AN INVESTIGATION INTO THE SYSTEMS IN KIDNEYS AND SPLEEN BY THE METHOD OF POLYESTER CRYSTIC INJECTION AND CORROSION

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SUMMARY : Plastic material injection into the organ vessels constitutes an important tool in investigating the vascular structures and carrying out morphometric studies. In the plastic injection method, Acrylic resin, Neophren latex, tensol, silicon rubber, simplex, polymethyl metacrylate are used. In this study, the three dimensional structure of the vessel system was investigated by injecting polyester crystic into the fresh kidneys and spleens of lambs.

In order to increase its flowability, acetone and for coloring purposes some special pigments were added to the polyester crystic. In addition, some materials to help hardening and to accelerate the setting process were included. The mixture was then injected into the vessel lumen and kept there for 24 hours for the completion of setting process. Afterwards, the remaining tissues were washed out with water and acids. The vessel models so obtained were studied under a stereo microscope. Micrographs of the models were taken to measure the size and examine other properties.

***Key Words :** Corrosion Method, Kidney, Spleen, Vascular System.*

INTRODUCTION

Polymer injection and the corrosion method is commonly used for the visualization of organ vessel systems. The methods in which the vein structure is reflected on plain surfaces are inadequate in giving the three-dimensional details of the vein structure. With the present method; however, it is possible to analyse the three dimensional structures of the organ vessels, their inter - relationships and their vaso vasorums in detail (13). Complex structures which can not be dissected can now be quite simply determined by the use of this method. In addition, as the space research and organ transplantation gain importance and with the developments in space medicine, it becomes quite necessary to restudy the vascular structures of the organs with excessive bleeding by the help of this method.

In this work polyester crystic 511-0196 material was used. Polyester materials find a large range of application in industry, especially in the manufacturing of furniture and other products; such as, kitchen utensils, toys, vehicle bodies, key holders, buttons, badges etc.

This type of polyester is resistant to acidic, alkaline and mechanical effects (4). The best results are obtained when the temperature is between 22 - 25°C while the polyester injected into the vessels gets hardened.

MATERIALS AND METHODS

The lamb kidneys and spleens used in this study are obtained from the central slaughter house of the Turkish Meat and Fish Corporation in Ankara. The organs were taken within the first 10 minutes after the animals were slaughtered. Kidneys were taken out by making an incision to the point where renal artery originates from the abdominal aorta. The spleen, however, was taken out with all the peripheral tissues without any damage to the splenic artery. Then, the organs were carefully cleaned from their peripheral tissues. To make the organs ready for the polymer - injection, saline solution containing 2 % heparin was injected 5-10 times from renal and lienal arteries. Then, for visualizing the kidney glomerular structure and the spleen arterial system, polyester crystic was introduced into both of the organ arteries, and at one kidney to renal artery, renal vein and urethra by inserting cannules. Polyester crystic has it own type of viscosity such that it can penetrate into the organ vessel system throughly enabling the filling of every capillary.

To prepare polyester crystic ready for injection, the procedure below was followed :

1. 8 ml polyester crystic (511-0196) was put in a glass vessel.

2. 2 ml acetone was added to increase the flowability and the mixture was homogenized.

3. 4 droplets of special pigment material (red "3012", Orange-6, Eosin, Scarlet blue) was added.

4. 5 drops of accelerator (E-549-0050) was put.

5. 5 drops of hardener (M-549-0040) was added.

This mixture was introduced into the vessel lumen with a plastic injector at a controlled pressure (150-200 mm Hg). The liquid processing in the vessels during the injection led to the swelling and enlargement of the organs. 10 minutes after the injection was completed, the polyester started to become gelatinous. After 24 hours when the polyester crystic was sufficiently hardened in the tissue, organs were taken and put in a glass vessel containing 37 % HCl solution. After keeping them in the acid bath for 24 hours, and cleaning them from remains of tissue and acid under running water they were dried out with hot air (3, 4). Organ samples were studied under a stereo microscope and photographs were taken.

