INTRODUCTION

Iatrogenic perforation of the esophagus in neonates is a rare occurrence and is most frequently seen in low birth weight infants [1]. The overall estimated frequency of iatrogenic incidents is 0.8% in preterm infants reaching 4% in very low birth weight newborns [2]. The most frequent site of perforation of the pharyngoesophageal junction in neonates is the anatomical narrowing. Therefore we shall use the term “pharyngoesophageal perforation” (PhEP). According to the literature, PhEP is most commonly a result of nasogastric tube insertion, oropharyngeal suction or forceful endotracheal intubation [3,4]. This complication may be misdiagnosed as esophageal atresia or esophageal duplication, thus indicating unnecessary surgery [5]. Herein, we review five cases with neonatal PhEP.
Material and Methods

A retrospective study of 5 newborns with PhEP was performed. The study took place between 1999 – 2014 in UMHATEM “N.I.Pirogov” and “Tokuda” Hospital, Sofia, Bulgaria. Contrast chest X-ray was performed right after admission. Clinical observation and intensive care were done as first therapeutic methods of choice. Oro- or nasogastric tube reinsertion was undertaken. Oral intubation was done as needed. Broad spectrum antibiotics, total parental nutrition, and tube feeding were administered during the treatment period in our intensive care unit.

Results

All of the newborns were premature and were born between 32nd and 35th gestation week. Three of the patients debuted with respiratory distress syndrome. All of the babies underwent oro- or nasogastric tube reinsertion. In two of the cases, esophageal duplication was revised as differential diagnosis, one patient was suspected for esophageal atresia and in only one baby esophageal perforation was taken into consideration before admission in our clinic. Four of the babies were treated completely conservatively, and conservative treating protocol was the first line of therapy. In one case surgery was required, including chest tube drainage, thoracotomy, esophagectomy and subsequent gastric transposition. The mortality rate in our series was 0%, despite the deteriorated condition of all the patients during the onset of symptoms.

Patient presentation and individual results

Cases 1 and 2. Identical perforation was found in two babies born at gestational weeks 33 and 35. All the attempts for inserting an orogastric tube at the neonatal ward failed. The tube stopped at a certain level and could not be introduced into the stomach. There was bloody aspirate from the lumen and inability to introduce fluid. The X-ray with contrast media showed a parallel tract along the native esophagus; this double shadow was interpreted as esophageal duplication (Fig. 1 and Fig. 2). The tube was removed; total parenteral nutrition and antibiotics were administered. After admission to our clinical department, a feeding tube was carefully introduced into the stomach by direct laryngoscopy, and a small crescent lesion at the posterior pharyngeal wall was found. Both babies were managed conservatively. Normal esophageal lumen was found at a control X-ray on Day 10. Case No. 3: We discuss a premature male newborn at Gestation Week 34 with no ultrasound data of polyhydramnios on prenatal examinations. The baby initially presented with respiratory distress, and oral intubation was subsequently performed. However, oro- or nasogastric tube could not be inserted. A contrast examination was performed due to the suspected esophageal atresia, which demonstrated a blind upper pouch (Fig. 3a). The baby was transferred to our clinical department 9 hours after delivery with a diagnosis of esophageal atresia. A repeated contrast esophagography demonstrated the same blind pouch and a normally situated esophageal lumen (Fig. 3b). Iatrogenic perforation of the esophagus was presumed. A nasogastric tube was meticulously inserted, and tube feeding was initiated on the next day. At the same time, broad spectrum antibiotics and proton pump inhibitor were administered. The baby was extubated within three days. A contrast examination showed free passage and regular shape of the esophagus a week later (Fig. 3c). The infant was discharged from hospital on Day 14 of life without any further complications. Case No. 4. A premature male newborn at gestation week 33 developed respiratory distress after delivery. Oral intubation was successful; several attempts for inserting oro- or nasogastric tube were
made. A contrast study with barium sulfate was established due to suspected esophageal atresia. The baby was transferred to our clinical department 9 hours after birth with a diagnosis of esophageal atresia. However, the presence of the plain film of upper contrast depot together with normal esophageal lumen was inconsistent with the diagnosis of esophageal atresia (Fig. 4). Direct laryngoscopy carefully inserted a new nasogastric tube. Close inspection revealed a small lesion of the posterior pharyngeal wall. With a diagnosis of iatrogenic perforation of the esophagus broad spectrum antibiotics and proton pump inhibitor were administered. On Day 10 of life, the contrast examination showed free passage and the normal lumen of the esophagus.

