Introduction

Urinary bladder carcinoma is the second most common tumour of the urinary tract ***(Al Assimy et al., 2012)***. It is the fourth most common cancer in males and the tenth most common cancer in females ***(Jemal et al., 2010)***. It occurs three to four times more frequently in men than in women and has a high recurrence rate, necessitating long-term surveillance after initial therapy. Patients with bladder cancer survive longer than those with most other common cancers ***(Yabroff et al., 2008).***

Also it is one of the more common cancers in the Middle East countries. Egypt had both the highest frequency and incidence rates and had a different histological pattern than other countries. This could be attributed to the relationship between bladder cancer and Schistosoma haematobium. Egypt was the only country that showed a high frequency and incidence of squamous cell carcinoma, which is the histologic type related to schistosomiasis. Egypt also showed an earlier peak of age-specific incidence rates, possibly due to the early age at schistosomal infection and the latent time needed for carcinogenesis ***(Ibrahim et al., 2008).***

Pathologically, bladder cancers are staged using a TNM staging system. And according to the 2004 World Health Organization/International Society of Urological Pathology classification, a two-tiered grading system for bladder cancer was introduced, which categorized bladder tumors as low and

high grade, additionally, it was classified as belonging to either the noninvasive or invasive type of tumor. Tumors with a high frequency and exhibiting highly varied biologic behavior were classified as high-grade tumors, and those unlikely to present aggressive behavior were defined as low-grade tumors ***(Otto et al., 2007).*** In general, surgical treatment of patients with early stage tumors like T1, or lower stage bladder tumors are achieved by an initial transurethral resection (TUR) procedure. Those presenting with a T2 or higher stage with organ-confined tumors usually undergo a partial or radical cystectomy, with or without adjuvant therapies ***(Sadow et al., 2008).***

Accurate preoperative staging is the most important factor in determining the appropriate management of bladder carcinoma because the therapeutic method chosen and prognosis depend on the clinical and radiologic stage at presentation ***(MacVicar, 2000).*** MRI especially the newer functional imaging technique like DWI may has a great potential role in localized bladder cancer like early detection, staging, evaluation of tumor aggressiveness and therapeutic responsiveness of patients in the assessment of urinary bladder cancer and so forth. Newer MRI has already proceeded promising results in bladder cancer application; and the explicit role of newer MRI in bladder cancer patients still needs further research and awaits to be thoroughly evaluated ***(Wang et al., 2013).***

Aim of the Work

The aim of this work is to highlight the role of Magnetic resonance imaging in evaluation of the urinary bladder carcinoma.

Chapter one

ANATOMY OF THE URINARY BLADDER

Introduction:

The urinary bladder is a musculomembranous sac which acts as a reservoir for the urine; its size, position, and relations vary according to the amount of fluid it contains; also the position of the bladder varies with the condition of the rectum, being pushed upward and forward when the rectum is distended ***(Soames et al., 1995).***

Anatomical relations of the urinary bladder:

The bladder lies preperitoneally behind the symphysis, the peritoneum covers parts of the ventral and dorsal wall. The space anterior to the bladder and behind the abdominal wall is called retropubic space (*space of retzius*). The space enables varius filling conditions of the urinary bladder. The bladder is adjacent to the small intestine and sigmoid colon (dorsal, towards the abdomen). The iliac vessels are lateral to the bladder. The bladder neck in men contacts prostate [figure 1]. In women, the bladder trigone and bladder neck are cranial to the vagina, the uterus is located posterior to the bladder [figure 2] ***(Benninghoff, 1993).***

The Female Bladder:

In the female, the bladder is in relation behind with the uterus and the upper part of the vagina. It is separated from the anterior surface of the body of the uterus by the vesicouterine excavation, but below the level of this excavation it is connected to the front of the cervix uteri and the upper part of the anterior wall of the vagina by areolar tissue. When the bladder is empty the uterus rests upon its superior surface. The female bladder is said by some to be more capacious than that of the male, but probably the opposite is the case (figure 2) ***(Soames et al., 1995).***

