Historical Vignette

Antonio Pacchioni (1665–1726): early studies of the dura mater

ANDREA BRUNORI, M.D., ROBERTO VAGNOZZI, M.D., AND RENATO GIUFFRÉ, M.D.

Center for Historical Documentation on Italian Neurosurgery, Institute of Neurosurgery, University of Rome "Tor Vergata" School of Medicine, Rome, Italy

The clustering of arachnoid villi along the sagittal sinus forms what is known as “Pacchioni granulations.” These structures were first described in 1705 by Antonio Pacchioni, an Italian scientist. Pacchioni was born in Reggio Emilia, Italy, in 1665, and there he received his degree in medicine. Later he moved to Rome where he built a successful career dedicated to medical practice, research, and teaching. He became a friend of some of the leading scientists of his age: Lancisi, Malpighi, and Morgagni, among others. He devoted himself to elucidating the structure and function of dura mater, and in his studies often used the new technique of maceration of anatomical specimens in various fluids. Among Pacchioni's written works, the Dissertatio Epistolariis de Glandulis Conglobatis Durae Meningis Humanae (1705) deserves the greatest consideration as it contains the first description of arachnoid granulations. He compared dura to cardiac muscle and attributed to its “glandulae” (glands) the faculty of secreting lymph for lubrication of the sliding movements between meninges and brain during contractions. Three centuries after Pacchioni's death in Rome in 1726, the fine structure of arachnoid villi has not been fully elucidated; moreover, many questions related to mechanisms underlying cerebrospinal fluid absorption remain unanswered.

KEY WORDS • history of neurosurgery • dura mater • Antonio Pacchioni • arachnoid villi

It is generally accepted that arachnoid villi play an essential role in cerebrospinal fluid (CSF) absorption and constitute the site of origin of meningiomas. In areas of maximum density (that is, along the superior sagittal sinus), they tend to cluster together forming the so-called “Pacchioni granulations.” In spite of the great popularity of this eponym, the discoverer of arachnoid granulations, Antonio Pacchioni, is unknown to many. The purpose of this short note is to rectify this deficiency by providing a portrait of Pacchioni, largely based on consultation of original documents.

Pacchioni's Life and Career

Antonio Pacchioni was born in Reggio Emilia, a small town in northern Italy, on June 13, 1665. However, he was considered Roman by adoption since he spent the most significant years of his life in the Eternal City. "... He was a short man, with oblong face, vivid eye and a rather melancholic temperament..." (Fig. 1).

Following the educational customs of his time, Pacchioni initially studied philosophy and only later turned to medicine, demonstrating a natural talent for anatomical dissection. He worked under the guidance of Antonio Vallisneri (1661–1730), Professor of Medicine at the University of Padova and member of the Royal Society of London (Vallisneri is also credited with the first description of the anatomical features of Stein- Leventhal syndrome).

In 1689, after graduating from the University of Reggio, Pacchioni moved to Rome, attracted by the stimulating cultural life and the distinguished personalities operating in the medical field. Here, he first attended the Ospedale di S. Spirito in Sassia and then successfully applied for a position as assistant physician at the Ospedale della Consolazione (May 26, 1690), well known at that time for emergency medicine. As stated by Pacchioni himself, this early experience involved the frequent management of head injuries, which aroused his particular interest in brain coverings.

Thanks to Marcello Malpighi's support, in July, 1693, Pacchioni became the town doctor in Tivoli, quickly gaining popular esteem and approval. Here he spent 6 years under the patronage of the Duke of Modena at the “Villa d'Este,” famous for its wonderful gardens and property. Upon his return to Rome, he collected and published in 1701 his first observations on the structure and function of dura mater in the text De Dura Meninge Fabrica et Usit Disquisitio Anatomica.
As clearly shown by the documents examined, Antonio Pacchioni was a brilliant medical doctor with a great passion for research and a constant devotion to constructive scientific debate, mutual confrontation with colleagues, exchange of experiences, and education of younger colleagues (he often presented candidates in the discussion of their doctoral thesis). Moreover, Pacchioni exhibited a remarkable attention to scientific progress beyond Italy’s borders as shown by the frequent quotation of foreign authors in his works (Willis and Vieuessens among others). Further evidence of his merits is the deferential friendship he shared with great men such as Giambattista Morgagni (1682–1771), Marcello Malpighi, the father of microscopic anatomy (1627–1694), and especially with Giovanni Maria Lancisi (1654–1720), who requested the collaboration of Pacchioni in the preparation of his famous De Motu Cordis et Aneurismatibus (1728) and in the first edition of the Tabulae Anatomicae (1714) collected by Bartolomeo Eustachio (1500–1574).2,5

In 1700, Pacchioni was on the verge of becoming Lancisi’s successor for the Chair of Anatomy at the University La Sapienza, upon the recommendation of Lancisi himself. Sadly, he decided to withdraw — formally in deference to his competitor Giorgio Baglivi (1668–1707), but more likely because the latter was known to be a protégé of Pope Innocenzo XII.7 The year 1705 was a special time in Pacchioni’s life: he was appointed head physician at the ancient Ospedale di S. Giovanni in Laterano, and published the original description of arachnoid granulations in his Dissertatio Epistolari de Glandulis Conglobatis Durae Meninges Humanae.10 He was fellow of several prestigious academies such as the Accademia delle Scienze of Bologna, Accademia de’ Fisiocritici of Siena, and the Accademia Cesareo-Leopoldina de’ Curiosi della Natura of Leipzig; he also attended meetings of the Roman Accademia dell’Arcadia under the pseudonym of “Euforo Craneo” (“attentive observer of the skull”).3,5,7 He was sometimes asked for consultation as a police doctor.12