Case No. 5 We discuss a baby born at Gestation Week 32, which was intubated at birth because of respiratory distress. An orogastric tube was repeatedly inserted. On Day 4 of life, the baby was reintubated due to clinical deterioration. Esophageal perforation was presumed; the contrast babygram showed a massive mediastinal leak. The nasogastric tube was drawn out, and conservative treatment was administered; the baby was extubated to CPAP. On Day 5 of life, the baby was transferred to our clinical department. A subsequent X-ray demonstrated tension pneumothorax on the right side (Fig. 5). Chest tube drainage of the pneumothorax was immediately performed. Because of persistency of the pneumothorax, a revisional right thoracotomy was indicated with following esophageal extirpation due to massive rupture of the upper esophageal portion. The recovery of the patient was difficult. Gastric transposition was performed at the age of 9 months.

Discussion

Although many authors argue that Elkof was the first who published a case with neonatal esophageal perforation, the first publication, in fact, belongs to Warden who reported a case of esophageal perforation due to iatrogenic injury in a neonate [6, 7]. According to Krasna et al. [8], there are two types of perforations: 1. Submucosal perforation, which leads to a blind mediastinal cavity mimicking esophageal atresia or duplication, and 2. Free esophageal perforation is leading to right-sided pneumothorax or pneumomediastinum. Gastric intubation and oropharyngeal suction are essential procedures in the management of premature newborns. Most traumatic perforations occur in the cervical portion of the esophagus at the level of the pharyngo-oesophageal junction proximal to the cricopharyngeal muscle; it may compress the esophageal lumen, facilitating the injury by the use of different devices. Hyperextension of the neck may also predispose a possible esophageal injury. A subsequent cricopharyngeal spasm may increase the danger of perforation.
The inserted feeding tube perforates the fragile pharyngeal mucosa and forms a blind periesophageal blind pouch or performs a tunnel through the loose submucosa along with the prevertebral space. [7, 9] Symptoms are suggesting PhEP may be delayed and non-specific, due to the poor general condition of the prematurely born baby. When evident, this is a sign of an advanced intrathoracic complication. The clinical presentation depends on the type and site of perforation. Symptoms may include respiratory distress, tachycardia, drooling and excessive salivation and regurgitation. Difficulty in the passing of a tube raises the first suspicion of esophageal atresia and indicates the need of contrast X-ray examination. The plain chest radiogram may reveal ectopic tube position or concomitant air leak (pneumomediastinum) or even pneumothorax; however, it is insufficient to point out a leak from possible perforation. To confirm and locate the injury and degree of extravasation, we perform a contrast X-ray study with water-soluble agents or diluted barium solution. The contrast esophagography may demonstrate a high positioned blind collection (pseudodiverticulum) mimicking esophageal atresia or abnormal shadow parallel to the native esophagus, mimicking esophageal duplication. [5, 10] Clues to diagnosis and conservative treatment may be based on three points: 1. Repeated and failed attempts to pass a feeding tube into the stomach or forceful tracheal intubation 2. Abnormal collection on X-ray of contrast media suggesting a “false” esophageal atresia or double-esophagus 3. Successful insertion of a new nasogastric tube and radiographic evidence of normal esophageal lumen. The modern endoscopic equipment allows attentive esophagoscopy, thus establishing a definitive diagnosis. [10] However, the procedure may worsen the perforation size itself when performed by new medical specialists. The management depends on the extent and location of the injury. The correct interpretation of the X-ray image based on the previous history and clinical symptoms are crucial for the choice of the approach to appropriate treatment and avoiding unneeded surgical procedures especially when the patient is hemodynamically stable [11, 12, 13]. Perforations of the pharynx and esophagus in neonates can be managed conservatively, except for cases with large lesion of the upper thoracic esophagus with accompanying pneumothorax and pleural effusion. The successful insertion of a new nasogastric tube for nutritional support would avoid the need for total parenteral nutrition or gastrostomy.

**Conclusion**

Pharyngoesophageal perforation is a rare complication in the modern neonatal intensive care which can occur unexpectedly even performed by experienced medical professionals. It occurs mainly in low birth weight babies. Primary indications for a possible PhEP in the neonatal period include a history of difficult naso- or orogastric feeding tube placement, sanguineous aspirate from the lumen opening, length and course of the inserted tube. Sudden deterioration of the general condition is often manifested. Establishing an exact diagnosis relies basically on the similar X-ray findings. Withdrawal of the tube, accurate placement of another feeding tube and continued conservative management with absence of serious surgical complications may result in complete recovery.

**Authors’ Statements**

**Competing Interests**