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Influence of Urinary Tract Mucosa on the Experimental Formation of Bone.

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The experimental formation of bone in the urinary tract was first observed by Sacerdotti and Frattin[1] in rabbits where the renal vessels had been ligated. This has also been observed by Poscharissky,[2] Maximow,[3] Liek[4] and Asami and Dock.[5] The bone occurs in thin lamellae immediately beneath the mucosa of the pelvis. Bone does not occur if the ureter also is ligated. Pearce,[6] following excision of the lower pole (approximately one-half) of the kidney with suture of the defect, observed bone formation in 6 of 19 dogs. Bone developed in connection with epithelial buds of the pelvic mucosa. He says "for this peculiar localization there is no explanation." In application of phenol (95%) and an electric current of high frequency to the renal pelvis of dogs, I have observed bone formation in 3 of 5 dogs. Strauss[7] observed bone formation beneath the regenerated ureteral mucosa, lining the lumen of the graft. Neuhof[8] observed formation of bone in a fascial patch sutured in a defect of the bladder in 18 dogs. Invariably confined to the fascia replacing the defect and situated in the surface of the graft bordering on the urine. This observation was confirmed by Phemister[9] in the dog, but not in the bladder of the rabbit or sheep. The explanations for the development of bone in the ureter or bladder were based on a metaplasia due to some factor in the urine.

In my experiments, auto-transplantation was done throughout.

Experiment I: 3 dogs. Both ureters transplanted to the skin, the bladder was emptied and fascia from the sheath of the *rectus abdominis* muscle was transplanted to fill a circular operative defect 3 cm. in diameter in the dome of the bladder. Examination 24 to 47 days

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1 Sacerdotti and Frattin, *Arch. f. Path. Anat. u. Phys.*, 1902, clxviii, 431.

2 Poscharissky, *Beitr. Path. Anat.*, 1905, xxxviii, 135.

3 Maximow, *Anat. Anz.*, 1906, xxviii, 609.

4 Liek, *Arch. Klin. Chir.*, 1906, lxxx, 279; *Ibid.*, 1908, lxxxv, 118.

5 Asami and Dock, 1920, xxxii, 745.

6 Pearce, *J. Med. Res.*, 1909, xx, 53.

7 Strauss, *Surg. Gynec. and Obst.*, 1914, xviii, 78.

8 Neuhof, *Surg. Gynec. and Obst.*, 1917, xxiv, 383.

9 Phemister, *Ann. of Surg.*, 1923, lxxviii, 239.

later showed bone formation in the fascial patch and confined to it. Microscopically, it was true lamellar, membranous bone containing Haversian systems. There were islands of bladder mucosa cells in the depths of the transplant and some islands of bone: whenever bone occurred, mucosal cells were closely adjacent.

Experiment II: 9 dogs. Portions of (a) bladder mucous membrane alone, and (b) entire bladder wall were excised and implanted in (c) *fascia lata* of thigh (d) sheath of rectus muscle. The results were similar without regard to the combination. An epithelial lined cyst formed at the 7th to 9th day. The adjacent connective tissue became edematous with large deeply staining nuclei in places at the 16th day, and bone developed surrounding a portion of the cyst, never more than one-half the circumference from the 20th day on. The epithelium had been sewed in so that its free surface faced towards the skin. The bone was always situated around that portion of the cyst nearest the skin. Was it due to gravity?

Experiment III: 8 dogs. Transplants of bladder mucosa and entire bladder wall were sewed in rectus sheath in such a way that (a) the free surface of the mucous membrane faced in the direction of the peritoneal cavity in some cases and in others (b) in the direction of the skin. In the cysts developing in (a) the bone faced the peritoneal cavity and in (b) towards the skin. The development of bone was always adjacent to the new formed mucosal portion of the cyst.

Experiment IV: 5 dogs. Scrapings of mucosa of the urinary bladder deposited in rectus sheath, yielded a cyst with bone completely surrounding it.

Experiment V: Transplantation of ureter, renal pelvis and hilus portion of calyx into connective tissue of abdominal wall gives precisely the same result as bladder. Similar transplantation of renal cortex, medulla or papilla portion of calyx fails to produce bone.

Experiment VI: Transplantation of bladder mucosa in (1) liver; (2) spleen; (3) kidney; produced a cyst lined with transitional epithelium: the wall of the cyst is surrounded by connective tissue. No bone formed. Transplantation of bladder mucosa in the lung produced a chronic lung abscess in 3 dogs, but no bone.

Experiment VII: Transplantation of gall bladder wall, adrenal, stomach wall, small intestine, colon and prostate into connective tissue of abdominal wall failed to produce bone although the graft survived in each case.

Experiment VIII: Transplantation of bladder mucosa in subcutaneous fat of abdominal wall, and in striated muscle produced cysts

surrounded in part by bone as in Experiment III. Insertion of urinary bladder mucosa into the knee joint was followed by attachment of the mucosa to the synovial membrane and formation of a plaque of bone here.

Experiment IX: Clean excision of the mucous membrane of the urinary bladder with the exception of the trigone and a narrow strip around each ureter and the urethra, was followed by regeneration of the mucosa over the denuded parietes, but no bone formed at the end of 90 days.

Experiment X: Transplantation of bladder mucosa to the sheath of the abdominal rectus muscle in 6 rabbits produced epithelial lined cysts surrounded by connective tissue but no bone as early as 60 days. In one rabbit at 93 days, there was a deposition of bone.

Conclusion: The influence of epithelium on connective tissue in certain places causing the formation of bone is demonstrated for the first time.

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Bronchial Fistula. A Method of Experimental Production.*

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Bronchial fistula, a not uncommon complication following certain operations and disease conditions in man, has been found somewhat difficult to produce experimentally. This fact is substantiated by the work of Pool and Garlock,[1] and others, who found the production of bronchial fistula in dogs attended with great technical difficulties. Their method consisted of resecting a piece of rib and suturing the underlying lung lobe to the very thin parietal pleura over an area 1.25 inches in diameter. At a second stage operation 2 weeks later, the lung parenchyma found adherent to the chest wall was entered by careful blunt dissection until a fair sized bronchus was located. This was then opened and the skin margins sutured to the opening in the bronchus. They were unable to retain this opening, however, without almost daily cauterization, as it tended to close spontaneously.

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[1] Pool, E. H., and Garlock, J. H., *Ann. Surg.*, 1929, xc, 213.