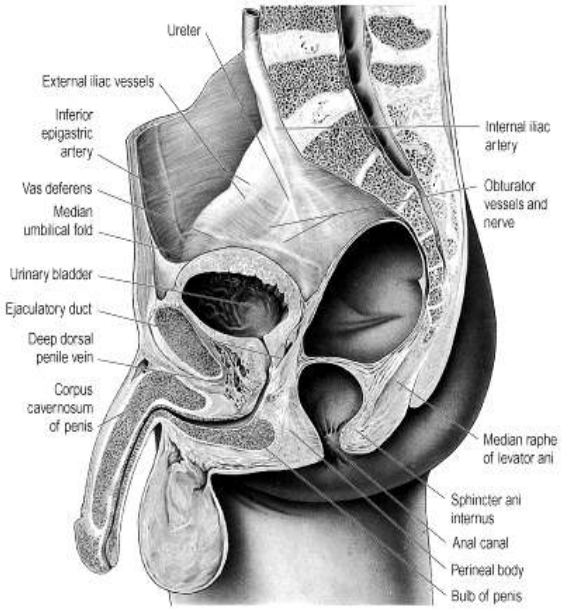

Figure (1): Median sagittal section to show male internal and external genitalia and bladder. A number of structures (e.g. obturator vessels, ureter) are only faintly visible through the overlying peritoneum ***(Susan Standring, 2005).***

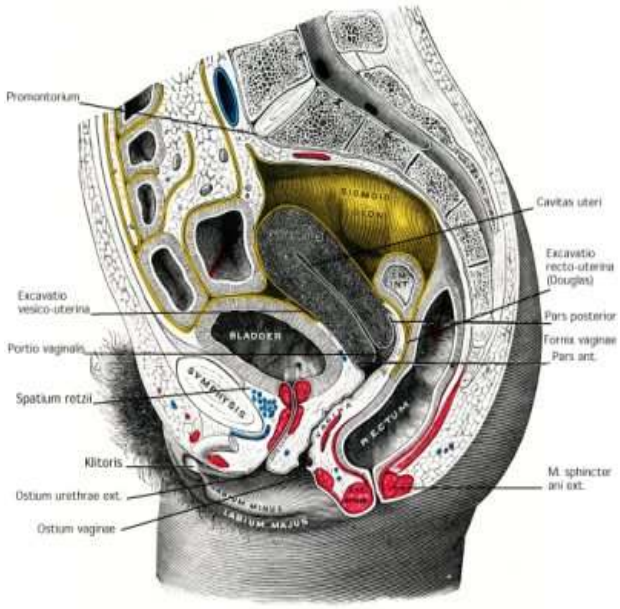

Figure (2): Anatomy of the female pelvis, median sagittal section ***(Soames et al., 1995).***

Peritoneum and anatomy of the inner surface of the abdominal wall:

The peritoneum covers the rectum and the dorsal wall of the bladder, forming a peritoneal pouch in the pelvis: rectovesical pouch in men (exacavatio rectovesicalis), and recto-uterine pouch in women (excavatio vesico-uterina). The urinary bladder and adjacent structures determine the inner surface of the lower abdominal wall (figure 3):

- Median umbilical fold (urachus)
- Medial umbilical fold (obliterated umbilical artery)
- Lateral umbilical fold (inferior epigastric vessels)

(Benninghoff, 1993)

