CLINICAL AND PHYSIOLOGIC IMPLICATIONS OF PHENYLEPHRINE IN TETRALOGY OF FALLOT

Case report

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Tetralogy of Fallot (TF) is the most common form of cyanotic congenital heart disease. Anaesthetic management should be focused on optimization of pulmonary/systemic flow ratio. The strategy to increase pulmonary flow is based on two cornerstones: α -I agonists (such as phenylephrine) and fluid therapy. The **goal of this case report** is to introduce the clinical and physiologic implications of phenylephrine and the differences between its administration by continuous intravenous infusion or bolus injection in these patients.

CASE REPORT

A 36 week newborn of 15 days of life with TF scheduled for a stent placement in the RV outflow tract.

PREOPERATIVE

Weight 3400g. SpO₂ (basal): 85%, SpO₂ (while crying): 68%. Grade III/IV systolic murmur.

Echocardiogram: two oval fossa defects (3 and 1.5mm). Displacement of the infundibular septum causing severe right ventricle (RV) outflow tract obstruction. Subaortic interventricular 5mm communication with bidirectional shunt. Overriding aorta. Pulmonary valve ring of 5mm. Normal pulmonary arteries. No other alterations were found.

INTRAOPERATIVE (surgery lasted 180 minutes)

General anaesthesia was induced with face mask with sevoflurane and oxygen, 3mg/kg of IV ketamine and 3 μ g/kg of IV fentanyl followed by orotracheal intubation with a 3.5mm cuffed tracheal tube.

10 ml/kg of 5% albumin and 9 bolus of phenylephrine (10 μ g/kg) were administered in order to keep SpO₂>90% and medium arterial pressure >40mmHg. It was also administered a infusion of 2ml/kg/h of crystalloid and 20ml/kg of intravenous contrast. At the end of the surgery the diuresis was >1 ml/kg/h.

	70 Min	130 min	150 min	180 min
pH	7.31	7.28	7.24	7.28
pCO ₂	45	47	49	46
pO ₂	64	127	53	74
Lactate	1.2	0.7	0.7	0.7
Hb	10.8	11.5	8.7	9.3

The stent was successfully implanted. The patient was extubated at the end of the procedure and transferred to the paediatric Intensive Care Unit without incidences.

TF CONSIDERATIONS

- ① Ventricular septal defect
- ② Right ventricular outflow tract obstruction
- ③ Right ventricular hypertrophy
- ④ Overriding aorta

- With non-restrictive interventricular communication, cyanosis and right to left shunt depend on the RV outflow tract obstruction grade.

- Hypoxemic crises are due to infundibular spasm caused by endogenous catecholamines.

ANAESTHETIC MANAGEMENT OF TF

- Preoperative evaluation: ECG, echocardiogram, chest X-ray and complete blood laboratory study.
- Avoid hypoxemic crises triggers:
 - ✓ Prolonged fasting
 - ✓ Release of endogenous catecholamines during crying that causes RV outflow tract spasm (treatment: premedication and inhaled induction).
 - ✓ Anaesthetic agents that decrease systemic vascular resistance (SVR), and/or that, at high doses, cause direct myocardial depression.
 - ✓ Hypoxia and hypercapnia that increase pulmonary vascular resistance (PVR).
- The main objective is to maintain pulmonary perfusion.
- Manoeuvres to maintain SVR and avoid the increase of PVR:
 - ✓ Increase of RV preload:
 - Adequate intravenous filling
 - Knee-chest position
 - ✓ β adrenergic blockers (may relax infundibular spasm):
 - IV esmolol (50 μ g/kg)
 - IV propranolol (0.1 mg/kg)
 - ✓ α adrenergic agonists (increase SVR):
 - IV phenylephrine (5-10 μ g/kg)
 - ✓ Anaesthetic manoeuvres:
 - 100% oxygen
 - Increase anaesthetic depth

PHENYLEPHRINE: GENERAL CONSIDERATIONS

- Selective α I-adrenergic receptor agonist with direct action and short half life.
- Increases left ventricle (LV) and RV afterload. Decreases heart rate (HR) and cardiac output (CO).
- Moderate inotropic effect with high doses.
- Increases myocardial wall stress and oxygen consumption, which may be associated with myocardial damage.
- In patients with TF the increase of blood pressure (BP) due to phenylephrine is correlated with an increase of pulmonary flow. This shows that phenylephrine increases LV afterload more than RV afterload.
- All the effects are dose-dependent and continuous intravenous infusion is associated with higher doses without being better in maintaining BP.

DISCUSSION

We did not request preoperative blood test for the risk of hypoxemic crises during the venoclysis.

Premedication was not prescribed (not indicated due to the short age of the patient).

Global CO reduction, myocardial wall stress increase and myocardial oxygen requirements increase caused by phenylephrine, all together with the fact that those effects are dose-dependent and continuous intravenous infusion is associated with higher doses, made us choose the bolus option, preceded by albumin 5% and adjustment of preoperative fasting.

Although lactic acid levels were always lower than 1.2mmol/l and there was not acidosis disorder, periods of hemodynamic instability - with hypotension and low arterial saturation - were observed. Absence of bladder catheterization and lack of cerebral/somatic oximeter complicated volume management, which was not as accurate as we thought.

LEARNING POINTS

Phenylephrine is a useful drug in the setting of children with TF, but its potential harmful clinical and physiologic effects should not be underestimated. Further studies comparing continuous intravenous infusion versus bolus injection in cases with TF are needed. Hemodynamic monitoring, able to provide oxygen-supply-to-demand ratio information, must be aggressive in this kind of patients.