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Original Article

AN ANATOMICAL STUDY ON BLOOD SUPPLY OF URETER

Chintala Durga Sukumar *[1], Ratna priyanka Janamala [2], V. Mahalakshmamma [3].

[*1] Assistant Professor, Department of Anatomy, Mamata Medical College, Khammam, Telangana, India.
[2] Tutor, Department of Anatomy, Khaja Banda Nawaz Institute of Medical Sciences, Gulbarga, Karnataka, India.
[3] Associate Professor, Department of physiology, Mamata Medical College, Khammam, Telangana, India.

ABSTRACT

Introduction: The ureter receives segmental arterial supply which varies along its course. The present study attempts to determine the blood supply of ureter and to understand the variation of supply to the ureter.

Materials and methods: The ureteral vascular pattern was studied in 42 cadavers- 32 male and 10 female and also studied in 25 still born infants- 20 male and 5 female which were procured from the Department of Anatomy, Mamatha medical college, khammam. Different types of injection methods were used to study the vascular pattern of ureter.

Results: From the present study, on statistical analysation 98% of blood supply to ureter was through Renal and uterine arteries, 92% is through superior vesicle artery, 86% is by vaginal artery, 60% is by internal iliac, 52% by aortic, 44% by Gonadal, 36% by inferior vesical, 34% by common iliac, 16% by artery to vas, 14% by middle rectal and 12% is by capsular arteries. In this study the longitudinal vascular pattern of ureter is found to be 83.6%.

Conclusion: It is observed from the study of vascular supply to ureter was significantly contributed by Renal arteries, uterine arteries, superior vesicle arteries and vaginal arteries. The present study also determines that Ureter at different age periods have the same sources of blood supply indicating that age has no effect on the vascularity and observed the vascular patterns of full time foetal and adult vascular patterns are the same. It is observed that the female ureter appears to have more liberal blood supply than in the male when the size of the arteries is taken into consideration.

KEY WORDS: Ureter, Vascular supply, Injection methods.

Address for Correspondence: Chintala Durga Sukumar, Assistant Professor, Department of Anatomy, Mamata Medical College, Khammam, Telangana, India. **E-Mail:** priyaratnaj@gmail.com

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INTRODUCTION

This study of the arterial supply to the ureter was made because of the prevalence of injuries to the ureter in pelvic surgery and gynecologic complications to the ureter following pelvic intervention. The damage to the vascular supply is the main factor in all complications following pelvic intervention. This study was undertaken in order to understand the variation of supply. The vascularisation of the human ureter is of considerable clinical interest in regard to transplantation of the duct.

The knowledge of the arterial supply of the ureter is limited and a few workers have labored to find

out the depths of present subject. The present day surgery is successfully progressing in the branches of thoracic surgery as well as urology. Due to lack of adequate knowledge about the blood supply of the ureter, ureteric injuries are commonly noted. The importance of blood supply to the ureter has long been identified, as the following statement proves this. "Any technique to preserve ureteral adventitial tissue and its blood supply together with the prevention of pelvic exudates hematoma is of benefit in reducing both injury and long term of cicatrix and stricture that may develop as a late complication."

An attempt is made here to find out the gaps that are left untouched in the form of following problems.

1. Does the blood supply to the ureter is always constant or it is variable? If there are variations what are the outstanding combinations. Is there any difference of arterial supply to the ureter on right and left sides in male and females?

2. Has the ureter got sufficient blood supply to hasten the process of healing when it is subjected to an injury, operational or accidental or due to disease. Is the blood supply same throughout the whole length of the ureter or there any critical points like critical point of sudeck as in the case of colon.

3. What is the pattern of vessels in the various coats of the ureter? Has age or sex show any influence on it. Are there any connections between the peritoneal vessels and the ureteric vessels? Is there any remarkable danger of freeing the ureter from adjacent tissues and diseased tissues like carcinomas?

4. How can we prevent the injuries to ureter in surgery? What is the nature of venous drainage of the ureter? Is there any communication between portal and systemic veins draining the ureter?

5. Does the comparative anatomical study give any additional information bearing on the problem?

MATERIALS AND METHODS

The ureteral vascular pattern was studied in 25 still born infants- 20 male and 5 female and in 10 cadavers (8 men and 2 women) with an average age of 45 years. Advantage was also taken while instructing the students when they are doing the dissection of abdomen during the period of 2 years four batches covering 32 bodies (24 male and 8 female).

Injection materials:

Dissolved polyvinyl acetate in acetone is selected as injection material for foetus. The solution is made up of 12.5 G of polyvinyl acetate in 100 cc of acetone and injected with a glass syringe in to the descending thoracic aorta of the foetus. The difficulty with this solution is the plunger becomes stuck to the barrel and cannot be released. The solution is not resilient when set. So the ureteral vessel did not become stiff after corrosion of the ureter with hydrochloric acid (30%).

Indian ink: It is found that undiluted ink gives the most satisfactory results. It has the advantage that after fixation in 10% formalin with few drops of concentrated hydrochloric acid, the ink has firm consistency.