RESULTS

Spleen Findings

It was found that the trabecular arteries move continuously towards right and as the diameter gets narrower they leave the trabeculas and enter into the white pulp without any anastomoses. Central arteries; however were found to generally exit the trabecular arteries at 40-45° angle. It was observed that when the diameter of the central artery reached a certain value, arteria penicillatae were formed and afterwards, the terminal arterioles continued up to the terminating section. No branching was observed in the terminal arterioles.

It was observed that the polyester material penetrated in a regular manner up to the terminating sections (Fig 1, 2, 3, 4).

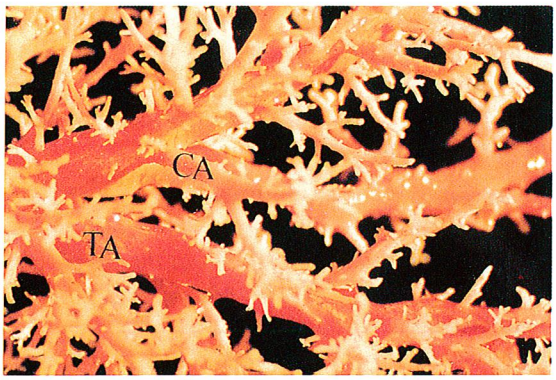

Fig - 1 : A general view of the arterial distribution of the spleen. TA. : Trabecular arteries, CA. : Central arteries, (→) Penicillate artery, (⇒) : Terminal arteriol X 6, 7

Kidney Findings

Starting from the arcuate arteries, interlobular arteries, afferent arterioles, glomerular and efferent arterioles were carefully examined. The diameters of the arteries were found to get narrower in the order given above. Interlobular arteries, which generally branched from the arcuate artery at a 90° angle, were getting thinner after a certain course and entering into the glomerule as afferent arterioles. With this method the glomerule was observed to have an oval shape distinguished with its fine grain internal structure. The efferent arteriole was seen to have a pretty narrow diameter in comparison to that of the

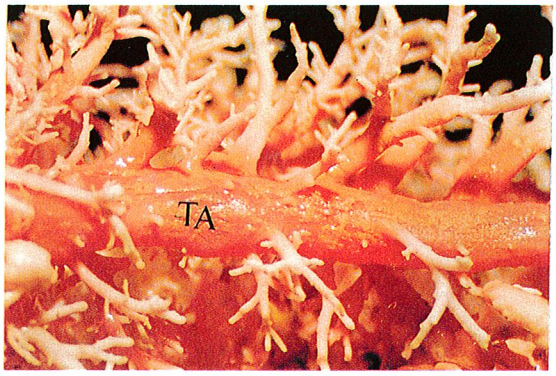

Fig - 2 : A higher magnification of Fig 1 T.A. : Trabecular artery. X 10.

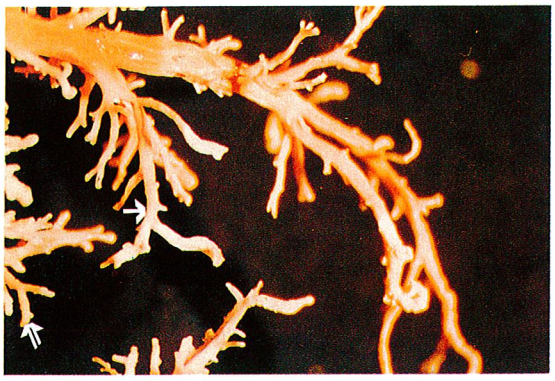

Fig - 4 :The terminal branches in the arterial distribution of the spleen. (→) Penicillate artery, (⇒) : Terminal arteriol. X 6, 7.

Fig - 3 :The terminal branches in the arterial distribution of the spleen. (→) Penicillate artery, (⇒) : Terminal arteriole. X 6, 7.

