

A successful interdisciplinary collaboration for the management of pneumoperitoneum and pericardial effusion in a premature newborn

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ABSTRACT

Objectives. Percutaneously central catheters are typically used in neonatal intensive care units (NICU) to provide parenteral nutrition and drug therapy administration. Their use is associated with specific complications: occlusions, infections, thrombosis, rupture, and migration, including rare life-threatening conditions such as pericardial effusion and cardiac tamponade.

Material and methods. We present the case of a patient hospitalized in the Neonatology Department of "St. Andrei" County Clinical Emergency Hospital of Constanta, diagnosed with cardiac tamponade at 18 days of life.

Outcomes. Premature male newborn, gestational age (GA) of 33 weeks, birth weight (BW) 2380 g, Apgar score 5/7, issuing from pregnancy without prenatal care, admitted in NICU with Continuous Positive Airway Pressure (CPAP) respiratory support. He required intensive care during the neonatal period and presented with sudden cardiac instability 18 days after the insertion of a peripherally inserted central catheter (PIC-Line). The echocardiography demonstrated severe pericardial effusion with evidence of cardiac tamponade. Successful urgent subxiphoid pericardiocentesis was performed. Totally 20 ml of fluid was collected, consistent with the composition of the hyperosmolar solution infused.

Conclusions. Despite the fact that it is a rare complication, cardiac tamponade should be considered in any newborn with a PIC-Line who presents with sudden suggestive deterioration (cardiorespiratory instability, bradycardia, cyanosis and metabolic acidosis), which does not respond to resuscitation maneuvers, when lines are considered to be placed correctly.

Implementing a modern algorithm, who is easy to learn and quick to perform, with the help of ultrasonography, represents the key of success for detecting urgent neonatal complications leading to sudden deterioration.

Keywords: premature newborn, pericardial effusion, cardiac tamponade, pericardiocentesis, continuous positive airway pressure

INTRODUCTION

The clinical syndrome that bears the name of *cardiac tamponade* is caused by the accumulation of fluid in the pericardial space, which determines reduced ventricular filling and subsequent hemodynamic compromise. The condition is a medical

emergency, which includes complications such as pulmonary edema, shock, and death.

Regardless of the etiology, in cardiac tamponade, the outer layer of the pericardium is stretched beyond its elastic limit, which causes the pressure inside the pericardial sac to act on the diastolic filling and decrease the volume of the cardiac cavities [1].

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Consequently, venous stasis occurs, the systolic flow is reduced, followed by compensatory tachycardia, a decrease in the cardiac output, and systemic hypoperfusion when the adaptive mechanisms are exceeded (increase in contractility and heart rate). The filling of the left ventricle is further reduced during inspiration by the increase in the systemic venous return, which is reflected in the volume of the right cavities which makes the intraventricular septum bulged to the left, further reducing the end-diastolic volume of the left ventricle. This phenomenon leads to the appearance of the paradoxical pulse, constantly encountered in cardiac tamponade [2].

The clinical picture depends a lot on the speed of fluid accumulation and, individually, on the velocity of the intrapericardial pressure (IPP) increase, thus creating a clinical form of acute tamponade, contrasting to the subacute one, with a slower build-up, in days or weeks. The symptomatology in neonates is dominated by exertional dyspnea that evolves into tachypnea, tachycardia, paradoxical pulse, jugular turgor, and arterial hypotension, without lung damage.

These presentations require a differential diagnosis compared to other forms of hypotension with increased venous pressure (shock, right heart failure) through paraclinical explorations.

In the subacute forms, the clinic is less noisy, in some cases, the presentation can be made in the stage of tamponade complications: acute renal failure, liver failure, or mesenteric ischemia. For a correct diagnosis, careful monitoring of the patient is necessary along with paraclinical explorations [3].

In acute forms, chest x-ray and echocardiography are necessary investigations for the evaluation of patients suspected of cardiac tamponade, with the mention that emergency echocardiography should be considered in the case of hemodynamically unstable patients.

The treatment of cardiac tamponade consists of draining the pericardial fluid to decrease the pressure in the pericardial cavity and improve hemodynamics. In most cases, supportive treatment is also necessary, consisting of fluid and electrolyte rebalancing and inotropic support of a limited time [4].

CASE PRESENTATION

We present the case of a male newborn, at the County Clinical Emergency Hospital of Constanta “St. Andrew”, BW 2380g, Apgar score 5/7, extracted vaginally, in cephalic presentation, GA 33 weeks. The 21-year-old mother, Gravida I, Para I, without prenatal care, presents herself in the emergency service, for acute renal symptoms, and was admitted to the nephrology department where she re-

ceived treatment with non-steroidal anti-inflammatory drugs and corticosteroids for renal pathology. The patient was transferred to the obstetrics and gynecology department following the onset of labor.

After birth the newborn is admitted to the NICU for respiratory distress syndrome, requiring nasal CPAP respiratory support. 48 hours after admission, pneumoperitoneum secondary to intestinal perforation occurred (Figure 1).



