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CLINICAL INFORMATION

Anesthetic management of an infant with giant abdominal neuroblastoma

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Abstract Neuroblastoma is the most common, non-central nervous system tumor of childhood. It has the potential to synthesize catecholamines. However, the presences of hypertension are uncommon. We report the perioperative management of a 15-month-old infant with giant abdominal neuroblastoma who presented severe hypertension. The pathophysiological alterations of neuroblastoma are reviewed and perioperative management presented.
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Manejo anestésico de criança com neuroblastoma abdominal gigante

Resumo Neuroblastoma é o tumor mais comum do sistema nervoso não-central na infância. Esse tumor tem o potencial para sintetizar catecolaminas; entretanto, a presença de hipertensão é rara. Relatamos o manejo perioperatório de uma criança de cinco meses de idade com neuroblastoma abdominal gigante que apresentou hipertensão grave. As alterações fisiopatológicas do neuroblastoma foram revistas e o manejo perioperatório apresentado.
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Introduction

Neuroblastoma is the most common extracranial solid tumor in childhood.[1] It affects yearly 6–10 million of children,

accounting 7–8% of pediatric tumors. Clinical presentation is highly variable depending on location. It may include nonspecific signs and symptoms such as abdominal pain, vomiting, weight loss, anorexia, fatigue, diarrhea and palpable mass.[2] Its origin is embryonic, developing from postganglionic sympathetic nerve fibers, and it can be associated with elevated levels of catecholamine's. Nevertheless hypertension is uncommon, being present in 10–27%

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Figure 1   Infant after anesthetic induction.

of cases.[3] Possible multiorganic affectation, mainly effects in cardiovascular and respiratory system, as well as the treatment of severe hypertension deserve to be reviewed. The parents of the patient gave written informed consent for publication of this article.

Case report

A 15-month-old, 8.5 kg boy was admitted on the emergency department of our institution, with fatigue, partial rejection of intake, weight loss, vomiting and abdominal distension (Fig. 1). Laboratory testing revealed hyperuricemia (7.1 mg/dL), hypoalbuminemia (3.2 g/dL), LDH 4205.0 IU/L, sodium 129.0 mEq/L, potassium 3.5 mEq/L, chloride 90.0 mEq/L. Abdominal MRI showed a large abdominal mass (12 cm × 10 cm × 10 cm) encompassing mesentery and retroperitoneum and compressed and displaced both kidneys, surrounding circumferentially the aorta and renal arteries and veins (Fig. 2). Persistent severe hypertension was present (180–120 mm/Hg). Echocardiography ruled out the presence of associated heart disease. Intravenous infusion of sodium nitroprusside (0.5–3 mg/kg/min) was administered for acute blood pressure control. After 72 h, sequential oral treatment was started with clonidine (20 mg/6 h), nifedipine (4 mg/6 h) and propranolol (3 mg/8 h), reaching a stable mean arterial pressure target
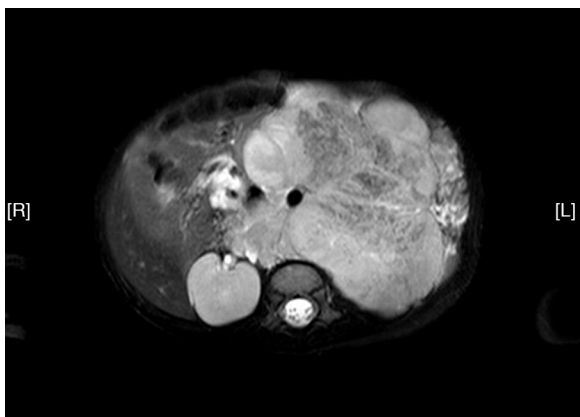

Figure 2   Axial MRI shows the giant intraabdominal mass.

of 100 mm/Hg. A MAP lower than 100 mm/Hg determined a critical decrease in tissue perfusion pressure reflected with the establishment of oligoanuria. He was taken to the operating room for a series of biopsies (abdominal mass, bone marrow and lymph nodes) to confirm the diagnosis. Rapid sequence induction was performed with Sellick maneuver after adequate preoxygenation with 100% oxygen, and anesthesia induction with remifentanil (0.2 μg/kg/min), propofol (2.5 mg/kg), rocuronium (1.2 mg/kg) and lidocaine (1 mg/kg). Tracheal intubation produced no significant changes in vital signs. The pressure-controlled ventilation was adjusted to maintain normocapnia using a mixture of oxygen-air (FiO 50%). Maintenance of general anesthesia was carried out using sevoflurane and remifentanil (0.2–0.6 μg/kg/min). Persisted hypertension was controlled with established antihypertensive treatment and increasing doses of remifentanil during the surgery. After completion of the surgical procedure infant was transferred to the PICU maintaining intravenous infusion of sodium nitroprusside. The diagnosis of neuroblastoma was confirmed. Urine catecholamine's or their metabolites were undetectable. The subsequent chemotherapy and tumor resection allowed restoration of normal blood pressure.

