



## Anatomy and pathology of the canal of Nuck

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### ABSTRACT

The canal of Nuck is the female equivalent of the processus vaginalis in the male but is less well known than its male counterpart. It is a rare entity not commonly encountered by radiologists, particularly in the adult population. Knowledge of the embryology and anatomy of the canal of Nuck is essential for identification of the various pathologic conditions that may occur in this location. Moreover, radiologists should be familiar with this entity to compose an appropriate and thorough differential diagnosis of a labial mass/swelling. In this review, we discuss both the anatomy and the more common pathology that can be encountered within it.

### 1. Introduction

The Canal of Nuck was first described by Dutch anatomist Anton Nuck in 1691 [1]. The canal of Nuck is an embryological anomaly whereby the processus vaginalis remains patent within the inguinal canal in a female. It creates a communication (potential space) between the peritoneal cavity, the female inguinal canal, and the labia majora. It is a rare entity more frequently encountered in the pediatric age group, but is being recognized more commonly in the adult population likely due to the increased use of cross sectional imaging in the past 30 years.

The processus vaginalis normally obliterates within the first year of life [2–4]. If it remains patent in a female, it provides one direct pathway into the inguinal canal thus allowing for hernias which may potentially contain various organs and/or collections. The most common clinical presentation of canal of Nuck pathology is a mass or swelling in the groin or labia with or without pain. Differential diagnosis of an inguinal mass in a female is wide and includes lymph node, cyst, inguinal hernia, infection/abscess, inguinal gonad, endometriosis, benign tumors and malignancy.

Many radiologists and clinicians, including surgeons, are not aware of this anatomic structure and the pathology it may contain. It is important for radiologists to recognize this entity so as to provide a correct diagnosis on imaging examinations and avoid unnecessary biopsy or surgical intervention. In this review, we will discuss the anatomy and embryology of the canal of Nuck, followed by a discussion of both the common and uncommon pathology that may be demonstrated using multimodality imaging.

### 2. Anatomy

The inguinal canal is a short, approximately 4 cm long, passage in the lower abdominal wall that transmits structures from the peritoneum to the perineum [5,6]. The embryology of the inguinal canal is related to 2 structures: the gubernaculum and the processus vaginalis. The gubernaculum is a cord of fibrous and muscular tissue that develops in the fetus between 8 and 12 weeks [3]. In females, it attaches to the mid portion of the uterus. Above this attachment it becomes the suspensory ligament of the ovary which contains the ovarian vessels and prevents descent of the ovary into the inguinal canal [3,6,7]. Inferior to the uterine attachment it becomes the round ligament that travels through the inguinal canal to attach to the labia majora [3,4,6,7]. The processus vaginalis is shorter in a female than a male and is an invagination of parietal peritoneum that descends anterior to the gubernaculum [3,6]. The superior portion of the processus vaginalis fuses at or just before birth, with the obliteration continuing caudally as the entire structure closes within the first year of life [2,4,6]. When there is partial or complete failure of obliteration of the processus vaginalis the result is formation of a potential space which is the canal of Nuck (Fig. 1).

The inguinal canal runs superolateral to inferomedial. It is lined by the aponeuroses of the three abdominal wall muscles: the external oblique, internal oblique, and transversus abdominis muscles [4–6]. In the male, the inguinal canal has openings at either end. The deep or internal inguinal ring is an oval opening in the transversalis fascia. The superficial or external inguinal ring is a triangular opening in the

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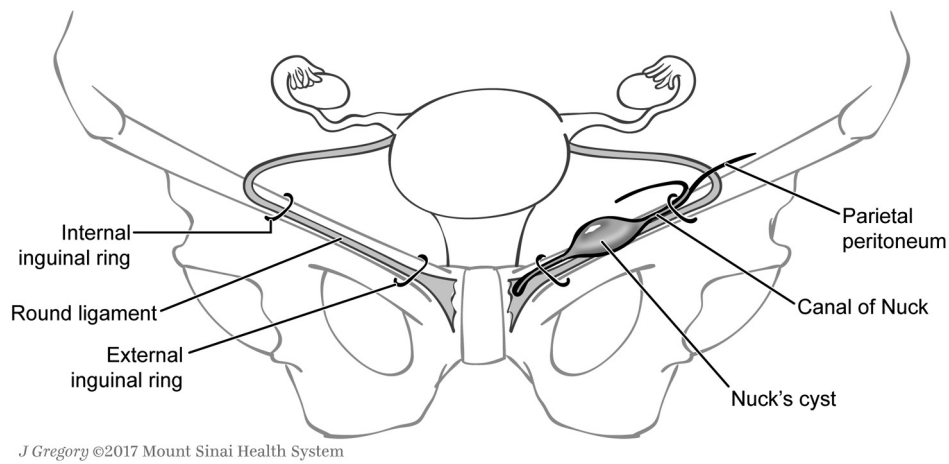


Fig. 1. Canal of Nuck.

