# Role of MRI in Diagnosis and Staging of Urinary Bladder Carcinoma

## Essay

*Submitted for partial fulfillment of M.Sc. Degree in Radiodiagnosis*

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# Introduction

Carcinoma of the urinary bladder is one of the most common malignant tumors of the urinary tract in male and female patients. It's the fourth most common tumor in men accounting for 6% of all men cancer. In females it's the eighth most common tumor accounting for 4% of all women cancer ***(Husband, 1995).***

In Egypt, The situation is worse as a result of bilharziasis. The uncommon squamous cell carcinoma is frequently associated with bilharzial bladder. The predominance of squamous cell carcinoma in schistosomal series is probably related to squamous metaplesia, and dysplasia which are common in chronic bilharzial cystitis and frequently associated with the carcinoma ***(El-Balkainy et al., 1981).***

Appropriate use of the different imaging techniques is curical for accurate assessment of tumors and for the development of appropriate treatment planning ***(Barentsz et al., 1995; Jager et al., 1996; Barentsz et al., 1999).***

Among the non-invasive imaging modalities, MRI is highly useful for imaging the urinary bladder cancer. Contrast enhanced MRI is a powerful tool for visualization of tumor vascularity ***(Barentsz et al., 1999).***

Multiple MRI protocols were applied in this field however, recent inclusion of Gadolinium enhanced dynamic

MRI examination proved to be a highly accurate modality of evaluation with improved accuracy of staging ***(Barentsz, 1999).***

Dynamic MRI is sensitive to the total endothelial surface area of perfused vessels. Therefore, it is of additional value in tumor staging ***(Barentsz et al., 1999).***

# Aim of the Work

The aim of this work is to emphasis the role of Magnetic Resonance Imaging in the diagnosis and staging of urinary bladder carcinoma.

# Urinary Bladder Anatomy

The pelvis consist of a bony ring containing the reproductive organs, lower urinary tract, small bowel, colon, rectum, blood vessels, nerves, lymphatics, fat and supporting musculature ***(Corrington and Hricak, 1991).***

The bladder is a distensible muscular organ acting as a reservoir for urine until it becomes convenient the muscular wall empties it through the urethera. When distended with urine part of it extends above public symphysis and become in contact with the anterior abdominal wall. The empty bladder has four surfaces ***(Fig. 1)*** each of which is triangular – tetrahedron like and has base, neck, apex, superior and two inferolateral surfaces ***(Inderbir Singh, 2003)***

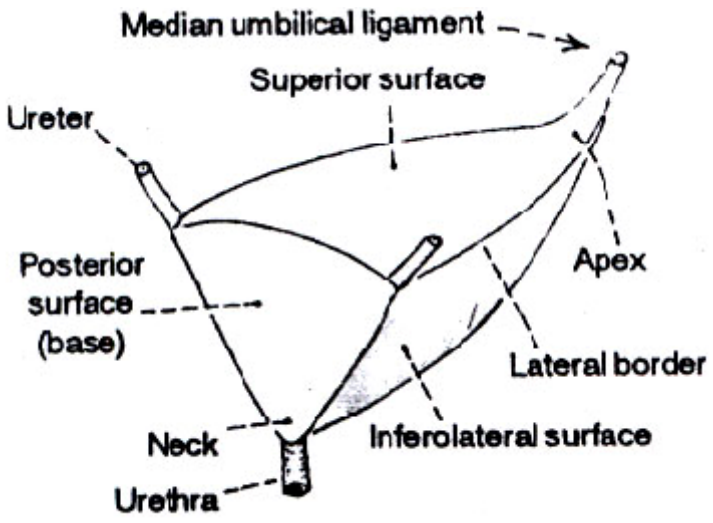


**Fig. (1): Diagram to show the surfaces of the urinary bladder** ***(Singh, 2003).***

## The base – fundus

The base of the bladder is triangular and posteroinferior. In females ***(Fig. 2)***, it is closely related to the anterior vaginal wall.

