COMPARATIVE ASPECTS OF RENAL EXCRETION IN VERTEBRATES

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Summary

A homeostatic balance between the external and internal environments is absolutely crucial for sustaining life. As animals left the marine life and adopted terrestrial conditions, the excretory system continually underwent adaptations to the unfavourable and changing living conditions. Studying the functional and morphological development of the excretory system both phylogenetically and ontogenetically beautifully shows this evolutionary trend and logic during the past few hundred millions of years. In this chapter, the main comparative features of the excretory system of the vertebrates are briefly discussed.

1. Introduction

August Krogh (see *Physiology and Maintenance*) stated that one can find a proper model for every study from nature. Life has persisted on planet Earth for billions of years and with the same notion mother nature has carried out billions of experiments in the line of evolution. Water and ion balances as well as renal excretion are certainly one

of those areas where many different successful systems exist among organisms, even today.

Aquatic and terrestrial organisms live under different situations; the former enjoy a abundance of water while the latter must use energy to maintain the water inside the body. Terrestrial animals have adapted to various degrees to the harsh conditions of life on the land, best exemplified by the animals living in deserts, which try to minimize their daily urine output. Camels, for instance, can survive without drinking for several days.

There are animals, such as frogs, which spend part of their lives in an aquatic environment and then become terrestrial for their adult functions. There are also species which hatch in a freshwater environment and then move to seawater, such as salmons, which at the end of their lives return to spawn, and die, in the freshwater rivers where they had first seen life. All these species have to develop new renal excretory systems to meet the different needs. They must be able to regulate their water and ion balances with different mechanisms in the different phases of their lives. The human fetus displays some of those developmental periods, being in a very different environment before and after birth. In this chapter, some features of renal functions are described in a few examples of different vertebrate taxa.

2. Fishes

2.1. Hagfishes

In hagfishes sodium and chloride are the main determinants of the body fluid osmolarity which is in osmotic equilibrium with seawater. The glomerular filtration rate (GFR) is high and the filtrate passes directly into primitive archinephric ducts along which glucose is absorbed and urea, potassium, phosphate, magnesium, and sulfate are secreted, but essentially no sodium or fluid is reabsorbed. Hence, the final urine is isosmotic with the plasma and seawater.

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Biographical Sketches

László Rosivall was born in 1949 in Budapest, Hungary. He is the head of Joint Nephrology Research Group of the Hungarian Academy of Sciences and Semmelweis University (2000-), Professor of Pathophysiology, Deputy Director, Department of Pathophysiology, Semmelweis University, Budapest (1991-). He is a member of the European Academy of Sciences and Arts. He is the Founding President of the Hungarian Kidney Foundation and the Budapest Nephrology School.

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