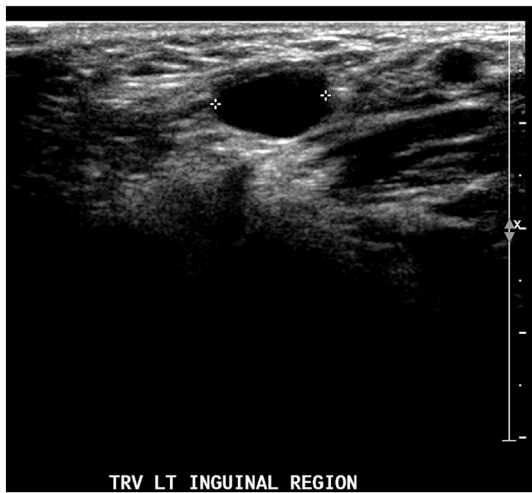


Fig. 2. Transverse ultrasound of the left inguinal region in a 10 month old female with a left inguinal mass shows a 1.0 cm well circumscribed fluid collection (between calipers) demonstrating no perceptible wall, posterior acoustic enhancement and no vascular flow on color Doppler (not shown), consistent with a Canal of Nuck cyst.

aponeurosis of the external oblique muscle [4–6]. These rings are less well formed and usually obliterated in females. In females the inguinal canal contains the round ligament of the uterus and the ilioinguinal nerve [4–6] as well as fat.

Most pathologic entities will be located within the patent processus vaginalis and therefore truly in the canal of Nuck. However, some may arise from structures, such as the round ligament or ilioinguinal nerve, which are located within the inguinal canal but outside the patent processus vaginalis. Although it may be considered controversial, for the purposes of this review, any pathology in the inguinal canal in a female will be considered to be in the canal of Nuck.

### 3. Imaging

Clinical presentation is most commonly a groin or labial mass/swelling, most often encountered in the pediatric population [3,8]. The mass/swelling may or may not be associated with pain. Given the broad differential diagnosis and the fact that the majority of cases are in the pediatric age group, grayscale and color Doppler ultrasound (US) has emerged as the imaging modality of choice for evaluation of superficial

masses as it provides a means for rapid acquisition of information including size, shape, location, internal contents, and vascularity. Provocative maneuvers such as raising intra-abdominal pressure with the Valsalva maneuver, provide additional dynamic evaluation of the mass in real-time [6]. Its lack of ionizing radiation and the superficial location of the inguinal canal make ultrasound an ideal modality for imaging canal of Nuck abnormalities, without the use of contrast material or sedation/anesthesia. Moreover, the high spatial resolution achievable with high frequency linear transducers (e.g. L12-5 MHz, L9-3 MHz, and L17-5io MHz [“hockey stick”]) contributes to characterizing a mass in the canal.

Magnetic resonance imaging (MRI) can be used as a problem solving tool in cases where US is inconclusive. MRI lacks radiation which is a benefit in the pediatric age group. In addition, its larger field of view can better establish the relationship between a mass in the canal and the intraperitoneal structures. Computed tomography does not play much of a role in assessing a groin mass in children. However, in the adult population CT is commonly performed for evaluation of non-specific abdominal pain in the emergency department as well as for surgical planning in patients with a known or clinically suspected inguinal hernia or palpable mass. In addition, since some groin masses are asymptomatic they can be incidentally discovered on CT scans performed for nonrelated indications.

### 4. Pathology

#### 4.1. Cyst

Although rare, a cyst in the canal of Nuck is the most commonly reported pathology in the canal [2,8–18]. A cyst originates when the processus vaginalis closes proximally with a portion that remains patent more distally. As it is an isolated portion of the processus vaginalis, it is lined by epithelial cells and is a true cyst and not considered a pseudocyst. Fluid accumulates in the potential space due to an imbalance of the secretion and absorption of serous fluid by the secretory epithelium of the processus vaginalis [8,13,14]. As the cyst represents fluid within a patent processus vaginalis it is often referred to as a female hydrocele [4,8,11–13,15–18]. Cysts are often described as sausage shaped since they frequently conform to the elongated and narrow configuration of the inguinal canal itself [8,12]. However, as more fluid accumulates, the cyst can become more rounded. As in other locations throughout the body, a cyst of the canal of Nuck may be simple or complex with internal septations and debris [8,10,11,13,15,18].

On US, a simple cyst appears as an anechoic collection with a thin

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