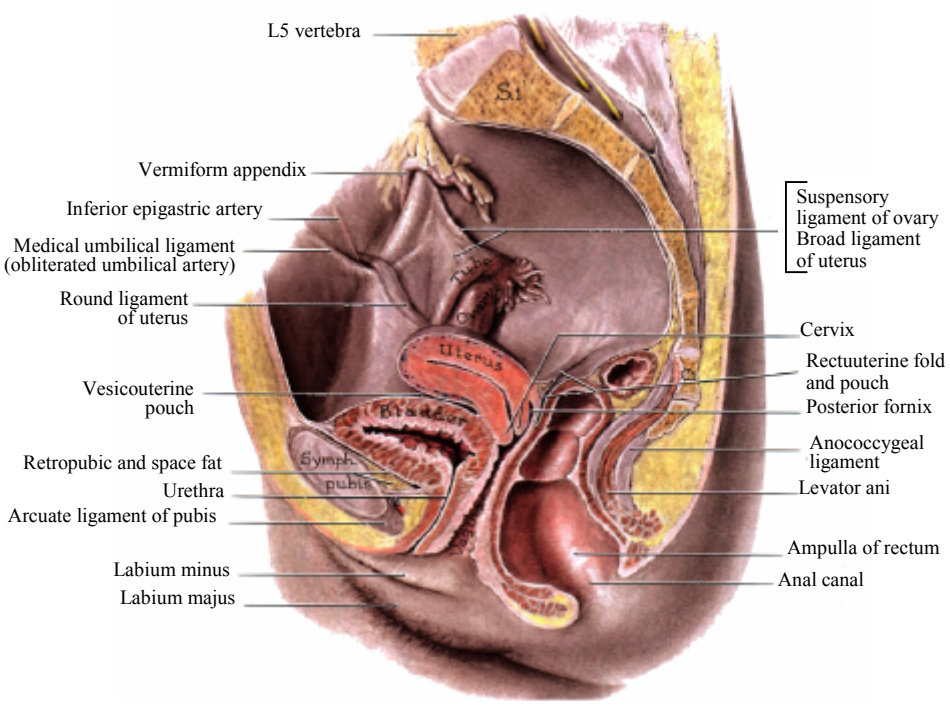


**Fig. (2): Median section in female pelvis *(Agur and lee, 1999).***

In males ***(Fig. 3)***, it is related to rectum although it is separated from it above by the rectovesical pouch and below by

the seminal vesicle and vas deferens on each side ***(Standring, 2005).***

In the triangular interval between the two deferens ducts, the bladder and rectum are separated by the rectovesical fascia. The inferior part of this triangular interval may often be obliterated by the approximation of the deferens ducts above the prostate ***(Williams and Warwick, 1989).***

