Case Report

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Pneumoscrotum: Case Series & Literature Review

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Running Title A Detailed Study of Pneumoscrotum through Case Reports and Literature Review

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ABSTRACT

Pneumoscrotum is the terminology used to describe the presence of air in the scrotal wall or within the tunica vaginalis. Etiology of pneumoscrotum is varied, ranging from idiopathic to Fournier's gangrene or perforated bowel leading to significant morbidity and mortality. This paper reviews the existing literature on pneumoscrotum whilst documenting our experience with the same. Diagnosis is dependent on the patient's anamnesis, clinical signs and imaging. We are presenting a case series of three such cases and a review of the existing literature on the same. The first case is a victim of a road traffic accident who subsequently presented with diffuse subcutaneous emphysema involving the scrotum. The second case is of Fournier's gangrene with pneumoscrotum. The third case presented with a spontaneous isolated pneumoscrotum without any cause. Imaging such as Contrast-Enhanced CT and USG may be done to help narrow the differentials.

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Introduction

Pneumoscrotum is the term used to describe the presence of air within the scrotal wall or tunica vaginalis [1]. The aetiology of this condition is varied, with causes ranging from non-life threatening to potentially fatal conditions such as Fournier's gangrene or perforated bowel [2]. Timely diagnosis and treatment are crucial for improving patient outcomes. This paper reviews the existing literature on pneumoscrotum and presents three cases of the condition. The diagnosis of pneumoscrotum is based on the patient's medical history, clinical signs, and imaging. Standard investigations include laboratory tests and imaging techniques such as contrast-enhanced CT and ultrasound. In cases of secondary pneumoscrotum, emergency intervention is necessary to reduce morbidity and mortality.

Case Presentation

Case 1

A 25-year-old man came to the emergency room after falling off his speeding bike and experiencing head, chest, and abdominal trauma. On arrival, he had a Glasgow Coma Scale score (GCS) of 3/15, non-reactive pupils, and anisocoria. The patient also had difficulty breathing and subcutaneous emphysema of his neck, chest, and abdomen. He was intubated due to his low GCS score. CT scan showed a 12mm extra-dural hematoma on the right frontoparietal lobe, cerebral edema, and a 3mm midline shift. The scan also revealed multiple cerebral contusions, intraventricular hemorrhage, and rib fractures on both sides. After intubation, the subcutaneous emphysema spread to the patient's scrotum. He was put on positive pressure ventilation with a tidal volume of 450 mL, PEEP of 6 mmHg, and FiO2 of 80%. The patient received multiple punctures with a wide-bore needle, but remained hemodynamically unstable and required resuscitation with fluids and inotropic agents. Despite these efforts, the patient died after four hours.

Case 2

A 65-year-old man with history of heart disease and taking dual anti-platelets for 4 years fell and injured his perineal region. Upon examination, the left perianal region had redness, tenderness, and palpable crepitus, but the scrotum appeared normal and the patient did not complain of discomfort. The working diagnosis included the possibility of extraperitoneal perforation of the rectum or a perianal abscess. However, a rectal examination did not find any mucosal discontinuity, ruling out the extraperitoneal perforation of the rectum, thus, incision and drainage was planned. While waiting for the operation, the patient's scrotum ballooned and the crepitus extended to the scrotum. A CECT abdomen revealed an enlarged left scrotal sac with extensive subcutaneous emphysema and extension of the air foci to the perineum and subcutaneous tissue of bilateral medial gluteal region with hypodense collection with few air foci within the left gluteal region near the natal cleft (Fig. 1). Cranially the air foci extend into the perirectal region, more on the right side, retroperitoneum and in the extraperitoneal compartment of the abdomen and pelvis.