Red Led Mass was used for studying the arterial system for gross dissection.

The main drawback of wax injection masses is the difficulty of warming the body to be injected sufficiently to prevent premature setting of the wax, before the vessels are completely filled. To overcome this difficulty, not only was the body immersed in hot water, but hot fluids were frequently run in to the vessels to warm them up, before the wax injection was thrown in Red led mass made up with gelatin was also used. It should not normally be used in greater concentration than that recommended, as a stronger solution absorbs so much water after setting, swelling in the process, that there is the risk that if a very concentrated gelatin solution is injected in to large thin walled vessels, their walls may be ruptured.

Vermillion (Mercuric sulphide) with gelatin has been recognized as an ideal pigment for injection masses. It gave fairly good results.

Prof.J.C. Sinlair's solution was used. But it was rejected as it did not give satisfactory results.

A mixture containing equal parts of lead acetate, barium sulphate emulsified in tragacanth or acacia with red led in gelatin. This was found to

give the best results.

Injection method

Immediately after receiving the foetus from the hospital the selected injection mass was injected by an glass syringe preferably with side nozzle or the metal brass syringe and injected directly into descending thoracic aorta or in to internal iliac artery in the adults. When the arteries were completely injected, the cannula was removed and aorta was tied off. The injected material was allowed to set inside the vessels for 3 to 4 hrs and then the specimens were kept in the cold storage or transferred to large containers of 10% formalin for fixation for 24 hrs.

In the case of study of veins after injection of acqueous colored solution like Indian ink, Berlin blue, cresol red, Saffranin red, natural red, aniline blue, caramine red, methylene blue etc..The specimen was kept in special jars containing Kaiserlings solution to preserve the color of the specimens.

After fixation for 24 hrs the inferior extremities were sawn through the hip joint, the sigmoid colon is cut after ligation and the other viscera are entirely removed except the urogenital system on the posterior abdominal wall and the overlying peritoneum with the injected blood vessels. Removing the whole of the trunk above the diaphragm and the lower extremities makes the specimen handy for dissection.

Dissection of the vascular branches under lens magnification was carefully done under water in good natural light. A special stand on which a large lens was mounted adjustable to any required position was used for this purpose. All the main vessels and their secondary branches were carefully traced to the ureters, uterus, bladder and the overlying peritoneum. A detailed observation of the anastomoses was made later under a dissection microscope with illuminating arrangement.

For adult specimens after removing the abdominal viscera the urogenital viscera was removed en bloc down from the diaphragm and with the terminal portion of the sigmoid colon and rectum. This portion of the bowel was later dissected out of the block.

Table 1: Showing percentage of occurrence of vessels.

Sl.no	Name of the vessel	Total no of bodies dissected 52 M and 15 F total 67	Each vessel found in no.of bodies	Unilaterally or bilaterally	Percentage
1	Lower suprarenal	67	12	Unilaterally	18%
2	Renal	67	65	Unilaterally	98%
3	Capsular	67	8	Unilaterally	12%
4	Gonadal	67	29	In 20 bilaterally and in 9 unilaterally	44%
5	Aortic	67	34	In 32 unilaterally and in 2 bilaterally	52%
6	Common iliac	57	22	In 15 unilaterally and in 7 bilaterally	34%
7	Internal iliac	67	42	In 18 unilaterally and in 24 bilaterally	60%
8	Uterine	15	14	Bilaterally	98%
9	Vaginal	15	12	In 10 bilaterally and in 2 unilaterally	86%
10	Superior vesical	67	61	Bilaterally	92%
11	Inferior vesical	52	18	In 12 unilaterally and in 6 bilaterally	36%
12	Artery to vas	52	8	Unilaterally	16%
13	Middle rectal	67	9	Unilaterally	14%

Dissecting out of the vascular tree was done under water in a glass plate which, when placed on a keleket x-ray view box, allowed used as in the foetus dissection , and the vessels were carefully traced to the ureter, genitals, bladder and peritoneum covering these organs.

RESULTS

In the present study 42 cadavers and 25 still born infants were studied and their vascular pattern to ureter has observed and their percentage of occurrence of vessels was shown in Table 1.

The vascular supply to the ureter is closely aligned with that of the peritoneum, and the ureteral vessels are closely adherent to the peritoneum.

The ureteral branch from the uterine artery is the most important and constant vessel to the pelvic ureter in the female and the superior vesicle artery in the male.

The periureteral sheath (sheath of waldeyer) which becomes prominent near the bladder end of the ureter protects the terminal ureteral branches, this nourish the end of the duct. If this sheath is injured, the resulting damage to the periureteral arterial plexus leads to necrosis and fistula formation.

If the arterial branches to the lower ureter derived from the uterine, the vaginal, and vesicle arteries are ligated and in addition to the periureteral arterial sheath and its plexus are damaged, the ureter will slough.

If the internal iliac artery is divided the ureter will not slough if the periureteral arterial plexus is not destroyed.