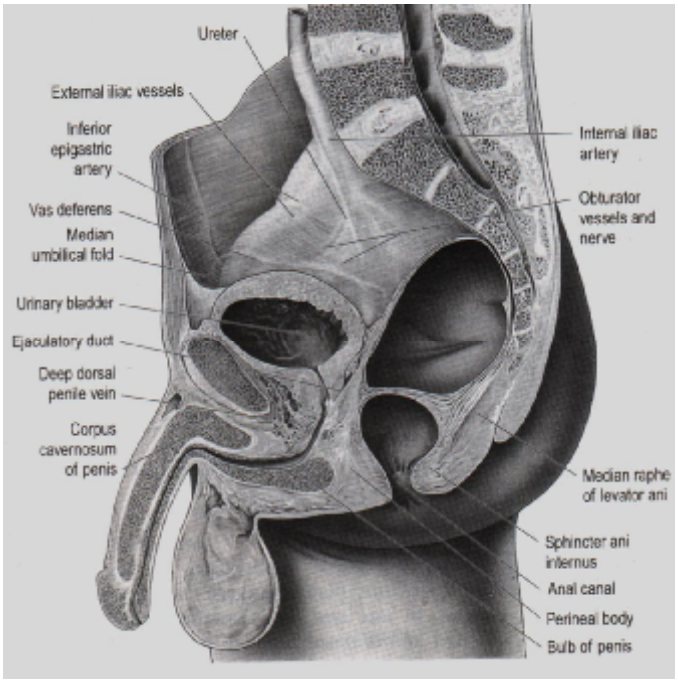


**Fig. (3): Median sagittal section through human male pelvis *(Standring,2005).***

## The Neck:

Is the lowest region and the most fixed part of the bladder, it lies 3 to 4 cm behind the lower part of symphysis pubis ***(Fig. 2, 3) (Williams and Warwick, 1989).***

In males the neck rests on, and is in direct continuity with, the base of the prostate. In females it is related to the pelvic fascia, which surrounds the upper urethra ***(Standring, 2005).***

## The Vesical apex:

In both sexes it is directed forward towards the upper part of the symphysis pubis; from it the median umbilical ligament ascends upwards, on the posterior surface of the anterior abdominal wall to the umbilicus, the peritoneum folded over this ligament is the median umbilical fold ***(Figs. 2,3) (Williams and Warwick, 1989).***

## The superior surface (dome):

Is triangular and bounded by lateral borders from the apex to the ureteric entrance and by a posterior border which joins them ***(Fig. 1) (Standring, 2005).***

In males, the superior surface is completely covered by peritoneum, which extends slightly onto the base and continues posteriorly into the rectovesical pouch and anteriorly into the median umbilical fold it is in contact with the sigmoid colon and the terminal coils of the ileum.

In females, the superior surface is also largely covered by peritoneum but posteriorly this is reflected to the uterus at the level of internal os to form the vesicouterine pouch ***(Fig.2).*** The posterior part of the superior surface, devoid of peritoneum is separated from the supravaginal cervix by fibroareolar tissue ***(Standring, 2005).***

## Each inferolateral surface

In males it is separated anteriorly from the pubis and puboprostatic ligaments by the (potential) retropubic space.

In females, the relations are similar, except that the pubovesical ligaments replace the puboprostatic ligaments. The inferolateral surfaces are not covered by peritoneum (***Standring, 2005)***.

## Interior of the bladder (*Fig. 4):*

### 1. Vesical mucosa

The vesical mucosa is attached only loosely to subjacent muscle for the most part it folds when the bladder empties and the folds are effaced as it fills, it is adherent to the subjacent muscle layer and always smooth ***(Standring, 2005)***.

### 2. Trigone:

The trigone is a triangular area at the base of the bladder lying between the internal urethral orifice below and the two ureteral orifices above in empty bladder these three opening

are 2-5 cm apart from each other but when distended the ureteral opening may be 5cm apart. The trigone is the least mobile part of the bladder being fixed on top of the median label of the prostate by the urethra and stabilized by the pelvic fascia in front of the vagina in females ***(McMinn, 1994).***

