

A STUDY OF NORMAL PERISTALTIC ACTION POTENTIALS IN URETER (Electro-Ureterogram)

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INTRODUCTION

The ureter at rest is devoid of any appreciable mechanical activity. Peristaltic waves, serving to propel urine from pelvis of the kidney to the urinary bladder, produce depolarisation of the muscle fibres and electrical activity—which is subject to measurement. Only a few studies have been reported (Baker and Haffer, 1953; Prosser *et al.*, 1955; Sleater and Butcher, 1956) on these action potentials. Even these differ in shape, voltage and duration of action potentials in ureters, and so it was decided to investigate the electrical activity of ureters in dogs.

MATERIALS AND METHODS

Healthy adult dogs of either sex were used for the study. The dogs were anaesthetised with ether and then 80 mg./Kg. body weight of chloralose was given intravenously.

Laparotomy was performed and 2 to 3 cms. of ureter was carefully freed from the peritonium and the surrounding viscera. A small glass hook was used to gently elevate the ureter from its bed. An indifferent electrode was placed in the abdominal skin. The animal was grounded by a contact attached to hind limb. The active electrode consisting of a No. 18 hypodermic needle attached to insulated wire, was inserted into the wall of the suspended ureter.

Electrical potentials from the ureter were fed into and amplified by means of a Standard Offner Electro encephalograph and were recorded by a Crystographic ink writing unit.

Electronegativity was recorded as a downward deflection and electropositivity as an upward deflection on a paper moving at the speed of one inch per second. Amplitude of deflection was calibrated at 10 uv/cm.

RESULTS

The records of electrical activity in the ureter immediately after insertion of the active needle electrode in the ureteric wall, were not characteristic. Wide variations were noticed with reference to voltage, duration, frequency and form of the early peristaltic action potentials. These variations invariably disappeared within 5-15 minutes. Later on records were uniform and regular.

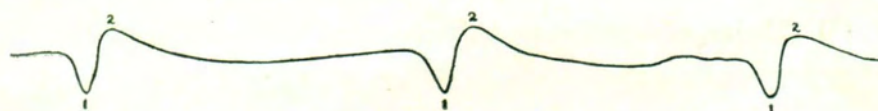
All the normal peristaltic action potentials in our series were biphasic, consisting of an electro-negative wave followed by an electro-positive wave (Figure 1.). Data concerning voltage, duration and frequency of representative electro-ureterograms are given in tables 1 and 2.

TABLE 1.

Dog No.	Wave I. Voltage in uv.	Wave II. Voltage in uv.	Frequency per minute.
1.	- 150	+ 150	
2.	- 200	+ 125	12
3.	- 500	+ 400	7
4.	- 600	+ 900	12
5.	- 250	+ 200	6
6.	- 600	+ 200	18
7.	- 350	+ 400	7
8.	- 100	+ 150	7
9.	- 750	+ 800	12
10.	- 150	+ 300	13
11.	- 450	+ 300	19
12.	- 350	+ 375	18
13.	- 500	+ 400	20
14.	- 450	+ 250	15
15.	- 150	+ 350	12
16.	- 350	+ 125	20
MEAN	- 369 \pm 193	+ 339 \pm 224	14 \pm 5

TABLE 2.

Dog. No.	Wave I. Duration in Milli-secs.	Wave II. Duration Milli-secs.	Total duration of component waves in Milli-secs.
1.	187	1250	1437
2.	375	0750	1125
3.	250	0625	0875
4.	937	1375	2312
5.	250	0350	0600
6.	187	0312	0499
7.	375	0375	0750
8.	062	0250	0312
9.	437	1375	1812
10.	250	1000	1250
11.	312	0750	1062
12.	312	1250	1562
13.	812	0750	1262
14.	437	0750	1187
15.	312	0875	1187
16.	312	0500	0812
MEAN:	363 ± 222	809 ± 379	1172 ± 499



NORMAL ELECTRO-URETEROGRAM.

Fig. 1.

DISCUSSION

The initial variations in voltage, duration and shape of the peristaltic action potentials recorded immediately after insertion of needle, were probably due to trauma and consequent depolarisation associated with preparation of the ureter and insertion of the needle electrode;

A perusal of tables 1 and 2 and figure 1 show that although there are wide variations in voltage and duration of waves I and II, the pattern is invariably similar.

Wave I is a sharp electro-negative deflection, — 369 ± 193 uv, lasting for 363 ± 222 milli-seconds. Wave II is a slow electro-positive deflection, 224 uv, lasting for 809 ± 379 milli-secs. Total duration of a component wave is 1172 ± 499 milli-secs. The component waves of electro-ureterogram appear at a frequency of 14 ± 5 per minute.

Baker *et al.* (1953) have reported that the normal ureter at rest is devoid of any appreciable electrical activity. Peristalsis produces depolarisation and electrical activity. Propagated potential changes immediately precede the wave of ureteral contraction. Although the form of peristaltic action potentials is apparently characterised by a triphasic curve, the amplitude of the individual waves is capable of great variation. The values for wave I were 138 ± 20.5 uv, wave II were 144 ± 20.7 uv and wave III, 172 ± 251 microvolts. The duration of the individual waves had a considerably lower range (Wave I: 31 ± 13.1 , wave II: 24 ± 13.2 , and wave III: 40 ± 16.8 milli-seconds). The total duration of component wave was 95 ± 12.3 milli-seconds. Prosser *et al.*, (1955) have observed a biphasic pattern consisting of a fast negative wave and a slow positive wave in rat's ureter. They have not reported any data relating to values of waves I and II. Similar observations have been made by Sleator *et al.*; (1955) in dog's ureter in situ. They have also described a biphasic wave form consisting of a rapid negative spike followed by a plateau of intermediate positive potential lasting for 0.5 second. In their report they have laid great stress on the propagation speed and not on the value of different waves.

The experiments carried out so far confirm the findings of Sleator *et al.*, as far as the biphasic character of the waves is concerned. The differences from the observations of Baker *et al.*, are difficult to explain.

SUMMARY

- (1) Method of recording electro-ureterogram has been described.
- (b) The electro-ureterogram consists of wave I and II. Wave I is a sharp electro-negative deflection (-369 ± 193 uv) lasting for 363 ± 222 milli-secs. Wave II is a slow electro-positive deflection ($+ 339 \pm 224$ uv) of 809 ± 379 milli-seconds duration. The total duration of component waves is 1172 ± 499 milli-seconds. The component waves of electro-ureterogram appear at a frequency of 14 ± 5 per minute.

REFERENCES

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