 20%, compared with the left lateral position. There is some collateral venous return to the heart via the paravertebral veins, but the capacity of these alternate pathways after acute inferior vena cava occlusion has not been documented. Kerr suggested that pregnant women who develop the syndrome have a poorer collateral venous circulation.

The effect of aortic compression is less clear. Compression of the abdominal aorta by the gravid uterus or, in this case, a tumor at the level of the 4th or 5th lumbar vertebrae, demonstrated by Bieniarz et al., appears to produce a temporary "physiologic coarctation." The pressure proximal to the "coarctation" was previously shown to be increased during late pregnancy in the supine position. Milsom et al. feel that the increase in aortic pressure will trigger a reflex bradycardia due to stimulation of the baroreceptor systems in the aorta and carotid sinus. A combination of baroreceptor-induced bradycardia and decreased stroke volume due to compression of the vena cava will produce a fall in arterial pressure. Yet, Lee et al. found that bradycardia is not common to all cases of the supine hypotension syndrome, and in the case we describe, the heart rate never dropped below 60 beats/min.

We conclude that supine hypotension syndrome may indeed occur with large abdominal tumors, and, more importantly, may first appear during anesthesia. The preanesthetic evaluation may not provide any findings to warn the anesthesiologist of the potential hazard. As discussed, the abdominal CT not only illustrates the anatomical relationships that cause the syndrome, but also may provide the key information that forewarns the anesthesiologist. We believe that, in a patient at increased risk for this syndrome, the establishment of monitoring prior to assuming the supine position under anesthesia is advisable. In addition, maintaining the lateral tilt during the earlier stages of the operation minimizes the effect of aortocaval occlusion. If necessary, anesthesia and the operation may be carried out in the left lateral decubitus position.

**REFERENCES**