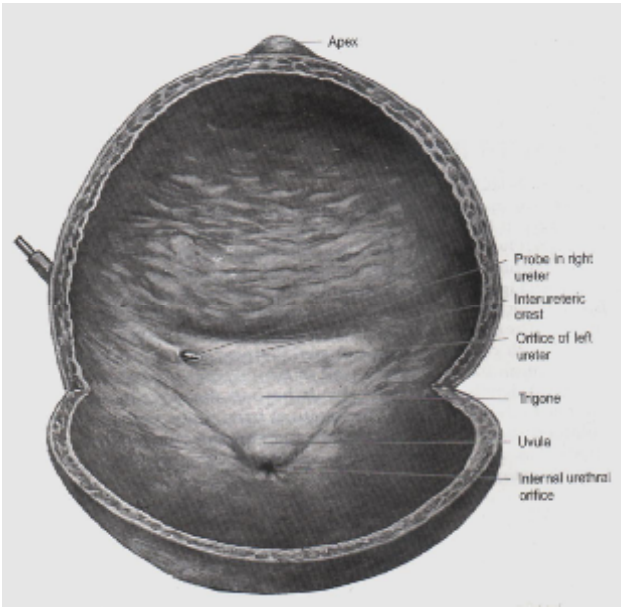


**Fig. (4): Anterior aspect of the interior of the urinary bladder** ***(Standring, 2005).***

## 3. Ureteric orifices:

The ureteric orifices placed at the posterolateral trigonal angles, they usually slit – like in empty bladder they are about 2.5cm apart and about the same from the internal urethral

orifice, in distension these measurements may be doubled ***(Standring, 2005).***

**4. Internal Urethral Orifice:**

The internal urethral orifice sited at the trigonal apex, the lowest part of the bladder, and is usually somewhat crescentic in section. In adult males, particularly past middle age immediately behind it there is a slight elevation caused by the median prostatic lobe, the uvula of the bladder (***Standring, 2005)***

**5. Urtererovesical Junction:**

The ureters pierce the posterior aspect of the bladder and run obliquely through its wall for a distance of 1.5 – 2.0 cm before terminating at the ureteric orifices. This arrangement is believed to assist in the prevention of reflux of urine into the ureter, since the intramural ureter is thought to be occluded during increases in bladder pressure ***(Snell, 2004)***.

## Bladder Microstructure:

The bladder is lined with transitional epithelium the epithelium is six to eight cells thick.

Stretching of the bladder wall, as a result of distention with urine, the transitional epithelium is much thinner and resemble a stratified squamous epithelium ***(Cormack, 1987).***

This arrangement exists throughout except over the trigone where the epithelium (mucous membrane) is firmly adherent to the underlying musculature this is why the trigone is smooth whether the bladder is full or empty ***(Standring, 2005).***

The fibroelastic lamina propria beneath the bladder epithelium also constitutes the cores of the mucosal folds. The deepest layer is somewhat looser in texture and contains higher proportion of elastic fibers; this deep layer is sometimes referred to as the submucosal layer of the bladder ***(Fawcett, 1998).***

The muscular coat of the bladder is made up of the three layers of non striated muscle cells. These intermingle at their interface so that the layers cannot be distinguished from one another. These layers consist of external and internal longitudinal fibers and middle circular ones. The outer longitudinal layer is most prominent and compact on the dorsal and ventral surfaces of the bladder. Of the three layers, the middle circular layer is the thickest. In the region of the trigone, at the base of the bladder, dense bundles of smooth muscle

encircle the transmural portion of the urethra, forming the internal sphincter of the bladder ***(Fawcett, 1993).***

The adventitia of the bladder is fibroelastic in nature. Over the superior surface of the bladder, this external connective tissue layer is covered with peritoneum, forming a serosa. Over the remainder of the organ, it merges with the adjacent connective tissue ***(Cormack, 1987).***

## Vascular and lymphatic supply of the bladder:

### Arterial supply:

The bladder is supplied principally by the superior and inferior vesical arteries, derived from the anterior trunk of the internal iliac artery ***(Fig. 5A)***, supplemented by the obturator and inferior gluteal arteries. In female ***(Fig. 5B)*** additional branches are derived from the uterine and vaginal arteries ***(Tanagho, 1992***).

- **Superior vesical artery:**

The superior vesical artery supplies many branches to the fundus of the bladder.