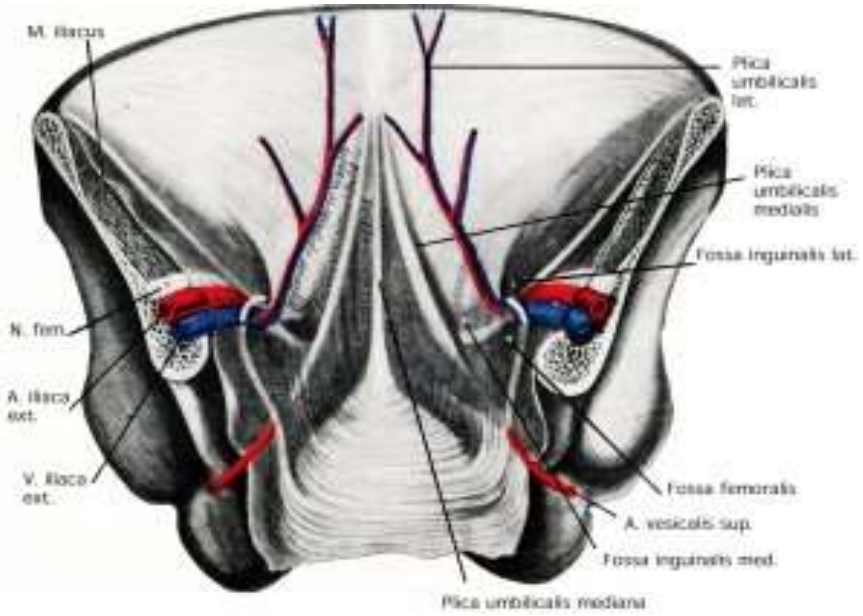

Figure (3): Anatomy of the inner surface of the abdominal wall ***(Soames et al., 1995).***

Ligaments:

- ***Pubovesicales***

The bladder is connected to the pelvic wall by the fascia endopelvina. In front this fascial attachment is strengthened by a few muscular fibers, the **Pubovesicales,** which extend from the back of the pubic bones to the front of the bladder ***(Soames et al., 1995).***

- ***Rectovesicales***

Behind, other muscular fibers run from the fundus of the bladder to the sides of the rectum, in the sacrogenital folds, and constitute the **Rectovesicales** ***(Soames et al., 1995).***

- ***Middle Umbilical Ligament***

The vertex of the bladder is joined to the umbilicus by the remains of the urachus which forms the **middle umbilical ligament,** a fibromuscular cord, broad at its attachment to the bladder but narrowing as it ascends ***(Soames et al., 1995)***.

- ***False ligaments of the bladder***

From the superior surface of the bladder the peritoneum is carried off in a series of folds which are sometimes termed the **false ligaments of the bladder.** Anteriorly there are three folds: the **middle umbilical fold** on the middle umbilical ligament, and two **lateral umbilical folds** on the obliterated hypogastric arteries. The reflections of the peritoneum on to the side walls of the pelvis form the lateral false ligaments, while the sacrogenital folds constitute posterior false ligaments ***(Soames et al., 1995).***

Interior of the Bladder

The interior of the bladder are the trigone of the bladder (*trigonum vesicae*), side walls of the bladder, rear and front wall (figure 4) ***(Benninghoff, 1993).***

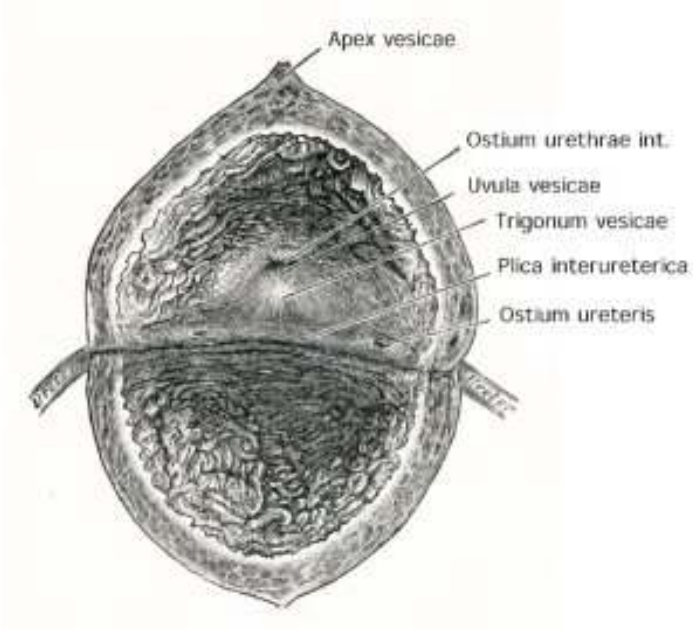

Figure (4): Internal anatomy of the urinary bladder: frontal section of the bladder. Figure modified from Gray's Anatomy, Lea and Febinger 1918 Philadelphia, USA.

Layers of the bladder wall:

The four defined layers of the bladder wall are:

- ***The urothelium:***

Which lines the bladder lumen. The urothelium is thin relative to the full thickness of the bladder ***(Jade et al., 2006)***.

- ***The highly vascular lamina propria (submucosa):***

The thickness of the highly vascular lamina propria varies with the degree of distention of the bladder ***(Jade et al., 2006)***.

