

## Case Report

# Ultrasonography assess the pneumoscrotum: a case series

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**Abstract:** Pneumoscrotum is an unusual disease that means that the gas is exist in the scrotum and usually described during diagnosis and treatment process, also with disease condition. The vast majority of literature about pneumoscrotum are case reports, and rarely see the research literature about it. The most common cause of pneumoscrotum are iatrogenic injury and traumatic factors. The presence of pneumoscrotum may indicate the possibility of a life-threatening disease process in the peritoneum or retroperitoneal, although itself is a benign and rare condition. This condition should never be underestimated.

**Keywords:** Pneumoscrotum, ultrasonography, submucosal tunneling endoscopic resection, esophageal leiomyoma, adrenal adenoma

### Introduction

Pneumoscrotum is rare in clinic, the vast majority of literature are case reports, and rarely see the research literature about it. The most common cause of pneumoscrotum are iatrogenic injury and traumatic factors. Pneumoscrotum is also due to spontaneous factors, but the former is more common. Most of the pneumoscrotum is a benign process, but should suggest a disease process elsewhere and can not be underestimated. It is more important to early recognize the condition and early and appropriate treatment than concert the precise etiology of these perforations. Ultrasound can be used for bedside examination for critically ill patients and provide physicians with important information to assess disease accurately. Meanwhile, CT examination is an effective method for general assessment of the condition of a patient.

Written informed consent were obtained from all the patients.

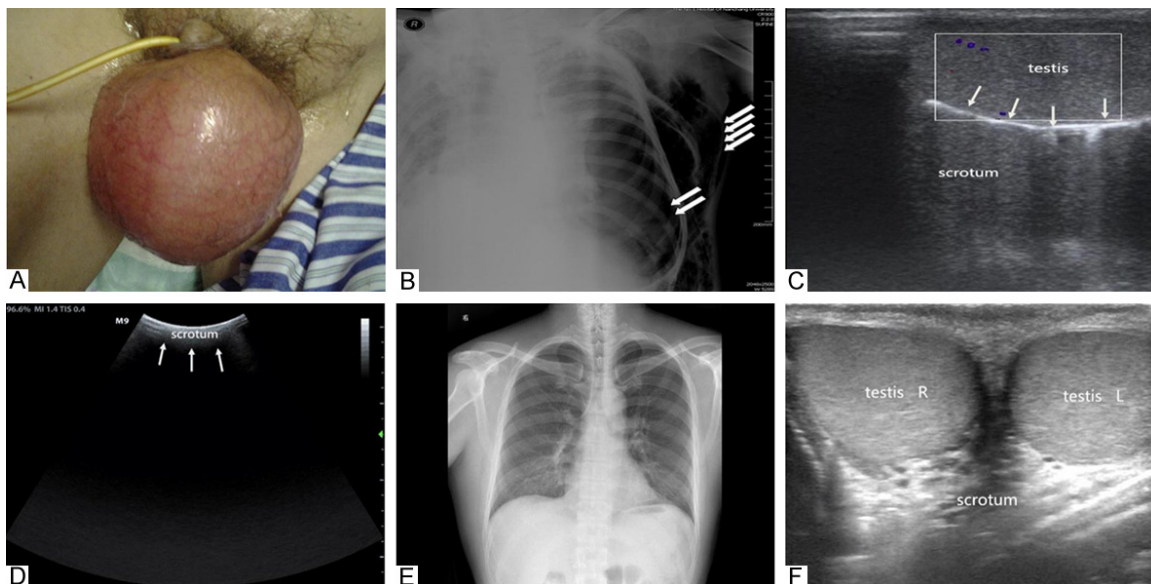
### Case 1

In October 2014, a 65 years old male affected by mechanical intestinal obstruction with septic shock and acute respiratory distress syndrome arrived on trans-tracheostomic jet-venti-