- **Inferior vesical artery:**

The inferior vesical artery often arises with the middle rectal artery from the internal iliac artery. It supplies the base of the bladder, prostate, seminal vesicles and lower ureter ***(Standring, 2005).***

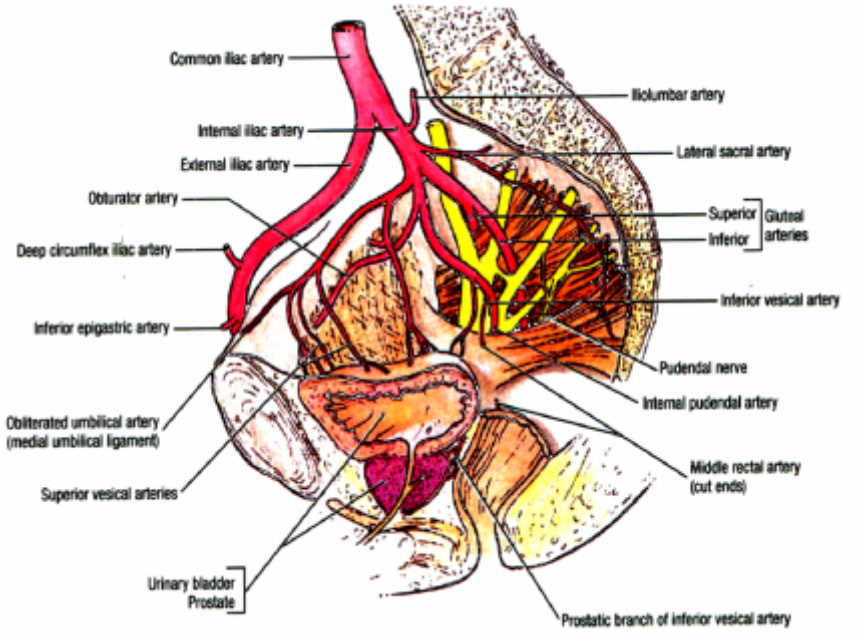


**Fig. (5A): The arterial supply of male pelvis *(Agur and lee, 1999).***

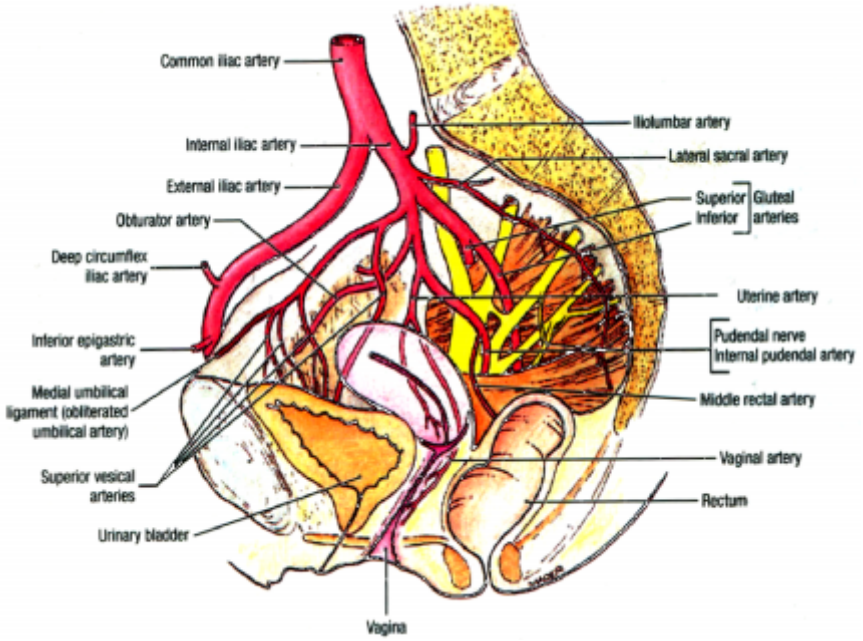

**Fig. (5B): The arterial supply of female pelvis *(Agur and lee, 1999).***

## Venous drainage:

Surrounding the bladder there is a rich plexus of veins ***(Fig.6)*** usually lying between the bladder wall proper and the adventitial layer covering it. These veins ultimately terminate in the internal iliac vein after gathering together in several main trunks, some of them accompany the arteries, others do not. The vesicovenous plexus also communicate with the retropubic venous plexus or plexus of Santorini, which drain the penis as well as other perineal organs ***(Tanagho, 1992).***