Fig - 5 : A general view of the arterial distribution of the kidney. A.A. : Arcuate arteries, I.A. : Interlobular arteries, Aa : Afferent arteriole, GL : Glomerule, Ea : Efferent arteriole. X 40.

afferent arteriole. In general, there was a 90° angle between the afferent and the efferent arterioles. Afferent and efferent arterioles in general showed a straight orientation. In this group, when the plastic material was applied also from the urethra, major, minor calices and collecting tubules were distinctively visible. In the same way, when a special vein stain was applied, stellate veins, interlobuler veins and arcuate vein were all distinguishable. It was found that the polyester and the stain were capable of penetrating into the extreme branches also in the kidney (Fig 5, 6, 7, 8).

DISCUSSION

Polyester injection and corrosion method is being used successfully in the investigation of the macroscopic and the microscopic structures of various organs such as kidney, spleen, and liver with some modifications (2, 3, 11, 13).

In this study, the same method was tested on the kidney and the spleen by using various stains for coloring. Silicon rubber (1), plastic resin (3, 4, 11, 13), methyl metacrylate (5, 7, 8, 9, 10) and various other alike materials are generally used in polyester injection studies. In this work, Polyester Crystic

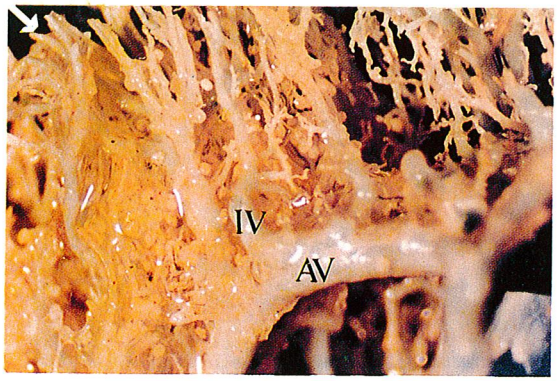

Fig - 6 : A general view of the arterial distribution of the venous system in the venous staining group. AV : Arcuate vein, IV : Interlobular vein, (→) : Stellate vein. X 12.

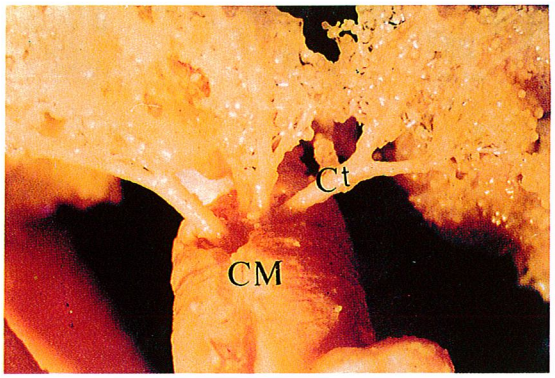

Fig - 8 : The collecting tubules and the calyx in the plastic injection applied group into the Ureter. CCM : Calyx minor, Ct : Collecting tubule. X6, 7.

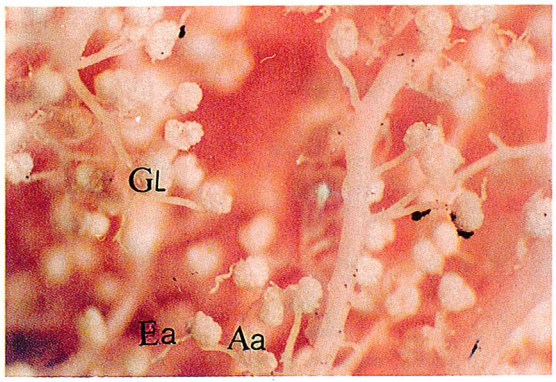

Fig - 7 : A general view of the arterial distribution of the kidney. GL : Glomerule, Ea : Efferent arteriole, Aa : Afferent arteriole. X 40.

(511-0196), with low viscosity but high flowability, was used. This material had a further advantage of being cheap and abundantly available.In this work besides using some well known and commonly used stains such as the special pigment (3012), other stains such as Eosin, Orange - G, Scarlet Blue, etc. which were never used before, were also tested as coloring agents.

