CASE REPORT

Acute left heart failure with pulmonary edema during resection of pediatric neuroblastoma: case report

Shan Gao, Youjing Dong

Shengjing Hospital of China Medical University, Department of Anesthesiology, ShenYang, China

Received 20 April 2020; accepted 11 September 2021
Available online 5 October 2021

Abstract  Resection of an unknown neck mass in a 6-year-old child triggered acute left-sided heart failure and pulmonary edema. The lesion was confirmed as neuroblastoma by postoperative tissue examination. Such tumors regularly synthesize and secrete catecholamines, warranting caution in advance of surgical manipulation.

Introduction

Neuroblastoma is one of the most common extracranial solid tumors in children. It always occurs on adrenal region, abdominal cavity, chest, neck, or pelvis. Early diagnosis is difficult and relies heavily on tissue biopsy. However, it is important to note that a key physiologic characteristic of neuroblastoma, as a neuroendocrine tumor, is the synthesis and secretion of catecholamine. Patients with neuroblastoma may have particular clinical manifestations, such as excitement, palpitation, facial flushing, headache, hypertension, and tachycardia, easily confused with pheochromocytoma. Furthermore, if the depth of intraoperative anesthesia is inadequate, or the tumor is tugged or compressed during resection, there is a danger of catecholamine surge. Severe hemodynamic fluctuations may then ensue, causing irreversible damage. In this report, we describe a child afflicted with acute heart failure during treatment of neuroblastoma. It is imperative that anesthesiologists are cognizant of this dire possibility and prepare adequately in advance of surgery to avoid a similar course of events.

Case report

This 6-year-old child was admitted to the hospital with the chief complaint of a right-sided neck mass. There was no history of other diseases, and computed tomography (CT) confirmed a mass of the intermuscular space in the right neck. To discern its nature, the surgeon in charge chose resection under general anesthesia.

Once in the operating room, the child was monitored regularly, and venous access was established. Sufentanil, propofol, and cisatracurium were used to induce general anesthesia.
anesthesia. The child’s blood pressure, heart rate, and oxygen saturation of blood were stable during the first 20 minutes of operative time. However, by exposing and tug-
ging on the mass, the BP increased to 220/110 mmHg, and
the HR to 140 beats/min. The anesthetist promptly inter-
vented and suspended the operation, concerned that the
depth of anesthesia was inadequate. More propofol and a
higher concentration of inhalation sevoflurane were sub-
sequently administered. After 30 seconds, the BP responded
(140/72 mmHg), but HR was little affected (135 beats/min).
Upon resuming resection, the surgeon triggered another
BP spike (210/105 mmHg), with no change in HR (138
beats/min).

Given the uncertain nature of this mass, pheochromoc-
toma was immediately considered by the anesthesiologist in
charge. In accord with consensus anesthesia manage-
ment of such tumors, phentolamine (1 mg), and esmolol
(10 mg) were given. Radial artery and left subclavian vein
catheterizations were also performed to invasively monitor
BP and gauge central venous pressure (CVP). A stan-
dard anesthesia protocol for pheochromocytoma, including
continuous phentolamine infusion and attention to intravas-
cular volume expansion, was then implemented. At this
point, BP was under control (130/75 mmHg), and HR had
retreated somewhat (120 beats/min), so the operation con-
tinued.

Shortly thereafter (10 min), \( \text{SpO}_2 \) (79%) and arterial BP
(77/43 mmHg) had fallen. We first suspended the intra-
venous infusion of phentolamine, giving dexamethasone
(10 mg) and norepinephrine (10 \( \mu \)g). Airway pressure and
CVP readings continued to rise at this juncture, and moist
rales were detectable in both lungs by auscultation. X-
ray fluoroscopy also showed characteristic Kerley B lines at
costophrenic angle. A state of acute left heart failure was
evident, complicated by pulmonary edema, necessi-
tating immediate cardiotoxic diuresis. Furosemide (10 mg),
cedilanid (0.25 mg), and morphine (2 mg) were injected
intravenously, and continuous intravenous dopamine infu-
sion served to maintain BP. The patient was switched to
dorsal elevated position, and positive end-expiratory pres-
sure was boosted to 5 cmH\(_2\)O.

Within 30 minutes, the child’s vital signs had stabilized
(BP, 95/62 mmHg; \( \text{SpO}_2 \), 95%; HR, 120 beats/min), allowing
surgery to proceed. Total operative time was 230 minutes.
After a fair volume of Ringer’s solution (1250 mL), uri-
nary output was only 130 mL, but another 120 mL of fluid
(pale pink) was suctioned via endotracheal tube. Postop-
eratively, the child was taken to the pediatric surgical
intensive care unit for further observation. Once there, all
vital signs were stable, and no heart failure was evident.
Extubation took place the next day. One week later, echocar-
diography, cardiac function, and brain natriuretic peptide
level had normalized, so the patient was returned to the
ward.

