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Chloride, the queen of electrolytes

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The study of chloride channels of membranes has seen an explosion of interest recently and exciting developments have sparked renewed interest in this field. In contrast, despite the prominent concentration of chloride in serum, textbooks in general do not allocate chapters exclusively on chloride or hypochloremia and hyperchloremia. Although chloride was the first electrolyte to be easily measured, its importance always has been overshadowed by other major serum electrolytes, seemingly serving as a sort of appendix of sodium or potassium or just a stand-in for bicarbonate. Chloride is responsible for about 100 of the 300 mosm/L of extracellular fluid tonicity and for two-thirds of all negative charges in plasma. To maintain acid-base balance, chloride has an inverse relationship with bicarbonate, which is part of the major chemical buffering system responsible for maintaining a normal pH when bicarbonate is lost by the kidneys or the intestines. Chloride and bicarbonate shift into and out of erythrocytes and tubuli to maintain acid-base balance. Because of its high concentration, chloride is the most important anion to maintain the balance of extracellular cations and anions to ensure electrical neutrality as the number of anions and cations in body fluids must always be equal. The high intracellular $[Cl^-]$ in erythrocytes allows chloride to move in and out of the red blood cells very effectively, as dictated by electrical charges on either side of the cell membrane. This important difference from other cells is the basis of the so-called "chloride-shift" with the movement of chloride from the plasma into erythrocytes as blood moves from the arterial to the venous end of systemic capillaries. The Donnan ratio represents the behaviour of charged particles near a semi-permeable membrane with imbalanced distribution across the two sides of the membrane. Since most of the CO_2 carried by the blood is in the form of HCO_3^- , the chloride shift is important because it enhances the carrying capacity of the blood for HCO_3^- . A major role of the chloride shift is therefore mitigation of the change in pH that occurs during gas transport. The chloride concentration is primarily regulated by the gastrointestinal tract and the kidneys. Chloride channels are expressed along the entire mammalian nephron. They participate in transepithelial chloride transport, cell volume regulation and acidification of intracellular vesicles. Abnormal chloride levels alone usually signify a more serious underlying metabolic disorder, such as metabolic acidosis or alkalosis. Abnormalities in chloride channel expression and function in many organs can cause a wide range of disorders. Chloride also is an irreplaceable component of diagnostic tests in many clinical situations.

Biography

Kenrick Berend completed his studies to become an intern at the University of Utrecht, the Netherlands. He is working in Curacao at the Department of Nephrology and Internal Medicine in the St. Elisabeth Hospital Curacao and the Curacao Dialysis Centre. He wrote a dissertation on subacute aluminium intoxication in haemodialysis patients in 2003. He published several papers on different subjects, including those on hypertension, acid-base and haemodialysis. His main research area is acid-base disturbances and he authored the guidelines on this subject for all hospitals in the Netherlands in a chapter (in a booklet) on acute internal medicine problems and among others a review in the *New England Journal of Medicine*. He gave lectures on acid-base disturbances in several places, including the General Massachusetts Hospital in Boston, several university hospitals in the Netherlands and at conferences in the USA, China, the Netherlands, St. Maarten and Curacao. He also has trained numerous medical students and residents from the Netherlands.

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