Ras and his colleagues (7) performed a plastic injection work in kidneys and showed that the efferent arterioles at superficial cortex had a special structure, vertically oriented with respect to the kidney capsule and branched from peritubuler capillaries. They also found that the superficial cortex glomerules showed a heterogenous distribution in terms of width, length and number in polycystic kidneys (6, 7, 12).

The present work showed that the interlobular arteries, which branched from the arcuate artery at a 90° angle, get narrower after a certain course and enter into the glomerule as the afferent arteriole. Afferent arterioles had wider diameters than those of efferent arterioles.

Cougard and his colleagues (2) observed three important findings from their studies using plastic injection and corrosion method. In the first one, splenic artery which was distributed at a far distance to the hylus of the spleen was seen as a lateral "Y" shape. In the second finding, there was an absence of anastomoses between the segmental branches. The third finding was that the branching between the segments was too little (2, 6, 12).

In this study, it was found that the trabecular arteries move continuously towards right. There was absolutely no branching at the terminal arteries.

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REFERENCES

1. Brune EO, Meiring JH : A silicon rubber cast of the cavities in the temporal bone as a teaching aid in human anatomy. Journal of audiovisual media in medicine 1989; 12 : 23-25.
2. Cougard P, Trouilloud P, Morizot B, Gelle MC, Autisier JM : Contribution a L'etude de la Segmentation vasculaire de la rate (Lien). Bull. -Assoc.-Anat.-Nancy 1984; 68 : 27-33.
3. Erençin Z, Hassa O, Sağlam M, Evren A : Beitrag zur Darstellung von Gangsystemen und Blutgefassen durch injektio vershiedener subtanzen. Acta Anatomica 1969; 74 : 138-147.
4. Hassa O : Korozyon preparatlarının, normal ve patolojik piyeslerin polyester'de bloka alınma tekniği. A.Ü. Veteriner Fakültesi Dergisi 1967; 14 : 378-386.
5. Kremer von A, Budras KD : Zur Blutgefassversorgung des Hodens beim Pekingerpey (Anas Platyrhyncas L.) Makroskopiche, lichtmikroskopische and rastelektronen mikroskopische untersuchungen. Anatomische Anzeiger, Jena 1990; 171 : 73-87.
6. Leeson TS, Leeson RC, Paparo AA. Text / Atlas of Histology. Philadelphia : WB Saunders Company 1988; 347-353, 537-543.
7. Ras AM, Ojeda JL, Garcia-Parrero JA : Vascular Architecture Modifications in the Steroid Induced Polycystic Kidney. Nephron 1985; 40 : 332-340.
8. Rattanachaikunsopon P, Chunhabundit P, Bamroongwong S, Somana R : Microvasculature of the Thyroid gland in the common tree shrew (Tupaia glis) : Microvascular corrosion cast / scanning electron microscopy study. Acta Anatomica 1991; 142 : 208-214.
9. Rodriquez M, Bur S, Fawre A, Weibel ER : Morphometry and Geometry of the peripheral airway system in rat and rabbit. The American Journal of Anatomy 1987; 180 : 143-155.
10. Staffel M, Friess AE, Kohler T : Efferent ductules of the Boar - A Morphological study. Acta Anatomica 1991; 142 : 272-280.
11. Tanyolaç A : Evcil memelilerde karaciğerin lobuler yapısı ve kan dolaşımı üzerinde morfolojik incelemeler. A.Ü. Veteriner Fakültesi Dergisi 1972; 427-446.
12. Williams PL, Warwick R : Gray's Anatomy. London : Churchill Livingstone, 1980; 1392-1401.
13. Yücel BD, Yücel HA, Oğuz O, Dere F : Nefron ve glomerül üç boyutlu yapısının plastik enjeksiyon ve korozyon metodu ile ortaya konulması. Ç.Ü. Sağlık Bil. Derg 1990; 5 : 67-72.