FIGURE 1. Abdominal-Chest X-ray showing: pneumoperitoneum (yellow arrow) with elevated supra hepatic diaphragmatic dome

He required surgical intervention with the excision of a portion of the small intestine and end-to-end anastomosis performed by the surgeon after the interdisciplinary examination.

The postoperative outcome was slowly favorable, the newborn required mechanical ventilation, only for 2 days. Because of prolonged total parenteral nutrition (TPN), a PIC line was inserted in DOL 17.

At 18 days of life, a sudden cardio-circulatory and respiratory deterioration occur. The newborn presents with generalized cyanosis, intense mottled teguments, low SpO₂, and bradycardia, which needed resuscitation maneuvers: intubation, ventilation, and cardiac massage. A favorable short-term response was obtained, followed by cardiorespiratory collapse under mechanical ventilation with FiO₂ 100%.

The thoracoabdominal X-ray showed cardiomegaly, with a normal lung pattern, and the distal end of the central venous line at the level of the RA (Figure 2).



FIGURE 2. X-ray showing: PIC Line in wrong position RA (yellow arrow)

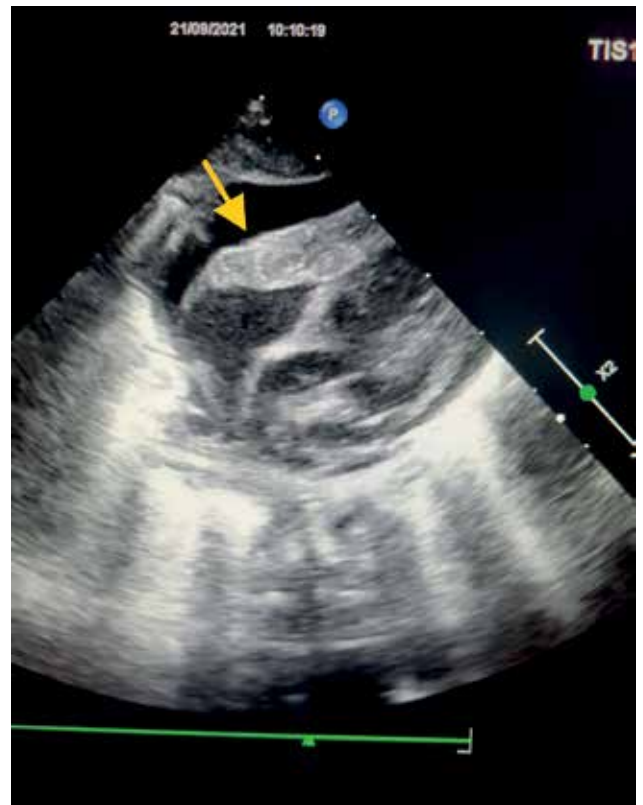


FIGURE 4. subcostal long axis view- echocardiography showing the pericardial effusion (PCE) (yellow arrow)



FIGURE 3. subcostal short axis view – echocardiography showing contracting chambers (red arrows) surrounded by pericardial fluid

The transthoracic echocardiography demonstrated severe pericardial effusion with evidence of cardiac tamponade. (Figures 3 and 4).

Emergency echo-guided subxiphoid pericardiocentesis was successfully performed, and approximately 20 ml of serohemorrhagic fluid was collected, resulting in consistency to the composition of the hyperosmolar solution infused (Table. 1).

TABLE 1. Pericardial fluid analysis

Cl -	74 mEq/L
Cholesterol	<4 mg/dL
Annotation	The determined value for glucose in the pericardial fluid is higher than the maximum detection limit of the analyzer.
Glucose	>750 mg/dL
LDH	68 IU/L
Proteins	0,33 g/dL
Triglycerides	72 mg/dL
Pericardial fluid culture	The bacterial flora did not develop on the culture.
Cytological evaluation of pericardial fluid	Hemorrhagic appearance. Number of elements: 201 white blood cells/mmc: 56,7% mononucleated. 43.3% polymorphonuclear. Gram-stained smear: bacterial flora is not evident.

The central venous catheter (CVC) was repositioned at the junction of the superior vena cava with the RA (Figure 5).

In NICU the outcome was adequate, and at the age of 34 days, he could be transferred to the premature department for continuous treatment and specialized care.

The newborn is discharged at 54 days (40 weeks corrected age), 3080g, with a good general condition, normal skin, with the absence of any neurological sign according to AMIEL TISON score, clinically stable, with good digestive tolerance.