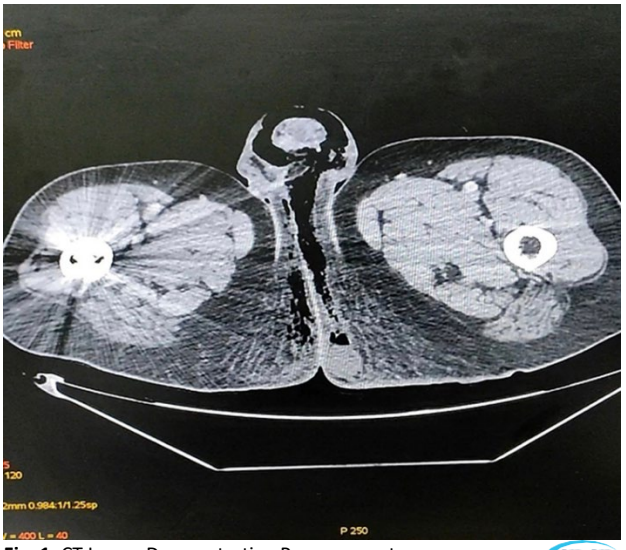

Fig. 1. CT Image Demonstrating Pneumoscrotum

Few air foci were found in the subcutaneous tissue of the lower anterior abdominal wall, which was in communication with the scrotal emphysema, suggesting Fournier's gangrene or necrotizing fasciitis. The patient was taken for emergency surgery, where minimal pus and a large amount of foul-smelling gas were released upon incision in the left perianal region. The incision was extended to the left scrotum, which appeared gangrenous and was excised. A similar incision was made in the right perianal region, resulting in evacuation of a small amount of pus and a large amount of gas, but the right scrotal wall was left intact. The culture showed a rich growth of Escherichia coli and Enterococcus faecium, and the antibiotics were adjusted accordingly. The patient recovered with subsequent dressings and IV antibiotics.

Case 3

A 50-year-old man with a history of peripheral vascular disease came in with complaints of an ulcer on his right second toe, throbbing pain in his right lower limb, and redness on his scrotum. On examination, the scrotum had palpable crepitus and swelling (Fig. 2), but no crepitus was found on any other part of the body. There was also an ulcer on the patient's right groin due to scratching related to a fungal infection (Fig. 3). TLC was 10,500. A CT angiogram of the bilateral lower limb showed a bilateral pneumoscrotum, with a significantly large amount of gas on the left hemiscrotum (Fig. 4).

Fig. 2. Swollen left hemiscrotum with palpable crepitus

Fig. 3. Infection of the Right Groin Area

Upon incision of the scrotum, air escaped, but no pus was found and the scrotal wall and testicles were normal. There was no evidence of infection. The skin infection was treated with topical and IV antibiotics, and the patient was discharged after full recovery. It was assumed that the isolated pneumoscrotum originated from the ulcer on the right groin, but it was unclear why it was more pronounced on the left side.

It is also possible that the pneumoscrotum was purely idiopathic. This type of isolated pneumoscrotum is extremely rare according to a review of the literature. Exhaustive workup with clinical examination and imaging is recommended for precise diagnosis and to avoid unnecessary surgery.

Fig. 4. Bilateral Hemiscrotum, Left more than Right

Discussion

Review of Literature

Etiology

Pneumoscrotum is a relatively rare condition. It manifests as swelling of the scrotum and palpable crepitus in most cases [1]. Pneumoscrotum has traditionally been classified into scrotal emphysema and pneumatocele. Scrotal emphysema is air in the layers of the scrotal wall and usually presents with crepitus. Pneumatocele is air within the tunica vaginalis layer of the testis, and as such, does not present with palpable crepitus [2]. Broadly, pneumoscrotum can be divided into primary and secondary causes (Table 1). For convenience, we can divide the causes of pneumoscrotum into scrotal and extrascrotal causes (Table 2). Extrascrotal causes can further be divided into abdominal and thoracic causes (Table 3).

Table 1. Broad Classification of Pneumoscrotum

Primary	Secondary
Fournier's Gangrene	Scrotal
Clostridial infection	Extrascrotal
Injection of air into the scrotum for autoeroticism	Pulmonary
Necrotising fasciitis	Peritoneal
Self-inflicted injury	Idiopathic

Table 2. Scrotal and Extrascrotal causes of pneumoscrotum

Scrotal	Extrascrotal
This includes many of the primary causes of Pneumoscrotum i.e. **Fournier's Gangrene** **Scrotal wall cellulitis** **Epididymoorchitis with gas-forming organisms**	Thoracic Abdominal Iatrogenic

Table 3. Extrascrotal causes of pneumoscrotum

Pulmonary	Peritoneal	Iatrogenic
Pneumothorax	Peptic Ulcer Perforation	Colonoscopy leading to perforation
Pneumomediastinum	Sigmoid Perforation	Endoscopic papillotomy
Thoracic trauma	Diverticular Perforation	Tracheal intubation
	Renal surgery	Cardiopulmonary resuscitation

Primary scrotal emphysema can be explained using gas production by infective organisms that have been inoculated locally or have spread via blood through another source [4]. The other explanation is the spread of air along the subcutaneous layers of the abdominal wall. Perforation of a hollow viscus can also lead to pneumotocele through a patent process vaginalis. Procedures such as colonoscopy or laparoscopic procedures where gas insufflation takes place can cause pneumoscrotum via inadvertent perforation of the bowel [5].

Diagnosis

Clinical examination plays an important role in pointing toward diagnosis of pneumoscrotum. It is important at this point to consider the cause of the pneumoscrotum. Radiological investigations also help with CT depicting the presence of air in the scrotal wall, or within, while also revealing the cause of the same in some cases (i.e., pneumoperitoneum) [6]. Ultrasonography is often useful as an initial modality of investigation. Causes such as abscess, viability of testis, and torsion of testis leading to abscess and gangrene can be discussed [7].

