Profiles in Cardiology

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Lorenzo Bellini

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Lorenzo Bellini (Fig. 1) was born in Florence, Italy, on September 3, 1643.¹ He was a pioneer in iatromechanism, a theoretic system that framed physiologic events such as the circulation of the blood in terms of mathematical and physical principles.² Bellini studied philosophy, mathematics, and medicine at the University of Pisa where he came under the influence of Giovanni Alfonso Borelli, a founder of iatromechanism.³ A brilliant student, Bellini was just 20 years old when he was appointed professor of theoretical medicine at his alma mater. Five years later, he was selected to fill the university's chair of anatomy.

For Borelli, Bellini, and other disciples of iatromechanism, "living bodies are machines," according to historian Thomas Hall. Hall explains that

The life of the machine is the totality of movements exhibited by the moving parts and by the machine as a whole. The whole machine is an assemblage of smaller component machines, and these of still smaller ones, and so on until we reach the corpuscular level.⁴

With other proponents of iatromechanism (including Robert Boyle in England, René Descartes in France, and Niels Stensen in Denmark), Bellini and his mentor Borelli embraced experimentation and careful observation as the chief methods for studying the structure and functions of living organisms and their component parts.

Precocious and ambitious, Bellini published his first book when he was just 19 years old. *Exercitatio anatomica de usu renum* (1662) was a pioneering work on the anatomy and physiology of the kidneys. Bellini rejected Galenic theories about renal structure and function that had dominated Western medical thought for almost 1,500 years. With the aid of a magnifying glass, he made observations that led him to conclude that the kidney was not composed of solid fibrous strands; rather, it contained vast numbers of hollow tubes or canaliculi that extended radially from the papillae to the renal cortex.⁵

Bellini proposed a physical theory of urinary secretion that reflected the tenets of iatromechanism. He argued that the small arteries of the kidney discharged blood into spaces in the renal parenchyma where it was separated into two parts: the aqueous portion drained off into the tubules he had identified to form urine while the more solid portion returned to the circulatory system via the renal vein. The size and configuration of the particles in the blood determined which route they took.⁶ Bellini's mechanical explanation of the formation of urine "came remarkably close to the process of glomerular filtration; the only component he had failed to observe was the glomerulus," according to nephrologist Leon Fine.⁷

Bellini's most important book, *De urinis et pulsibus et missione sanguinis*, was published in Bologna in 1683. Now very rare, this 606 page volume represented the first significant attempt to frame medical theory in terms of iatromechanism. In some respects, it was an extension of Borelli's *De motu animalium*, published 3 years earlier.⁸

William Harvey's theory of the circulation was of fundamental importance to Bellini and other proponents of iatromechanism.⁹ Bellini asserted that good health depended on optimal function of the circulation of the blood, and that disease was a manifestation of an inefficient circulation. Rejecting ancient humoral pathology, he viewed blood as a physical fluid with specific properties that could be interpreted in terms of mathematical and physical principles. He also emphasized the importance of analyzing the chemical composition of the urine.

Bellini emphasized that disease was often due to alterations in the elasticity or "tone" of the solids, or in the density of the fluids which hindered their motion. This, in turn, could cause

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FIG. 1 Lorenzo Bellini, 1643–1704. Photograph from the collection of W. Bruce Fye, M.D.

local congestion or stagnation. Bellini's enthusiastic support of therapeutic bleeding reflected this pathophysiologic concept. He tried to prove that this phlebotomy increased the velocity of the circulation, thereby washing away "morbid matter" and restoring health.¹⁰

In the section of his 1683 book that dealt with disorders of the chest, Bellini described several examples of heart disease. Syncope, orthopnea, and other cardiac symptoms were discussed and interpreted. He also made early observations on the coronary circulation. According to historian Joshua Leibowitz, Bellini proposed that coronary calcification could reduce coronary blood flow. Leibowitz also notes that Bellini reported the case of a patient who died with a clinical picture consistent with ischemic heart disease as we now understand it, "in whose coronary arteries he found a 'stone'." Leibowitz concluded that Bellini had observed a coronary occlusion at autopsy.¹¹

Italian physician and anatomist Marcello Malpighi affirmed on the imprimatur leaf of *De urinis et pulsibus et missione sanguinis* that he considered the book an important achievement. He applauded the fact that medicine was "treated solidly and ingeniously by a new method."¹² The most vocal champion of Bellini's theories was the Scottish physician and mathematician Archibald Pitcairne, lecturer on theoretical medicine at the University of Leyden.¹³ Bellini's works were also admired by Hermann Boerhaave of Leyden, the most prominent medical teacher of the early eighteenth century.

Pitcairne thought Bellini's general theory of disease was an important innovation and urged him to expand his approach beyond the organ-based focus that he had used in his book on the kidney and in *De urinis*. Bellini responded by publishing *Opuscula aliquot* in 1695, which he dedicated to Pitcairne. His interpretation of iatromechanism was developed most fully in this book which was structured as a series of postulates, theorems, and corollaries dealing with a wide range of medical topics.

Bellini's theories were championed in England during the early eighteenth century by George Cheyne and Richard Mead, but his influence declined in the mid-eighteenth century as iatromechanism came to be viewed as an oversimplification that ignored chemical phenomena and other factors that influenced health and disease.

After a decade of failing health, Bellini died in 1704.

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