- ***The muscularis propria:***

The muscular layer of the bladder is also referred to as the detrusor muscle and consists of a complex network of interlacing smooth muscle fibers. The inner and outer muscle fibers tend to be oriented in a longitudinal fashion, but distinct layers are usually not discernible ***(Jade et al., 2006)***.

- ***The outermost serosa:***

It is formed by a loose layer of connective tissue (figure 5) ***(Jade et al., 2006).***

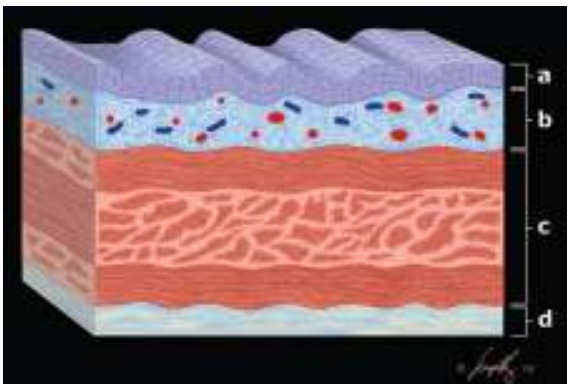

Figure (5): Normal bladder wall. Diagram shows the urothelium (a), lamina propria (b), muscularis propria (detrusor muscle) (c), and adventitia (d) ***(Jade et al., 2006).***

Urinary bladder orifices:

The orifices of the ureters are placed at the postero-lateral angles of the trigonum vesicae, and are usually slit-like in form. In the contracted bladder they are about 2.5 cm. apart and about the same distance from the internal urethral orifice; in the distended viscus these measurements may be increased to about 5 cm ***(Soames et al., 1995).***

The internal urethral orifice is placed at the apex of the trigonum vesicae, in the most dependent part of the bladder, and is usually somewhat crescentic in form; the mucous membrane immediately behind it presents a slight elevation, the uvula vesicae, caused by the middle lobe of the prostate ***(Soames et al., 1995).***

Sphincter of the Urinary Bladder:

The sphincter of the urinary bladder consists of smooth muscle (internal sphincter muscle) and striated muscle (external sphincter muscle) ***(Benninghoff, 1993)***.

- ***Internal sphincter muscle:***

The smooth muscle of the bladder trigone surrounds longitudinally as well as circularly the bladder neck ***(Benninghoff, 1993)***.

- ***External sphincter muscle:***

The striated external sphincter muscle has a horseshoe-shaped aspect. In women, he surrounds the middle and proximal urethra. In men, the muscle surrounds the entire length of the membranous urethra. In both cases, the striated sphincter has a close contact with the pelvic floor, however, can be distinguish clearly from the pelvic floor muscles ***(Benninghoff, 1993).***

The arteries supplying the bladder are:

- ***The superior, middle, and inferior vesical:***

Derived from the anterior trunk of the hypogastric ***(Soames et al., 1995).***

- ***Small visceral branches***

Coming from the obturator and inferior gluteal arteries ***(Soames et al., 1995)***.

- ***Additional branches***

Iin the female are derived from the uterine and vaginal arteries ***(Soames et al., 1995).***

The veins:

Form a complicated plexus on the inferior surface, and fundus near the prostate, and end in the hypogastric veins ***(Soames et al., 1995).***

The lymphatics:

- ***External iliac lymph nodes***

It is carried out by vessels that pass from the superolateral aspects of the bladder.

- ***Internal iliac lymph nodes***

By vessels passing from the neck and fundus.

- ***Sacral or common iliac lymph nodes.***

(Moore et al., 2005)

The nerves of the bladder:

Somatic nervous system:

The pudendal nerve from the sacral plexus controls the striated external sphincter muscle. Afferent nerve fibers of the pudendal nerve measure the urinary bladder filling (via the stretch of the urothelium) and the contraction of the detrusor muscle (via the wall tension) ***(Benninghoff, 1993).***

Autonomic nervous system:

Parasympathetic preganglionic neurons are located in the sacral cord (S2 to S4) and run via the ventral roots to the parasympathetic ganglia next to the pelvic organs. In the case of the bladder, the ganglions are located in the detrusor muscle and in the vesical venous plexus ***(Benninghoff, 1993)***.

