

PRO EXPERIMENTIS

Resection of the Renal Papillae in Rats

In connection with investigations into the relationship between neurosecretion and renal function, we started a few years ago to carry out surgical extirpation of both renal papillae in rats.

After developing our surgical technique, we found that a similar operation (unilateral nephrectomy and unilateral papillectomy) had previously been carried out in rabbits by RIBBERT¹, as early as 1883, subsequently by HAUSMANN (reported by MEYER²), and recently in rats by SEGALOFF (reported by STERNBERG et al.³). These investigators were not very successful, the post-operative survival of their animals being brief, and moreover they gave only short and casual accounts of their experiments.

Since we obtained satisfactory survival after bilateral papillectomy in rats, we present a more detailed description of our technique in this paper. Brief mention will also be made of some effects of the operation on the water and electrolyte metabolism.

White rats of our inbred laboratory strain were used (weight about 200 g, age about 4 months). After pentobarbital anaesthesia (0.08 ml/100 g body weight), one of the kidneys is exposed by a dorsal incision along the costal arch and delivered through the wound. The vascular pedicle is clamped at the renal hilus with a straight arterial clamp, according to Dieffenbach (Figure 1), after which the kidney is incised as far as the renal pelvis, using an ophthalmological scalpel placed on the median side, perpendicular to the longitudinal axis. The protruding white papilla is grasped and fixed with the aid of a glass tube (internal diameter $1\frac{1}{2}$ –2 mm) connected to a water-jet pump (Figure 2; Figure 3). The tube is first used to remove the blood arising from the incision (suction drainage). Curved small scissors are then used to resect the papilla at its base as completely as possible (Figure 4). The renal wound is then closed with two silk sutures (No. 00).

The wound in the kidney heals without extensive necrosis if some streptomycin powder, mixed with penicillin, is dusted into it before closure. The renal circulation is completely restored immediately after removal of the arterial clamp.

The abdominal wall is closed in two layers, using catgut for the muscular layer and agraffes for the skin.

An experienced surgeon can complete the entire operation on one kidney within 7–8 min. The right-sided

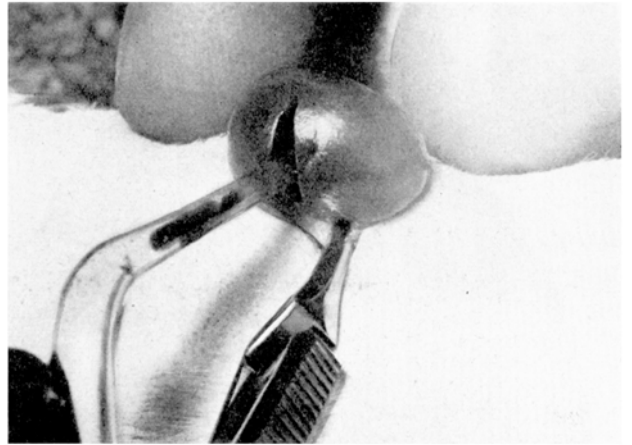


Fig. 2. Median incision and suction drainage of blood.

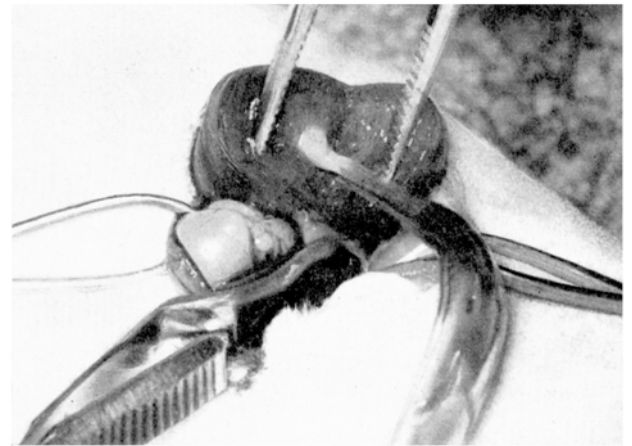


Fig. 3. Grasping the papilla (for the photograph, this kidney was incised further than normally necessary).

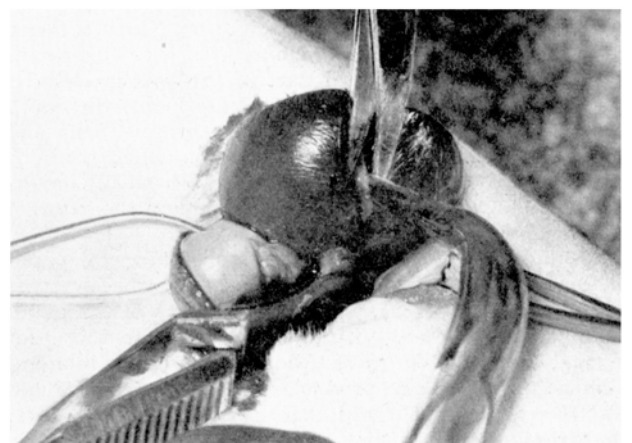


Fig. 4. Severing the papilla.