Discussion

Neuroblastoma derives from cells of neural crest, which can be located at any place where these are present and they retain the potential to synthesize catecholamines. Both features are determinants of associated pathophysiological alterations.[4]

Its location is usually intraabdominal, although it is possible intrathoracic or cervical location and may produce airway compromise. The presence of an abdominal mass increases intra-abdominal pressure (IAP).[1] This increases the risk of aspiration therefore, rapid sequence induction is recommendable. In the respiratory system it determines cephalic displacement of the diaphragm, increasing intrathoracic pressure and decreasing lung compliance and functional residual capacity, which determines a greater tendency to pulmonary atelectasis, impaired ventilation perfusion ratio after induction of general anesthesia and hypercapnia and hipoxemia. It produces pulmonary vasoconstriction and increases the gas exchange impairment in the alveolar-capillary unit. The extent of changes in the cardiovascular system is dependent on the magnitude of the IAP, presence of cardiomyopathy, intravascular volume status, mode of mechanical ventilation, surgical conditions, and anesthetic agents employed. Systemic vascular resistance increases due to mechanical compression of the abdominal aorta, high levels of neurohumoral factors like vasopressin, activation of the renin–angiotensin–aldosterone system and compression of the renal arteries, leading to hypertension. This high afterload increases the risk of acute pulmonary edema. Compression of the inferior vena cava reduces preload and cardiac output decreasing tissue perfusion, particularly in presence of hypovolemia. Tachyarrhythmias are frequent due to hypercapnia and increased levels of circulating catecholamines. All these changes may decrease after laparotomy due to decompression of the abdominal cavity, but the correction may be gradual.

Table 1 Common drugs used to treat hypertension in pediatric patients.

Drug	Route of administration	Dose	Notes
Clonidine	PO	5–10 g/kg 24 h (2–4 doses)	α2-adrenergic agonist. Risk of prolonged sedation.
Nifedipine	PO	0.25–0.5 mg/kg 4–6 h	Dihydropyridine calcium antagonist. Predominantly vascular effects.
Propranolol	PO/IV	0.05–0.2 mg/kg iv 0.5–1 mg/kg 24 h (3–4 doses) vo	Nonselective β blockade. Risk of bronchospasm, myocardial dysfunction, AV block and hypoglycemia.
Labetalol	IV	0.25–1 mg/kg/h	Nonselective blockade. Side effects are similar to those of propranolol.
Esmolol	IV	50–200 μg/kg/min	Relatively selective blockade. Short half-life (10 min).
Sodium nitroprusside	IV	0.5–10 μg/kg/min	Potent direct relaxation of vascular muscle tissue, both arteriolar and venous capacitance vessels. Potential cyanide toxicity; reflex tachycardia.
Nitroglycerin	IV	0.5–10 μg/kg/min	Direct smooth muscle relaxation, predominantly of venous capacitance vessels.
Phentolamine	IV	0.5–5 μg/kg/min	Selective blocker, mainly arteriolar vasodilation.
Hydralazine	IV	0.1–0.2 mg/kg 6 h	Direct smooth muscle relaxation, predominantly of arteriolar. Long half-life. Tachyphylaxis; reflex tachycardia; thrombocytopenia; lupus-like syndrome.
Urapidil	IV	Initially: 2 mg/kg/h Maintenance: 0.8 mg/kg/h. Max. 7 days	Elective antagonist of peripheral postsynaptic 1-adrenergic receptors.
Enalapril	PO/IV	0.1–0.5 mg/kg 24 h (1–2 doses) PO 5–10 μg/kg 8–24 h iv	Angiotensin converting enzyme inhibitor. Effect of long duration. Hyperkalemia, renal failure, angioedema; severe hypotension with anesthetic agents.

PO, Orally; IV, intravenously.

Hypertension, in addition to the above mechanisms, can result from the vasoconstrictor action of catecholamines secreted by the tumor or the stimulation of the renin–angiotensin–aldosterone system secondary to compression of the renal artery. There may be an associated cardiomyopathy but it is uncommon. Its etiology is multifactorial[3]; it includes catecholamine-induced vasoconstriction, coronary vasospasm, chronic tachycardiomyopathy secondary to a hyperadrenergic state, b-adrenergic receptors down regulation and promotion of calcium influx into sarcolema. Effective treatment of hypertension before surgery is mandatory to reduce perioperative morbidity and mortality. Intraoperative hypertensive crisis may occur, especially during tracheal intubation, anesthetic induction and tumor manipulation. Thus, it is critical to minimize the sympathetic response secondary to direct laryngoscopy.[5] Thiopental, succinylcholine, and morphine should be used with caution due to catecholamine release secondary to histamine release from morphine or thiopental, increased abdominal pressure or sympathetic stimulation following succinylcholine.[2] Intraoperative hypertension in patients with catecholamine secreting neuroblastomas is controlled using short-acting agents such as sodium nitroprusside, calcium antagonists, phentolamine, adenosine or prostaglandin E1.[2] The use of antihypertensive drugs in pediatric patients should be initiated in the lower dose under close cardiovascular monitoring and titrated to effect.[6,7]

Table 1 shows the drugs commonly used for treating hypertension in pediatric population.

Management of patients with giant abdominal neuroblastoma is an anesthetic challenge. The knowledge of pathophysiological implications and the adequate antihypertensive treatment are essential for successful anesthetic management.

Conflicts of interest

The authors declare no conflicts of interest.

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