The preganglionic sympathetic nerve fibers come from the thoracolumbar cord (T11 to L2) and are switched to postganglionic fibers in the ganglia of the sympathetic trunk. The postganglionic fibers run via the hypogastric nerve into the pelvis ***(Benninghoff, 1993)***.

The innervation of the detrusor muscle is mainly parasympathetic. While the sympathetic innervation of the detrusor muscle is of secondary importance, the bladder neck is innervated by the sympathicus to close the bladder neck during ejaculation. The parasympathetic, the sympathetic and the somatic nervous system have afferent nerve fibers, which pass through the dorsal root to the spinal cord (figure 6) ***(Benninghoff, 1993).***

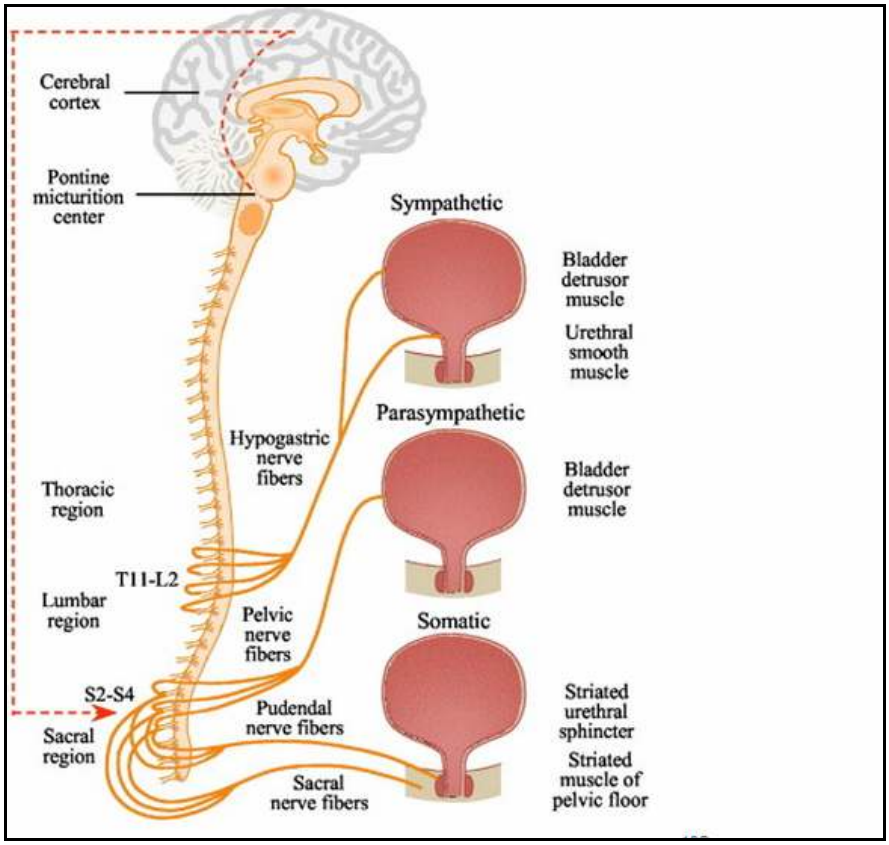

Figure (6): Innervations of the lower urinary tract ***(Richard, 2010).***

Chapter Two

PATHOLOGY OF THE URINARY BLADDER TUMORS

Classification according to cell type origin:

Bladder neoplasms can arise from any of the bladder layers. They are broadly classified as either ***epithelial*** or ***non-epithelial*** (mesenchymal), with over 95% being epithelial (table 1) ***(Woodward et al., 2006).***

A) Epithelial tumors:

Epithelial tumors with differentiation toward normal urothelium are urothelial. Urothelial tumors exhibit a spectrum of neoplasia ranging from a benign papilloma through carcinoma in situ to invasive carcinoma ***(Murphy et al., 2004).***

The term urothelial carcinoma is now preferred over transitional carcinoma. Other primary epithelial tumors include squamous carcinoma and adenocarcinoma. Adenocarcinomas are rare and typically represent urachal cancer. Much rarer epithelial tumors are small cell/neuroendocrine carcinoma, carcinoid, and melanoma. Because epithelial masses derive from the most superficial layer of the bladder wall, they often appear as irregular, intraluminal filling defects ***(Jade et al., 2006)***.