Treatment

As with all conditions, the primary cause of the disease should be dealt with. Local causes such as necrotising fasciitis, scrotal cellulitis, and Fournier's gangrene need to be operated on emergently [3]. Debridement, baring of the testis and orchidectomy, if required, are done [8]. Abdominal causes such as perforation peritonitis need to be treated. However, there are accounts of post-colonoscopy perforations (usually minute) that have been managed conservatively [9]. Diffuse subcutaneous emphysema due to thoracic trauma needs to be addressed with intercostal drainage tube insertion [10]. Isolated scrotal emphysema due to perineal trauma can also be treated with a local puncture with a wide-bore needle. A high index of clinical suspicion is required to diagnose isolated pneumoscrotum [11].

Conclusion

Pneumoscrotum is a rare condition. It is the accumulation of air in the scrotum. Although the condition is benign and can be dealt with by non-surgical methods [12], it is essential to identify and treat the primary cause. The cause can be gas-forming bacteria, direct air introduction from scrotal injuries, or thoracic or abdominal conditions [1, 2]. Table 4 lists all the studies found in our literature review and the cause of pneumoscrotum in each one. It is necessary to categorise the cause of pneumoscrotum. Suspected cases must be recognized immediately to prevent further morbidities. Rare cases can present with isolated scrotal emphysema which can be treated with non-surgical methods [4]. Thorough clinical examination, biochemical markers, and imaging can aid to avoid unnecessary surgical intervention.

Table 4. Studies listing causes of pneumoscrotum

Author and Year of publication	Aetiology
Dencker *et al.* 1972	Peritoneal
Castellanos *et al*. 1973	Unknown
William and Simmons 1974	Retroperitoneal
Archer 1974	Pulmonary
Christenson *et al*. 1980	Peritoneal
Fishman and goldman 1981	Peritoneal
Bray 1982	Peritoneal
Andreani and Buffet 1984	Peritoneal
Humphrey *et al*. 1984	Peritoneal
Redman and Pahls 1985	Pulmonary
Zikrillaev and Zikrillaev 1985	Extraperitoneal
Garcia and Markowitz 1987	Peritoneal
Klimach *et al.* 1990	Extraperitoneal
Menzies *et al.* 1991	Pulmonary
Millmond and Goldman 1991	Pulmonary
Watson *et al*. 1991	Unknown
Hasel *et al*. 1993	Peritoneal
Firman *et al.* 1993	Scrotal
Heimbach *et al.* 1993	Pulmonary
Wakabayashi and bush 1994	Pulmonary
Tan *et al.* 1995	Peritoneal
Divita *et al.* 1996	Peritoneal
Stavem and Heivik 1996	Pulmonary
Raudat *et al.* 1996	Pulmonary
Katkhuda *et al.* 1999	Peritoneal
Kono *et al.* 2002	Pulmonary
Golpe Gomez *et al.* 2002	Pulmonary
Mazraany *et al.* 2004	Peritoneal
Martinez-Ordaz *et al.* 2005	Peritoneal
Fu *et al.* 2005	Peritoneal
Casey and Al-dousari *et al.* 2006	Pulmonary
Graepler *et al*. 2007	Peritoneal
Yang *et al.* 2007	Peritoneal
Singh and Thakur *et al.* 2008	Peritoneal
Das and Tappouni *et al.* 2007	Peritoneal
Di Capua Sacoto *et al.* 2008	Pulmonary
Simaioforidis *et al.* 2008	Pulmonary
De'Ath *et al.* 2008	Peritoneal
Heiner *et al.* 2009	Pulmonary
Akdogan *et al.* 2010	Peritoneal
Toro *et al.* 2010	Peritoneal
Su *et al.* 2011	Pulmonary
Patel and Barnacle 2011	Peritoneal
Tan *et al.* 2010	Extraperitoneal
Silak *et al.* 2011	Peritoneal
Cakmak *et al.* 2011	Peritoneal
Hill *et al.* 2012	Peritoneal
Netsch *et al.* 2012	Pulmonary
Wilson *et al.* 2012	Pulmonary
Boumans *et al.* 2012	Peritoneal
Khan and Narasimhan *et al.* 2012	Peritoneal
Lostoridis *et al.* 2013	Pulmonary
Fosi *et al.* 2015	Pulmonary
Cochetti *et al.* 2015	Scrotal, Pulmonary
Anaye *et al.* 2015	Peritoneal
Dagur *et al.* 2016	Peritoneal, Scrotal, Thoracic
Milone *et al.* 2017	Peritoneal
Firmanto *et al.* 2019	Pulmonary
Sunderland *et al.* 2020	Colonic
Jandou *et al.* 2020	Pulmonary
Noujeim *et al.* 2021	Pulmonary

Ethical Considerations

Compliance with ethical guidelines

Consent was obtained or waived by all participants in this study. Approval from the institutional review board was not required for this study.

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Conflict of interest

The authors declared no conflict of interest.

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