

Hyposthenuria: Sándor Korányi's Concept of Renal Insufficiency

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Key Words

Korányi · Urine · Freezing point depression · Renal insufficiency

Abstract

Around the turn of the 19th century, the Hungarian physiologist and clinician, Sándor Korányi, started to use physicochemical methods to estimate renal function. In parallel with the deterioration of renal function, he found characteristic changes in the freezing point depression of urine, which he termed hyposthenuria. On the basis of these findings, he was the first to introduce the functional concept of renal insufficiency.

Before the 19th century, the main approach to the study of diseases was the morphological concept. Virchow, in one of his major presentations [1], promulgated the anatomical concept 'seek the answer to the question: ubi est morbis?'

One of the most famous proponents of the structural concept was Morgagni, who was working and teaching in Padua. In the second half of the 18th century, a revolutionary change occurred with the identification of functional changes in relation to the morphological changes

observed in diseases. The pioneer and most famous representative of this concept was Claude Bernard [2].

Sándor Korányi, the Hungarian physiologist and clinician, was greatly impressed by the functional concept and fundamental works of Claude Bernard. Korányi's most important research activity was in renal physiology and pathophysiology.

The method of cryoscopy had been used to measure the freezing point depression (FPD) of fluids for the estimation of osmotic pressure. In 1892 Dreser [3] and in 1896 Winter [4] published their findings that the FPD in the blood of normal subjects was rather constant (0.56°C), but varied in the urine over a fairly wide range (from 0.45 to 2.40°C). Korányi confirmed these observations [5], but he made further steps by using cryoscopy in patients with kidney disease and in experimental animals. He found that the FPD changes characteristically in certain circumstances and pathophysiological conditions and observed that in rabbits fluid loads produced an increased urine flow. The urine became lighter, the volume increased and the FPD values came closer to the lower limit (0.08), but if the animal was restricted in its fluid uptake, the FPD values moved close to the higher limit observed [5].

He made his probably most important observations in connection with studies of the changes in renal function. He observed that when there was a deterioration in renal

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function, the spontaneous changes in the FPD shrank, and with changes in the hydration there was an inability to modify the urine osmolality appropriately. Eventually the FPD and the values approached the plasma values. To this pathophysiological condition he gave the name 'hyposthenuria'. This is described in his text in the following way: 'Bei Krankheiten kann die Kraft, mit welcher die Nieren eine Veränderung in der osmotischen Spannung der sie passierenden Flüssigkeit hervorbringen, abnehmen. Dann nähert sich die Gefrierpunktserniedrigung des Harnes derjenigen des Blutes, und befindet sich zwischen 0,56–1,3°; es entsteht Hyposthenurie' [6].

Table 1 illustrates the results of his investigations of a patient with hyposthenuric polyuria caused by nephrosclerosis.

At the time when Korányi was practising as a clinician, it was not rare for surgeons to connect the ureter of the diseased kidney to the abdominal wall. In these cases, Korányi made separate renal function studies [7]. These were very good opportunities to compare the functions of the normal and the diseased kidney. The impaired renal function was indicated by the hardly changeable FPD and correlated with the decreased excretion of sodium, chloride, phosphate and urea with the urine.

These observations led Korányi to the view that the kidney function is responsible for keeping the osmolality and FPD of the blood stable. If the renal function is deteriorating, the kidneys cannot function appropriately and excrete materials properly, which leads to an impairment of renal function (i.e. hyposthenuria develops and the osmolality and the FPD in the blood should be elevated. To quote one of the findings of Korányi referring to this: '... die Erkrankung der Niere so hochgradig ist, dass die gesamte Nierenfunktion darunter leidet. Es handelt sich in diesen Fällen um eine Niereninsuffizienz', i.e. 'the renal disease had progressed so much that the total renal function had nearly stopped. In such cases, renal insufficiency developed'.

Franz Volhard, the famous German nephrologist, in a lecture given in 1938 under the title 'Über Niereninsuffizienz' states [8]: 'The idea of renal insufficiency is fairly new. ... The concept was first formulated by v. Korányi at the beginning of this century.'

Gabriel Richet, dealing with the history of renal pathophysiology, recently wrote as follows [9]: 'In 1897, Korányi measured the FPD of the urine during water restriction. He found that in advanced renal disease it was lower than the normal, approaching that of the plasma, a phenomenon which he named isosthenuria. He introduced the concept of renal insufficiency when, whatever the



Fig. 1. Sándor Korányi.

Table 1. Results of functional studies on a patient with hyposthenuric polyuria (Dg.: Essential hypertension, 'benign nephrosclerosis')

Stunde	Harnmenge cm ³	Spez. Gewicht	Kochsalz- gehalt, %	Gefrier- punkt, °
6	90	1012	0,22	0,84
7	36	1012	0,20	0,78
8	52	1012	0,19	0,78
9	32	1012	0,36	0,78
10	80	1012	0,36	0,74
1	160	1012	0,35	0,76
4	194	1012	0,32	0,77
7	212	1012	0,29	0,78
nachts	960	1012	-	-
-	1816	-	-	-

Vorlesungen über funktionelle Pathologie und Therapie der Nierenkrankheiten A. v. Korányi, Springer Verlag, Berlin, 1929.

lesions, the urinary excretory function does not adapt to the needs of the body'.

Sándor Korányi (fig. 1) was born in Budapest (Hungary) on 18 June 1866. His father was professor of medicine in Budapest. He studied medicine and received his medical diploma in Budapest in 1888. He made several study

trips to France and Germany. In Strasbourg, while spending several months under the tutelage of Hoppe Seiler, he conducted studies on physicochemical methods in physiological conditions. In 1909, he was appointed a full professor of internal medicine and chairman at the Department of Medicine at Budapest University. He died in 1944.

To summarize, Korányi's most important contribution to nephrology was the introduction of functional diagnostics into nephrology through the use of physicochemical methods for estimation of the renal function. In doing so, he became the first to introduce the functional concept of renal insufficiency.

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