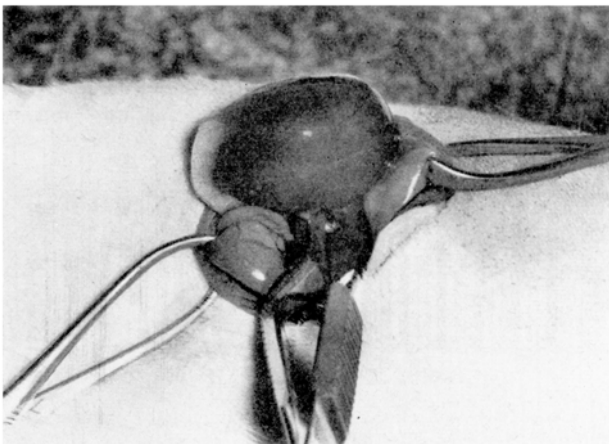


Fig. 1. Clamping the vascular pedicle.

¹ H. RIBBERT, *Virchow's Archiv* 93, 169 (1883).

² H. MEYER, *Marburger Sitzungsberichte über Diurese* (31st July 1902), p. 92.

³ W. H. STERNBERG, E. FARBER, and C. E. DUNLAP, *J. Histochem. Cytochem.* 4, 266 (1956).

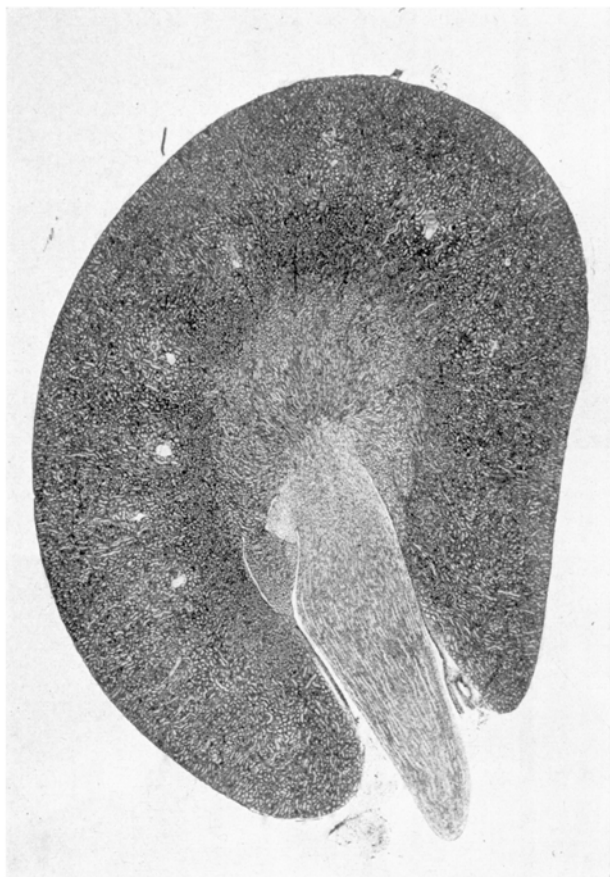


Fig. 5. Transverse section through the normal kidney.

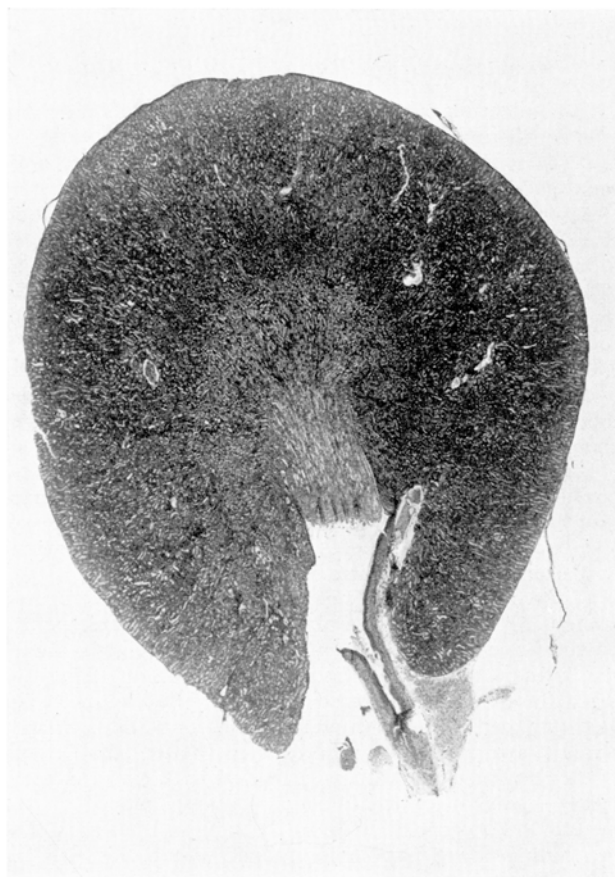


Fig. 6. Transverse section through the kidney after papillectomy.

and left-sided papillectomies are not carried out in immediate succession but at an interval of one week.

