The Use of Nitroglycerin to Control Severe Hypertension of Pregnancy during Cesarean Section

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There is no ideal anesthetic for cesarean section in patients with severe hypertension of pregnancy. During general anesthesia laryngoscopy and endotracheal intubation are often accompanied by dangerous elevations of blood pressure, which may produce intracranial hemorrhage and cardiac failure. The response to endotracheal intubation can be dampened by controlling blood pressure with antihypertensive agents during induction of anesthesia. However, none of the commercially available drugs produces optimal results when considering both mother and fetus. Our experience with intravenously administered nitroglycerin, an effective antihypertensive agent,[1-3] indicates that it may be suitable for controlling hypertension during general anesthesia for cesarean section.

Report of a Case

A 32-year-old primigravida, weighing 139 kg, was admitted to the hospital at 30 weeks' gestation with proteinuria and edema. She had a history of chronic hypertension which was treated with alpha-methyldopa and hydrochlorothiazide. In the following five days her blood pressure rose from 150/90 to 180/110 torr, her weight increased 6 kg, and clonus was elicited. Daily urinary protein values were 13–16 g/24 hr, and creatinine clearance decreased from 100 ml/min to 80 ml/min. Other laboratory values were: hemoglobin 11.2 g/dl; hematocrit 34 per cent; serum sodium 138 mEq/l; potassium 3.8 mEq/l; chloride 109 mEq/l; carbon dioxide content 22 mEq/l; blood urea nitrogen (BUN) 10 mg/dl; creatinine 0.8 mg/dl; calcium 8.1 mg/dl; albumin 2.4 g/dl; plasma oncotic pressure 13 torr (normal 19 torr). Coagulation profiles and liver enzyme values were normal for pregnancy.

Due to the patient's obesity, assessment of fetal status by amniocentesis and ultrasonography was impossible, and this problem delayed the termination of pregnancy. On the sixth day of hospitalization, the patient complained of frontal headache and blurred vision. Subsequently, a 1–2-min tonic–clonic seizure occurred, followed by 15–20 min of postictal depression. After injection of magnesium sulfate, 8 g, iv, a central venous pressure line (CVP) was established, and a radial artery was cannulated for continuous blood pressure monitoring. The decision to perform a

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cesarean section was made because of the threat to maternal life of continued pregnancy.

In the operating room the patient was placed in Trendelenburg position to facilitate the surgical procedure, while a 15-degree left lateral tilt was established to prevent aortocaval compression. Preanesthetic blood pressure, pulse rate, and central venous pressure (CVP) were 230/110 torr, 90/min, and 13 cm H_2O, respectively. Following preoxygenation for 5 min, an infusion of nitroglycerin was begun at a rate of 32 μg/min, iv, and increased to 220 μg/min over the next 10 min. The nitroglycerin solution, 32 μg/ml, was prepared by dissolving 20 tablets (0.4 mg/tablet) in 30 ml of physiologic saline solution. This mixture was injected into an additional 220 ml of physiologic saline solution through a 0.22-μm Millex® bacterial filter. §The blood pressure and CVP subsequently decreased to 160/80 torr and 9 cm H_2O, while pulse rate was unchanged. Following induction with thiopental, 300 mg, iv, and succinylcholine, 100 mg, iv, the trachea was rapidly intubated during application of cricoid pressure. Blood pressure and pulse rate subsequently increased to 190/80 torr and 110/min. Anesthesia was maintained with 0.8 per cent enflurane, 60 per cent nitrous oxide, oxygen, and a continuous succinylcholine infusion (0.1 per cent). Nitroglycerin administration was continued, and the blood pressure decreased to 150/80 torr within 5 min after induction. A 1,504-g infant with Apgar scores of 7 and 8 at 1 and 5 min, respectively, was delivered 8 min after induction of anesthesia. Ten minutes after delivery, neonatal blood pressure was 50/30 torr, a normal value for the gestational age.

Following delivery, brisk hemorrhage from a broad-ligament laceration was associated with a reduction in blood pressure and CVP to 120/60 torr and 3 cm H_2O, respectively. This was corrected by discontinuation of the nitroglycerin infusion and by rapid administration of lactated Ringer's solution. Urinary output was 70 ml during 85 min of anesthesia. Although the postoperative course was complicated by anemia and a wound infection, the patient was discharged in good condition on the twenty-first day.

Discussion

Choosing the method of anesthesia for cesarean section in patients with severe gestational hypertension is difficult. Since capillary hydrostatic pressure is increased and plasma oncotic pressure and intravascular volume are decreased,[4] worrisome hypotension may occur with conduction analgesia. However, an exaggerated response to catecholamines[5] may produce severe hypertension following tracheal intubation during general anesthesia. Tracheal intubation is mandatory to prevent gastric aspiration, while a light plane of anesthesia is desired to obviate

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neonatal depression. If a reliable way to control marked hypertension could be devised, the safety of general anesthesia would be greatly increased. We believe that the use of intravenously administered antihypertensive agents is indicated.

Hydralazine hydrochloride increases uterine blood flow while decreasing maternal blood pressure.[6] Its slow onset of action negates rapid control of blood pressure, and its long duration of effect may instigate hypotension during periods of hemorrhage. Chlorpromazine and phentolamine are only moderately effective for controlling severe hypertension of pregnancy. Their effects are not rapidly reversible, and chlorpromazine may depress the neonatal central nervous system. Trimethaphan effectively controls maternal blood pressure but may produce undesirable autonomic effects[7] and may prolong the action of succinylcholine.[8] Sodium nitroprusside is efficacious for treating maternal hypertension, and it preserves uterine blood flow.[6] However, concern exists about the metabolic effects of cyanide, which has been detected in fetal blood after maternal exposure to nitroprusside.[9]

Intravenously administered nitroglycerin is safe and effective for inducing deliberate hypotension[2] and for controlling hypertension during open-heart surgery.[3] Although we are unaware of previous reports of its use for controlling pregnancy-induced hypertension, its properties should recommend it for this purpose. A fast onset of action facilitates rapid control of hypertension. Rapid hepatic clearance[1] and short duration of effect[2] permit close adjustment of blood pressure. Its basic pharmacologic effect is direct smooth-muscle relaxation, but smooth-muscle cells are not completely prevented from responding to an appropriate stimulus.[1] Therefore, the hypotensive effect can be partially antagonized by vasopressors. Nitroglycerin crosses the placenta because of its low molecular weight (227) and its uncharged state, but should not produce direct neonatal central nervous system depression or adverse metabolic effects.

Hypotension should not occur when newborns are placed in the usual head-down position.

We have used nitroglycerin in six severely hypertensive mothers given general anesthesia for cesarean section. The cases are well represented by the case presented here, with nitroglycerin rapidly providing control of hypertension and blunting the response to endotracheal intubation. In this patient, the short duration of effect allowed rapid adjustment of blood pressure during a period of hemorrhage. Neither neonatal depression nor hypotension has been apparent. It is concluded that in comparison with other antihypertensive agents, nitroglycerin may be a good agent for controlling severe hypertension of pregnancy during general anesthesia for cesarean section. However, the effects of nitroglycerin on uterine blood flow, uterine tone, and fetal acid-base status are unknown and warrant investigation.

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