Precarious health later forced Dr. Pacchioni to accept the less demanding charge of head physician at his favorite Ospedale della Consolazione, where he worked until retirement.2,5,15 He was struck by an undetermined disease of the central nervous system (perhaps a tumor or intracranial hematoma) that caused seizures, a right hemiparesis, and progressive mental deterioration. He was attended to by his most trusted colleagues and his old master Vallisneri. Antonio Pacchioni died in Rome at 62 years of age, on November 5, 1726.5

Pacchioni’s Thought and Works

Despite his extreme versatility, Antonio Pacchioni is best known as an anatomist and a skilled dissector. He made significant contributions to the elucidation of the structure and function of dura mater, not limited himself to gross anatomy, but deeply investigating its fine structure. Following Malpighi’s teachings, he made use of the microscope, an advanced technology of his time, and systematically treated the anatomical specimens by original techniques of maceration into “...strong, sour, salted, sweet, and oily fluids . . .”3

For example, in the Dissertatio Epistolari . . . , Pacchioni pointed out how arachnoid villi swell “...to the size of a millet seed . . .” after dura is “...soaked
In Longitudinali Sinu, immediate sub membranosis expansionibus, in arcolis chordarum Vvilliansanum, quin & supra eadem chordas conficiens funginuere, glandulae conglobate, propra, & tenuissima membrana, veluti in faculo concluxerat, que racematum ut plumum coeunt; raro sparsi in superficie: ha glandulae utrinque ad latera Faldci Messoriae, ab ejusdem apice ad basis visque positi can partem miro propemodum arti-

for a month first into plain water and then into vinegar..." (recommending frequent renewal of the bath in order to avoid smell!).

The interpretation of Pacchioni's brilliant morphological findings was adversely influenced by his adherence to the "iatromechanical doctrine," whereby the function of an organ was merely based on its mechanical activity. Therefore, he believed that dura mater was a special kind of membranous muscle ("musculus sui generis membranaceus"), comparable to cardiac muscle, made up of several layers of fibers and arranged in three bellies and four tendons; its contractions served to squeeze the glands which, in Malpighi's opinion, constituted the cerebral cortex, pushing their secretion along nerve roots.

Among Pacchioni's findings, we recall the description of the tentorial notch (the so-called "Pacchioni's oval foramen"), observation that dural adherence to the inner table is variable in different areas, and especially the discovery of arachnoid granulations. In 1705, Pacchioni dedicated to Professor Luca Schrok (a German colleague from Augsburg) the Dissertatio Epistolaris de Glandulis Conglobatis Durae Meningis Humanae, indeque Oris Lymphaticis ad Piam Meningem productis (Fig. 2). The paper, written in Latin and illustrated with two figures, is remarkable for its scientific rigor, careful report of materials and methods, and frequent quotation of up-to-date international literature.

While exploring the internal structure of the superior sagittal sinus, Pacchioni was struck by those minute globular bodies (which he named "glandulae conglobatae"), each wrapped by its own capsule, clustering on
either side of the sinus (Figs. 3 and 4). Numerous thin filaments, which he thought were lymphatic vessels, seemed to bloom from the "glandulae," running toward the pia on one side and penetrating dural layers on the other. Therefore, he concluded that his "glandulæ" (glands) had the function of secreting lymph to lubricate the sliding movements between brain and meninges during contractions.⁹⁻¹¹

Although these speculations may appear grossly incorrect in the light of present knowledge, new observations seem "to do justice" to Antonio Pacchioni. In a recent study, Go, et al., using enzyme ultracytochemistry, detected Na⁺/K⁺ adenosine triphosphatase activity on cap cells of arachnoid villi; they proposed that this biochemical mechanism could contribute to CSF absorption. This assumption implies a "secretory" component in CSF absorption along with the already widely accepted mechanisms. It is remarkable to note that, if this single observation is confirmed, we may have to look at arachnoid villi not simply as hydrostatic pressure-gated valves, but as actual secreting structures; that is, as glands or "glandulæ," as Antonio Pacchioni suggested three centuries ago.

Acknowledgments

We are indebted to Miss Laura Febraro and Miss Anna Maria Torroncelli for their assistance in the preparation of this manuscript.

References

16. Valliseri A: Istoria della Generazione dell'Uomo e Degli Animali, se sia da' Vermicielli Sperrmatici o Dalle Uova; con un Trattato nel Fine della Sterilità, e de' Suoi Rimedi; con la Critica de' Superfluì e de' Nocivi; con un Discorso Accademico Intorno alla Connesione di Tutte le Cose Create; e con Alcune Lettere, Istorie Rare, Osservazioni d'Uomini Illustri. Venezia: Hertz Gio Gabbriel, 1721, p 146

Manuscript received March 18, 1992. Accepted in final form July 22, 1992.
Address reprint requests to: Andrea Brunori, M.D., Via A. Poerio 33, 00152 Rome, Italy.