DISCUSSION

The problems raised in the form of questions in introducing to focus attention on the points requiring further clarification in the study of blood supply to the ureter are discussed in the light of the present study.

Individual variations no doubt occur. The cause of variability is probably due to developmental factor. As the kidney and the ureter during the course of development migrate upwards from the pelvis to the lumbar region they carry their blood supply with them during this ascent and incorporate new branches. Of these as in common with the development of the vascular system.

Some vessels may persist and other disappears. Thus the variations in the blood supply of the ureter can be explained.

When one goes through the literature it is seen as mentioned by all the authors, that the sources are not same. The lower end of the ureter has attracted more attention from the workers than the ureter as a whole. Consequently the abdominal sources of the ureteral blood supply are not usually mentioned in detail. Why there is no uniformity of opinion regards the sources of blood supply? There may be two causes for this. One is individual variation are commonly met with or there may be some dominant arteries reducing them to insignificance. The other reason is that in instance where information is obtained from injected cadaver material, variations may be due to differences of the injection techniques employed by different workers.

Varveriko's [1] while studying the arterial blood supply asserts that it is very variable. He believes that there is no constant blood supply and that uterine artery in the female is the only constant artery. He observes the following percentage in 151 vessels dissected in the intermediate vessels i.e. Those from aortic, common iliac, internal iliac and gonadal in the new born and fetuses. Aortic 40 to 50 %, common or internal iliac 60 to 65%, gonadal 48%. In the type of supplying arteries his percentage are large (supplying more than one half of ureter) 10 % medium (supplying on third or less of ureter) 78.1%. He believes that the ureter receives 4 to 5 vessels on average. The results of the present study are in agreement with those of Varveriko's [1] as it is found that the ureter received 4 to 5 twigs on average and that too small type of arteries.

Callander [2] mentions that the ureter may receive branches from the lower suprarenal branch of the renal artery. The author in this present study has observed this branch in 18% of specimens.

Campbell [3] and Michels [4] mention the capsular source of ureteric blood supply.

A similar source of blood supply is observed in 12% of specimens. Braithwaite [5] mentions of a ureteric twig from the vesiculo deferential artery. In 16% of fetuses he studied, the ureter received arterial supply from the vesiculo deferential artery.

Racker and Braithwaite [5] mention a long descending branch from the inferior colic artery to the left ureter and branches from the ilio-lumbar and internal pudendal arteries supplying ureteral twigs. They did not observe any branches from the superior gluteal, lateral sacral, inferior gluteal, middle rectal or obturator arteries. The author has observed the ureteric twigs from the middle rectal artery in 14% of his series but did not notice any branch from the other arteries mentioned above.

The present study confirms the observations of Harper [6] and Vaveriko's [1] that the ureter also receives blood supply from the lumbar arteries and some twigs also directly from the front of aorta. Varveriko's [1] gives their percentage as 40 to 45% where as it is found 52% in the present study.

Daniel and shackman [7] in their observations on 100 ureters found that 88 received branches from the renal and uterine or vesicle arteries, augmented by one or two or three long arteries which joined the intermediate portion of the ureter and some are augmented only by minute peritoneal twigs and 2 of the 100 ureters had three long arteries to their intermediate portions but did not receive any branches from the renal, uterine or vesical arteries. In the present study dominant uterine branch, the only branch was found in 3 fetuses to the lower end of the ureter.

Dominant superior vesical artery was found in 9 cases. The percentage of the arteries in the present series is renal 98%, uterine 98%, superior vesical 92%, and inferior vesical 36%.

The results of the present study are in agreement with those of Sampson [8] that the blood vessels of the ureter accompany the ureter from the kidney to the bladder forming a longitudinal chain in the adventitia.

In dissections no differences was noted between the full term foetal and adult vascular pattern. Harper [6] and Braithwaite [5] also state foetal and adult vascular patterns are the same. Structurally also foetal and adult ureters showed no differences. So age seems to have no effect on vascularity and structure of ureter.

The findings of the present study are in partial agreement with those of Harper [6], in that no specific sex differences were noted. The inferior vesical artery and the artery to the vas deferens in the male may be said to be proportionately more in the female when compared with the distribution of the corresponding arteries in the male.

CONCLUSION

In this present study ureter receives significant vascular supply through renal and uterine arteries of about 98%, and 92% is through superior vesical artery. Ureter received a very small extent of blood supply from Artery to vas about 16%, middle rectal 14% and 12% from capsular arteries. In this study about 83.6% of longitudinal vascular pattern of ureter is observed and also noted that Ureter at different age periods have the same sources of blood supply indicating that age has no effect on the vascularity. It is also determined that full time foetal and adult vascular patterns are the same. It is examined that the female ureter appears to have more liberal blood supply than in the male when the size of the arteries is taken into consideration. From the anatomic- surgical point of view the final conclusions of the study play a key role in taking prophylactic measures in pelvic surgery and gynecologic complications.

Conflicts of Interests: None

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