Postoperative haemorrhage into the cavity of the renal pelvis is exceedingly small, as is shown by the fact that the urine becomes perfectly clear within a few days.

The microphotographs (Figure 5; Figure 6) show that the papilla is virtually severed at the boundary between the external and the internal medullary zone. This means that resection of the distal part of the papilla includes the ductuli colligentes, the thin Henle loops, the capillaries, the transversely arranged 'interstitial' cells and the apical connective tissue of the papilla, which contains much mucoid. We found that the reason why haemorrhages seldom occur is that the vasa recta in the external medullary zone remain intact.

We have so far submitted 96 rats to bilateral papillectomy; 24 rats died after the operation; the survivors made a rapid recovery. The growth curves of the papillectomized rats were virtually the same as those for normal controls (Figure 7). About 3 days after bilateral papillectomy the urine production (unrestricted food and water) was about 3 times that in normal control rats; the average urine output of the latter did not exceed 10 ml/day.

Determinations at intervals of several months showed that this polyuria persisted completely unchanged. The amount of water ingested to compensate for the increased urine excretion varied from 40 to 60 ml; the intake of the normal controls was 20–30 ml/24 h.

The specific gravity of the urine from papillectomized rats was 1.018 to 1.028; in normal controls under similar conditions it was 1.050 to 1.070.

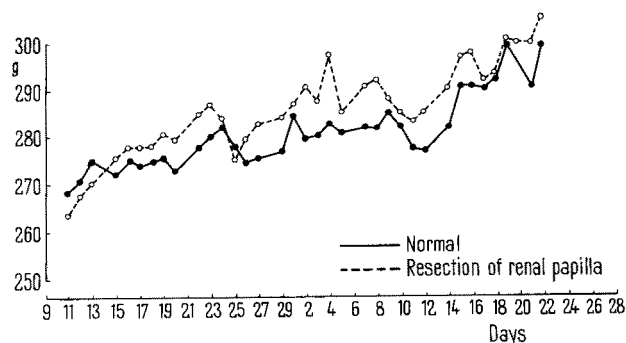


Fig. 7. Growth curves of a normal and a papillectomized rat over a 7-week period, beginning 11 days after bilateral papillectomy.

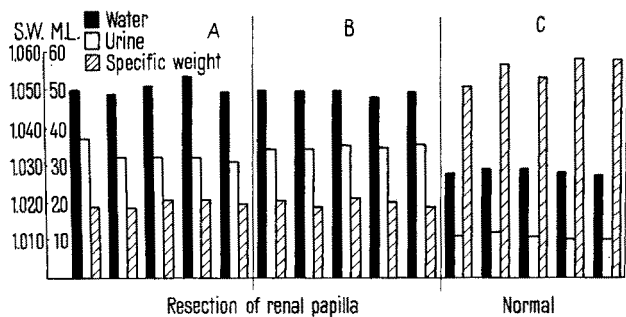


Fig. 8. (A) Daily water intake and urine volume and specific gravity, as measured in a papillectomized rat for one week. (B) The same determinations in the same rat, one month later. (C) The same determinations for one week in a normal control rat.

These data are illustrated in a block diagram (Figure 8).

In 40 rats, both kidneys were incised without removing the papillae. The specific gravity of the urine from these rats differed slightly from the normal but was significantly higher than that of urine from papillectomized rats.

Since the food intake and weight gain in papillectomized rats did not differ from those in normal controls, it must be presumed that water and electrolyte balance is maintained in the former.

In papillectomy the Henle loops (responsible for production of urine with a high specific gravity according to the countercurrent hypothesis of HARGITAY and KUHN⁴) are eliminated; in view of this the results described constitute direct experimental confirmation of this hypothesis. The fact that papillectomy is well tolerated also warrants the conclusion that—at least in rats—the most important and possibly the sole function of the renal papilla is that of concentrating the urine, i.e. saving water for the organism.

One of us⁵ will shortly be presenting a thesis on further physiological and histological studies in papillectomized rats⁶.

Zusammenfassung. Es wird eine Technik für die doppel-seitige Entfernung der Nierenpapille bei der Ratte beschrieben, nebst Erscheinungen die als Operationsfolge sofort und stationär auftreten.

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Histologisch Laboratorium, Universiteit van Amsterdam (The Netherlands), June 28, 1962.