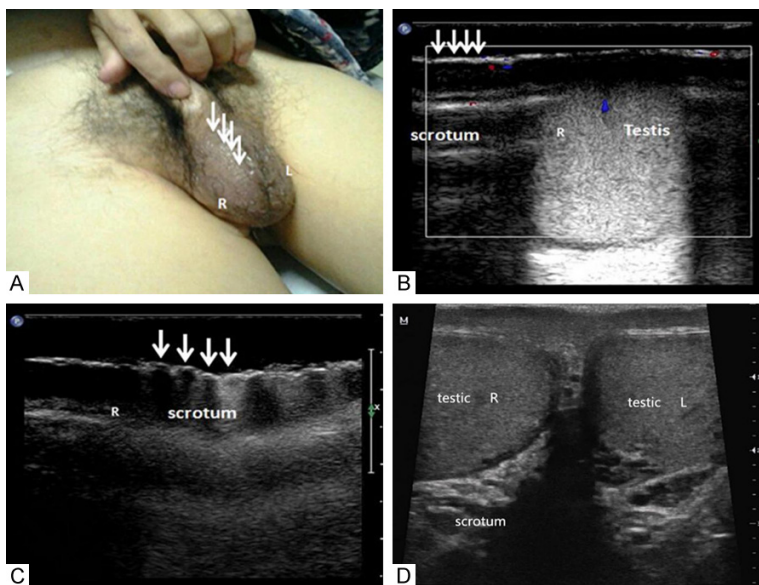
lation (pressure controlled ventilation [PCV]: inspiratory pressure [PI] 20 cm H<sub>2</sub>O; positive end-expiratory pressure [PEEP] 5 cm H<sub>2</sub>O; breathing rate [BR] 27 breaths/minute; fraction of inspiration O<sub>2</sub>[FiO<sub>2</sub>] 70%; blood oxygen saturation [SPO<sub>2</sub>] 96%, was admitted to our intensive care unit for hypotension, dyspnea, and blood oxygen desaturation due to acute pulmonary edema and acute left heart failure during submount hospital treatment. Prior to this patient experienced intestinal adhesions release surgery due to gastric cancer surgery five years ago. With norepinephrine upregulation of blood pressure can be maintained at 130/70 mmHg. The use of morphine and estazolam was due to patients with agitation. Cultural specimens of blood was collected and analyzed. The leucocyte count was  $22.11 \times 10^9/L$  (normal range,  $4.0-10.0 \times 10^9/L$ ), 94.9% of the leukocytes were neutrophils. The patient underwent antibiotic therapy including tigecycline, meropenem, caspofungin, and reducing the cardiac preload with hydrochlorothiazide and spironolactone.

Three days later, the patient suddenly sustained breathing difficulties. At this time, auscultation left chest, breathing sounds disappear, and physical examination showed serious

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**Figure 1.** Case 1. A 65-year-old male presenting with significant swelling of the scrotum (A). The thoracic X-ray showed pneumothorax on the left side and extensive subcutaneous emphysema (B). Ultrasound found multiple linear hyperechoic reflections with significant retro-acoustic shadowing (C). Ultrasound found linear hyperechoic reflections with significant retro-acoustic shadowing on bilateral scrotum area, and we can not see anything in the rear (D). A follow-up chest X-ray exhibited a resolving of the pneumothorax 5 days later (E). A follow-up testicular ultrasound exhibited a resolving of the pneumoscotum 6 days later (F).



**Figure 2.** Case 2. A 68-year-old male presenting with the right scrotum swelling slightly (A). On the right side of testis, above the scrotum area, we found multiple linear hyperechoic reflections with significant retro-acoustic shadowing (B, C). The pneumoscotum was resolved spontaneously within a day (D).