Throughout the surgical procedure, observed clinical
manifestations resembled those of ectopic pheochromo-
cytoma. Repeat abdominal CT indicated that the
adrenal glands were disease-free. Postoperative pathologic
examination of neck mass disclosed a type of neuroblas-
toma.

Discussion

Similar to sympathetic postganglionic fibers and adrenal
medulla, neuroblastoma cells are capable of catecholamine
release and uptake. However, most of the catecholamine is
inactivated internally, and less is released. This is why chil-
dren regularly escape cardiovascular symptoms until cardiac
enlargement, heart failure, or even cardiogenic shock devel-
ops. Without adequate preoperative provisions, the risk of
anesthesia increases substantially.

In this case, we believe such lack of preparedness led
to abrupt hemodynamic instability. As we stressed:
(1) any mass of unknown nature requires caution, call-
ing for a careful history, needle biopsy, and preoperative
catecholamine testing of blood and urine to exclude neu-
roblastoma or occult pheochromocytoma; (2) in the absence
of diagnostic clarity, stark hemodynamic fluctuations in
children during surgery raise a question of neuroblastoma
or pheochromocytoma and demand a protocol devised for
pheochromocytoma; and (3) active intraoperative monitor-
ing is helpful in this setting to guide appropriate usage of
various drugs and infusions that are key to ensuring circula-
tory stability.

Traditional BP and CVP hemodynamics correlate poorly
with volume loads, failing to accurately reflect patient
status, and are unduly influenced by intrathoracic pres-
sure shifts during mechanical ventilation. The pulse index
contour continuous cardiac output systems now available
are minimally invasive and better suited for this purpose,
generating whole-body hemodynamic metrics via arterial
access and central venous catheter. Cardiac output is mea-
sured as isolated values by thermal dilution and charted
continuously through area under arterial pressure wave
curve analysis.\(^2\) Pulse index contour continuous cardiac out-
put monitoring is based on cardiac index, intrathoracic blood
volume index, and extravascular lung water index as sen-
sitive gauges of cardiac function, cardiac preload state,
and pulmonary edema, respectively. These parameters
are almost never affected by catecholamines, circulatory
capacity, mechanical ventilation, or other factors. They
help determine the need for speed/volume of rehydration
and whether cardiotoxic diuretic or vasoactive drugs are
indicated to augment cardiac function and improve perfu-
sion/oxygenation of tissues. Reducing the adverse effects
of pulmonary edema and hypoxemia bolsters the prognosis,
limiting durations of mechanical ventilation and ICU hospi-
talization, and lowering mortality.\(^3\)

In this particular patient, pre- and postsurgical manage-
ment in certain aspects of anesthesia were not optimally
addressed. When the sudden hemodynamic fluctuation
occurred, pheochromocytoma was first suspected. Thus, we
used low dose phentolamine immediately to control the BP.\(^4\)
In addition, when BP firstly decreased to 77/43 mmHg, aside
from initial adjustment, maintenance anesthesia had not
changed, so anesthetic overdose was doubtful. Likewise,
the child’s prior history and marginal decline in end-tidal CO\(_2\)
level were not supportive of acute pulmonary embolism.
Still, anaphylactic shock could not be excluded, even with-
out cutaneous signs. We first suspended the intravenous
infusion of phentolamine, giving dexamethasone (10 mg)
and norepinephrine (10 μg). However, according to the CVP and imaging examination results, the child was diagnosed with acute left heart failure and pulmonary edema. Our first choice on an emergency basis was dopamine. In retrospect, however, dobutamine is preferential, given its positive effects on cardiac contractility and lesser impact on HR. Nonetheless, it was gratifying that the patient quickly rebounded and recovered uneventful, with no lingering complications.

Conclusion

The pathophysiologic mechanism of neuroblastoma during resection may be similar to that observed in pheochromocytoma. It is necessary to make a timely diagnosis and take active measures. The purpose of perioperative period is maintenance of hemodynamic stability. In addition, perfect preoperative examination can help us make correct clinical judgments.

Conflicts of interest

The authors declare no conflicts of interest.

References

1. Castel V, Grau E, Noguera R, et al. Molecular biology of neuroblastoma. Clin Transl Oncol. 2007;9:478–83.
2. Martín Vivas A, Saboya Sánchez S, Patiño Rodríguez M, et al. Hemodynamic monitoring: PICCO system. Enfermería intensiva. 2008;19:132–40.
3. Roeleveld PP, de Klerk JCA. The Perspective of the Intensivist on Inotropes and Postoperative Care Following Pediatric Heart Surgery: An International Survey and Systematic Review of the Literature. World J Pediatr Congenit Heart Surg. 2018;9:10–21.
4. Endo Y, Kitago M, Shinoda M, et al. Extra-adrenal pheochromocytoma with initial symptom of haemoptysis: a case report and review of literature. BMC Surg. 2021;21:13.
5. Farmakis D, Agostoni P, Baholi L, et al. A pragmatic approach to the use of inotropes for the management of acute and advanced heart failure: an expert panel consensus. Int J Cardiol. 2019;297:83–90.