⁴ B. HARGITAY and W. KUHN, *Z. Elektrochem.* 55, 539 (1951).

⁵ J. F. JONGKIND, Thesis Amsterdam, in preparation.

⁶ We are indebted to Mr. C. BERNARDT for elaborating the surgical technique and performing the many papillectomies.

Tonspektrographische Untersuchungen des Säuglingsgeschreis

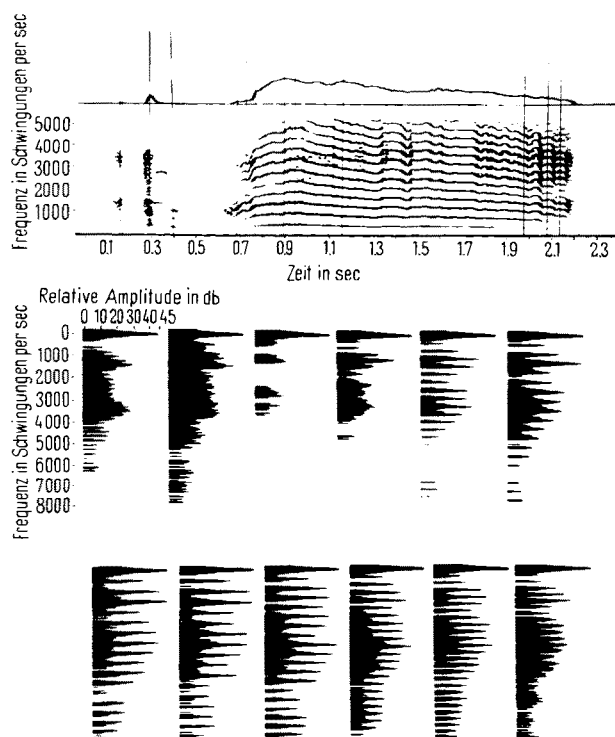
Das Geschrei des Neugeborenen oder Säuglings dient als non-verbales Mittel, sich der Umgebung mitzuteilen. Im allgemeinen glauben die Mütter, Kinderpflegerinnen und Kinderärzte, dass verschiedene Typen von Geschrei verschiedene Gefühle und Bedürfnisse ausdrücken.

Unsere Forschergruppe: Kinderärzte, ein Kinderpsychiater und ein Phonetiker, studieren, von verschiedenen Gesichtspunkten aus gesehen, die Entwicklung des Geschreis, des Plapperns und des Sprechens. Eine präliminare Mitteilung von dem Gebrauch der tonspektrographischen Technik bei der Untersuchung dieser Art, könnte von Interesse sein.

Die Laute verschiedener Säuglinge wurden mit einem Magnetophon¹ von hoher Qualität in ein und demselben Raum aufgenommen. Spezieller Wert wurde auf die Beseitigung der Nebengeräusche und des Echos gelegt. Die elektrophysikalische Analyse wurde mit dem Sona-Graph, hergestellt von Key Electric Co., New York, gemacht. Trotz Anwendung dieser Methode von Sprachforschern^{2,3}, haben wir noch keinen Bericht über ihren Gebrauch in der medizinischen Literatur gefunden. Zwar präsentierten KARELITZ et al. im Jahre 1959⁴ einige Bandaufnahmen von Säuglingsgeschrei, aber sie verzichteten auf jede eingehende Analyse. Später erfuhren wir jedoch, dass unabhängig von uns in Stockholm eine Forschergruppe unter Leitung von LIND⁵ mit derselben Methode wie wir arbeitete. Inzwischen ist es zu einer Zusammenarbeit gekommen.

Der Sona-Graph ist ein Instrument, mit welchem komplexe Signale analysiert und als Funktion der Frequenz und Dauer graphisch dargestellt werden können. In dem hervortretenden Sonogramm wird die Frequenz des Signales in der vertikalen Richtung und die Intensität durch die Dichte der Musterung angegeben.

Im Sonogramm werden normalerweise die Frequenz von 85 bis 8000 Schwingungen pro sec in vertikaler Richtung von ungefähr 10 cm und die Dauer von 2,4 sec in horizontaler Richtung von ungefähr 31,5 cm, angegeben. Eine



¹ Der Movicorder Stereo-A-Two Magnetophon, hergestellt von Movie Co., Kopenhagen (Dänemark).

² G. A. MILLER, *Language and Communication* (McGraw-Hill Book Co., Inc., New York 1951).

³ R. POTTER, G. A. KOPP und H. C. GREEN, *Visible Speech* (Van Nostrand, New York 1947).

⁴ S. KARELITZ, R. KARELITZ und L. ROSENFELD, *Cry Study* (Long Island Jewish Hospital, New Hyde Park, N. Y. 1959).

⁵ J. LIND, persönliche Mitteilung (1962).