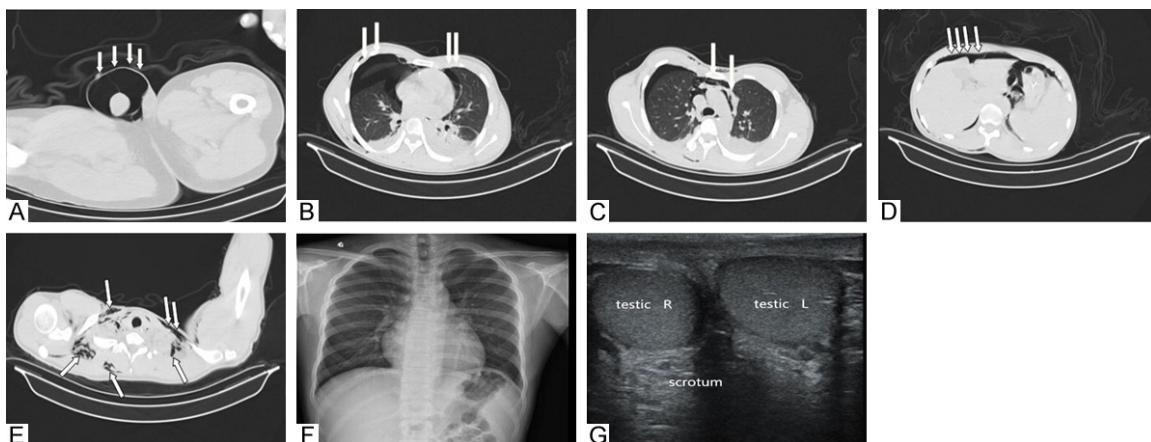
swelling of the scrotum (**Figure 1A**), suspicious for the presence of pneumoscotum. In order to find the etiology of the disappearance of breath sounds and the scrotal swelling, a bedside

chest X-ray and testicular ultrasound were performed. The thoracic X-ray showed pneumothorax on the left side and extensive subcutaneous emphysema (**Figure 1B**) and the testicular ultrasound showed bilateral pneumoscotum (**Figure 1C, 1D**). Inter-costal closed thoracic drainage and pressurized dressing of the left pneumothorax was performed immediately. Subsequently, 5 days later and 6 days later respectively, a chest X-ray and testicular ultrasound showed a resolving of the pneumothorax and pneumoscotum (**Figure 1E, 1F**). The patient was discharged from the hospital 30 days later.

### Case 2

In March 2015, a 68 years old male was admitted to the First Affiliated Hospital of Nanchang Medical University for physical examination. Ultrasound prompts the right adrenal mass. A

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**Figure 3.** Case 3. A 17-year-old boy presenting with significant swelling of the scrotum. The CT scan confirmed the presence of the pneumoscrotum (A) and demonstrated a bilateral pneumothorax (B), pneumomediastinum (C), pneumoperitoneum (D) and extensive subcutaneous emphysema including the neck, back, chest and axilla (E). The chest X-ray revealed that the gas in the subcutaneous and thoracic cavity had been absorbed (F). The testicular ultrasound revealed that pneumoscrotum had been solved (G).

computed tomography (CT) scan confirmed the presence of the adrenal mass and suggests adrenal adenoma. Two days later, the patient returned to the same hospital for an adrenalectomy surgery. Twenty-four hours after the surgery, the patient felt painful mainly in the right lower quadrant and right testicular. The pain was described as persistent and constant. A physical examination was performed by the attending physician and confirmed that the right scrotum swelling slightly (**Figure 2A**) and accompanied by crepitus. The doctor suspicious for the presence of testicular torsion. A bedside testicular ultrasound was performed in order to find the etiology of the testicular pain. The testicular ultrasound tip: The echogenicity of bilateral testicular and epididymis was homogeneous, size and shape was normal. On the right side of testis, above the scrotum area, we found multiple linear hyperechoic reflections with great retro-acoustic shadowing (**Figure 2B, 2C**). We considered that this was gas within the scrotum owing to the flow and hyperechoic nature of these linear. So an pneumoretroperitoneum etiology was presumed, as the patient had experienced adrenal surgery one day ago. Since the small amount of gas, we choose conservative treatment. The pneumoscrotum resolved spontaneously within a day by re-examining testicular ultrasound (**Figure 2D**). After an uneventful course, the man was discharged from the hospital 10 days later.

### Case 3

In January 2017, a 17-year-old boy received a gastroscopy at the First Affiliated Hospital of  
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Nanchang University, as he felt nausea and vomiting lasted for one year, the vomit does not contain blood but the food eaten. The gastroscopy revealed an esophageal leiomyoma, 6 cm in diameter, most of which protruded into the esophageal cavity, located 35-40 cm from the incisor.