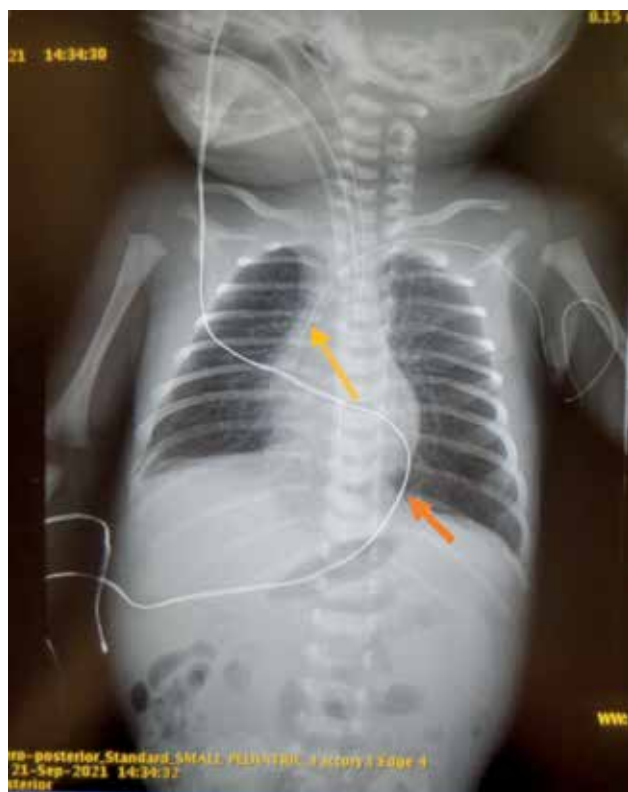


FIGURE 5. X-ray after replacement of PIC-line (yellow arrow), temperature sensor (orange arrow)

DISCUSSIONS

Pneumoperitoneum in preterm infants is a surgical emergency, usually indicative of intestinal perforation. Just a few cases of idiopathic pneumoperitoneum have been reported in the literature, the underlying causes, and pathophysiology of which remain unknown. The key point in solving such a case is represented by the interdisciplinary collaboration, the speed of the surgical intervention, and being in a hospital where there is a neonatology and pediatric surgery department [5-6].

The echocardiography was essential for early diagnosis and fast pericardiocentesis when cardiac tamponade, was performed by the neonatology team in NICU, our case being proof of a very good ultrasound performance.

In the case of extremely low birth weight or low birth weight neonates, the situation can be much worse, even leading to the death of the patient. Also because of the lack of specific clinical manifestations and low incidence, medical staff often ignore this condition and delay the diagnosis and treatment. For all neonates with a PIC-line, if unexplainable and refractory dyspnea appears, apnea, abnormal heart rate, and blood pressure, metabolic acidosis, or deterioration of the base disease conditions are present, the PIC-line placement should be checked [7-8].

The main etiologies of neonatal pericardial effusion are iatrogenic (central venous catheter-related,

postoperative), infection, congenital anomalies, tumors, and idiopathic.

At the moment, the ideal position of the catheter tip is still being disputed. The majority of studies point out that the catheter tip should be in the vena cava, but outside the heart outline (for preterm infants) [9].

We suggest that accidental events following catheterization cannot be excluded even when the catheter is correctly inserted. In the case of newborns with PIC lines who present clinical deterioration, consideration must be given to pericardial effusion/cardiac tamponade and appropriate measures adopted. No strong argument can be made for the catheter as the leading cause in the case of pericardial effusion. One etiological factor that should be taken into consideration is the erosion of the vascular or cardiac wall by the tip of the catheter. The hyperosmolar parenteral nutrition fluid diffuses into the pericardial space creating the effusion and, subsequently, cardiac tamponade. With the growing accumulation of pericardial fluid, intrapericardial pressure increases and begins to further affect right heart filling. A general effect of restriction of the total blood volume allowable within the four cardiac chambers occurs and, therefore, an amplified respiration-dependent ventricular volume interaction. Due to stiffer walls, the left ventricular filling is less impacted than the right one [9].

It should be mentioned that the right atrial tip of the catheter position is accepted in line with published recommendations and still considered acceptable practice in some units in the United Kingdom, in contrast with the practice in the United States [10].

Timely diagnosis accompanied by correctly performed pericardiocentesis can radically change the final results of the therapeutic management of this pathology. Pericardial effusion and cardiac tamponade are uncommon neonatal emergencies that carry a high mortality. Emergency ultrasound protocols are generally used in adult emergency and critical care medicine. From a modern and current point of view, an attempt is being made to establish a protocol to be implemented for patients hospitalized in neonatal intensive care whose clinical condition suddenly deteriorates. These protocols must be considered and implemented [11].

Nadia Yousef proposed a quick reliable point-of-care ultrasound exam, testing, five main organs: heart, lung, aorta, abdomen, and brain, to provide information in real-time to aid clinical decision-making, because unexpected and potentially fatal complications like cardiac tamponade, pneumothorax, massive pleural effusion, critical aortic occlusion, free abdominal fluid, severe intraventricular hemorrhage, can be detected which is essential to

prompt life-saving management in the newborn [11].

Bedside functional echography is a necessity when monitoring a neonate with sudden deterioration and definitely can save the child. Such complicated cases may be a challenge for neonatologists, surgeons, and echocardiographers, who require close collaboration.

CONCLUSIONS

Despite the fact that it is a rare complication, cardiac tamponade should be considered in any new-

born with a PIC-Line who presents with sudden suggestive deterioration (cardiorespiratory instability, bradycardia, cyanosis, and metabolic acidosis), which does not respond to resuscitation maneuvers, when lines are considered to be placed correctly. Implementing a modern algorithm, who is easy to learn and quick to perform, with the help of ultrasonography, represents the key of success in detecting urgent neonatal complications leading to sudden deterioration.

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