Two months later, the patient returned to the same hospital for a submucosal tunneling endoscopic resection (STER) of esophageal leiomyoma. Before surgery the culture specimen of blood were collected and analyzed. The laboratory data showed that the blood analysis, liver and kidney function was normal. The gastroscopy revealed esophagus from the incisors 35-40 cm showed a huge mucosal uplift, smooth surface. We established a tunnel mouth from the incisors 32 cm and separated the submucosal to the mass. Then continue to injected hook knife and dual knife to peel the mass. The mass had multiple antennae, part of them invaded mucosal layer, so we used high-frequency electric trap sub-cut the tumor, after most of the tumor was stripped, and no residue in the mass. The wound was treated with a heat biopsy clamp and then closed the tunnel mouth with a titanium clip. We saw a break at the tunnel and used a titanium clip to clamp immediately. We used a scalp needle for subcutaneous exhaust the neck subcutaneous accumulation of gas, during the surgery. Following the STER, on residual tumors in the edge and any definite perforations were found. The whole operation lasted one hour and forty-four min-

utes. After the STER, the patient underwent gastrointestinal decompression.

Approximately fifteen hours after the operation, the patient complained of scrotal pain and felt difficulty breathing and chest tightness gradually. So an emergency bedside testicular ultrasound was performed and revealed a pneumosrotum. In order to fully assess the patient's condition, a CT scan of the chest and abdomen was also performed. It confirmed the presence of the pneumosrotum (**Figure 3A**) and demonstrated a bilateral pneumothorax (**Figure 3B**), pneumomediastinum (**Figure 3C**), pneumoperitoneum (**Figure 3D**) and extensive subcutaneous emphysema including the neck, back, chest and axilla (**Figure 3E**). In addition, the right lung infection and left pleural effusion also existed. The laboratory data showed that the white blood cell count was  $16.80 \times 10^9/L$  (normal range,  $4.0-10.0 \times 10^9/L$ ), 89.1% of the leukocytes were neutrophils. Due to the extensive surgical wounds, we considered the possibility of merging mediastina infection. So the sulperazone was used for anti-infective treatment. As the patient's vital signs were stable, did not develop into peritonitis, the cardiothoracic surgeon recommended conservative treatment, including electrocardiograph monitoring and oxygen supply. We observed in patient with subcutaneous pneumatosis intimately. Three days later, the patient received a chest X-ray and testicular ultrasound in order to assess whether the subcutaneous emphysema, pneumothorax and pneumosrotum was completely absorbed. The chest X-ray and testicular ultrasound showed that the gas in the subcutaneous and thoracic cavity had been absorbed (**Figure 3F**) and the pneumosrotum had been solved (**Figure 3G**). After an uneventful course, the boy was discharged from the hospital 10 days later.

### Discussion

Pneumosrotum is an unusual disease that means that air is exist in the scrotum and usually described during diagnosis and treatment process, also with disease condition. It includes pneumosrotum and pneumatocele [1-3]. This can be either an accidental discovery of benign lesions or early signs of life-threatening conditions [4]. Pneumosrotum always show typically clinical signs, consist of swelling of the scrotum or palpable crepitus, and palpable. However

pneumatocele is not palpable as the gas is exist in the tunica vaginalis of the testicle [5]. Compared with a pneumatocele, pneumosrotum is always restricted to one side of the scrotum and scrotal gas cannot be reduced manually [6].

Pneumosrotum is rare in clinic, the vast majority of literature are case reports, and rarely see the research literature about it. The most common cause of pneumosrotum are iatrogenic injury and traumatic factors. Pneumosrotum is also due to spontaneous factors, but the former is more common [7]. By reviewing the literatures, the pneumosrotum can exist in the following cases: ① Tracheal or lung injury such as tracheal intubation, cardiopulmonary resuscitation, closed thoracic trauma, pneumonec-tomy, spontaneous tension pneumothorax. ② Gastrointestinal injury such as esophageal-osc-opy, endoscopic retrograde cholangiopan-creatography, endoscopic mucosal resection, endoscopic duodenal papillary muscle incision, sigmoid diverticulum seminal vesicle. ③ Spontaneous such as perforation of hollow abdominal organs, spontaneous pneumothorax, and fournier gangrene.

There are three mechanisms to explain air in the scrotum [8]. Firstly, the probable mechanism is that the gas diffusing from the lungs owing to pneumomediastinum, pneumothorax, or thoracic traumas. The gas present within subcutaneous or retroperitoneal can diffuse from the lungs on the way of Camper's and Scarpa's fascias [5]. These fascias are different exist in the abdomen but fuse to form Colle's fascia and Darto's fascia, respectively, at the penis and in the testes [9]. Gas following this way frequently performs with scrotal edema, cramp, and sometimes pain [8]. It can be resulting in one swollen hemiscrotum due to the mid-line septum of the scrotum, if the gas is deep to Darto's fascia [5]. Similarly, pneumomediastinum may cause gas to diffuse through the fascia around esophagus and aorta, then the gas through diaphragmatic hiatus direct access into the perinephric space and lead to pneumoretroperitoneum, ultimately. The air diffuse from inguinal canal can reach into scrotum through spermatic fascia. Finally, the diaphragm of the sternocostal margin may allow the air to diffuse the layers of the abdomen hollow and the pelvis through direct communication [10]. This unusual condition mainly caused

by iatrogenic or traumatic, is usually in adults. Secondly, the mechanism may be that the pneumoperitoneum can be transmitted along with proprietary processus vaginalis into scrotum, then result in a pneumatocoele. This is the most common reason cause of pneumosrotum in newborns and children as the processus vaginalis secondary to an embryological defect is patent in 80-90% of babies [11]. Thirdly, the mechanism may be due to the anaerobic bacteria or fungi producing gas, which lead to the spread of gas along with the subcutaneous tissues or directly into the scrotum.

In the first case of this article, the intrusive tracheal operation leads to pneumothorax and extensive subcutaneous emphysema, the gas spreads into the scrotum along with Camper's fascia and Scarpa's fascia, a connective tissue across the abdominal segments. After the pneumothorax was diagnosed, we performed an intercostal closed thoracic drainage and pressurized dressing of the left pneumothorax immediately. There is no risk of urethral compression or vascular compromise due to the elastic properties of the scrotal skin [5, 8]. We chose a conservative treatment for the pneumosrotum. The second case we reported was due to adrenal surgery. As the adrenal gland belongs to the retroperitoneal organs, during the surgery a small amount of air may be into the retroperitoneal space result in pneumoretroperitoneum. The gas spread from the inguinal canal, then reach into scrotum along with spermatic fascia. Since the small amount of gas in scrotum and the patient without other complications, we choose conservative treatment. The pneumosrotum resolved spontaneously within a day. In the third case of this article, the pneumosrotum was mediastinal origin due to perforation of the esophageal. On the one hand, Pneumomediastinum reach to transverse fracture through the periesophageal and periaortic fascial planes. Air through this transverse fracture directly to the perirenal space, and ultimately may lead to pneumoretroperitoneum. The gas can spread along with inguinal canal and reach into scrotum along with spermatic fascia. On the other hand, the gas reach into the pleural cavity through a rupture of the mediastinal pleura, and then caused the pneumothorax [11, 12]. The CT scan confirmed the exist of pneumosrotum and demonstrated a bilateral pneumomediastinum, pneumothorax,

pneumoperitoneum and extensive subcutaneous emphysema including the neck, back, chest and axilla. As the patient's vital signs were stable and did not develop into peritonitis, the cardiothoracic surgeon recommended conservative treatment, including electrocardiograph monitoring and oxygen supply. We observed in patient with subcutaneous pneumatosis intimately by re-examining chest X-ray and testicular ultrasound. After an uneventful course, the boy was discharged from the hospital 10 days later.

In conclusion, most of the pneumosrotum is a benign process, but should suggest a disease process elsewhere and can not be underestimated. It is strongly recommended to make an attentively history-taking that consist of any thoracic and abdominal trauma or surgery, recent endoscopic procedures, and history of spontaneous pneumothorax. It is more important to early recognize the condition, as well as early and appropriate treatment, than concert the precise etiology of these perforations. Ultrasound, a diagnostic technique, can be used to diagnose and distinguish a number of diseases associated with pneumosrotum, such as torsion, epididymitis, orchitis, hernia and hydrocele. Ultrasound can be used for bedside examination for critically ill patients and provide physicians with important information to assess disease accurately. Meanwhile, CT examination is a effective method for comprehensive assessment a patient's condition.

### Disclosure of conflict of interest

None.

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