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Concealed lung anatomy in Botticelli's masterpieces *The Primavera* and *The Birth of Venus*

Davide Lazzeri
Plastic Reconstructive and Aesthetic Surgery, Villa Salaria Clinic, Rome, Italy

Summary. Sandro Botticelli was one of the most esteemed painters and draughtsmen among Renaissance artists. Under the patronage of the De' Medici family, he was active in Florence during the flourishing of the Renaissance trend towards the reclamation of lost medical and anatomical knowledge of ancient times through the dissection of corpses. Combining the typical attributes of the elegant courtly style with hallmarks derived from the investigation and analysis of classical templates, he left us immortal masterpieces, the excellence of which incomprehensibly waned and was rediscovered only in the 1890s. Few know that it has already been reported that Botticelli concealed the image of a pair of lungs in his masterpiece, *The Primavera*. The present investigation provides evidence that Botticelli embedded anatomic imagery of the lung in another of his major paintings, namely, The Birth of Venus. Both canvases were most probably influenced and enlightened by the neoplatonic philosophy of the humanist teachings in the De' Medici's circle, and they represent an allegorical celebration of the cycle of life originally generated by the Divine Wind or Breath. This paper supports the theory that because of the anatomical knowledge to which he was exposed, Botticelli aimed to enhance the iconographical meaning of both the masterpieces by concealing images of the lung anatomy within them. (www.actabiomedica.it)

Key words: Botticelli, lung, concealed anatomy, Renaissance

Introduction

Alessandro di Mariano di Vanni dei Filipepi (1445-1510), better known as Sandro Botticelli, is one of the most esteemed painters and draughtsmen of the Florentine Renaissance artists. Under the patronage of the De' Medici family, Sandro spent almost his entire life in Florence, giving expression to the lives and thoughts of his fellow citizens better than many other masters of the Renaissance (1-3). In the second half of the 15th century, he was exposed to the resurgence in interest in the human anatomy and in the reclamation of lost medical knowledge from ancient times by Renaissance artists through the dissection of the corpses of executed criminals (4). Indeed, artists of this period were highly interested in discovering and investigating directly the inner structure of the human body in order to attain the lost mastery of the ancient classic artists in representing the human form. Because of strong opposition by the Church, dissection of cadavers was prohibited in this period, and even though Sandro Botticelli became one of the most appreciated artists of the freethinking de' Medici family in Florence a generation before Michelangelo, he was still not openly authorized to explore the human body by dissection (1).

Blech and Doliner (5) report that Botticelli concealed the image of a pair of lungs in his masterpiece *The Primavera*. The present investigation attempts to shed further light on the evidence that he embedded the image of lungs in another of his major paintings, The Birth of Venus. This paper discusses the presuma-

ble intended iconographical meaning of the concealed respiratory anatomy in light of the allegorical interpretations of Botticelli's masterpieces. This paper also discusses the influences in his anatomical presentation and his direct or indirect involvement as an anatomist.

Apprenticeship, formation, and production

Sandro was the youngest of four children of a prosperous Florentine tanner named Mariano. The name "Botticelli" (which means *a small wine cask* in Italian) or "Di Botticello," which was used to refer to the painter throughout his life was acquired from his eldest brother Giovanni, a leather merchant who was nicknamed "Botticello" either as a reference to the barrel that was a sign of his shop or as a reference to his corpulent figure (1-3).

Sandro was apparently of delicate health and was not interested in reading, writing, or mathematics. He always seemed discontent, and his father, on observing his eccentric habits, found him an apprenticeship with a goldsmith. Soon, he found himself in the workshop of Fra Filippo del Carmine (Filippo Lippi) in Florence, described as "*a most excellent painter of that time*" (2), who taught him painting. Influenced by the sculptural style of the great Florentine artists Antonio Pollaiuolo (1431/32-1498) and Andrea del Verrocchio (1435-1488, Leonardo da Vinci's master), Botticelli had his own workshop by 1470.

Botticelli was most productive and created his greatest works of art between 1478 and 1490. Based on to the neoplatonic teachings and influences of Marsilio Ficino (a humanist philosopher who was a reviver of Neoplatonism, 1433-1499) and Angelo Ambrogini, known as Poliziano (an Italian classical scholar and poet, 1454-1494) in the de' Medici entourage, he employed a new mature style that was inspired by a combination of the typical elegant courtly style of painting and the hallmarks derived from the investigation and analysis of classical templates. The consequence of this melting was a style that was simultaneously *nuovo* (new) and *antico* (old), which was depicted for the first time in *The Primavera* (The Spring, c. 1478; Uffizi Museum, Florence) and reached a highpoint in *The Birth of Venus* (c. 1484; Uffizi Museum, Florence) (1,6). During this period, Sandro was also summoned by Pope Sixtus IV to take part in the decoration of the Sistine Chapel in Rome (7).

The artist's performance and inspiration indubitably faded implacably in the last two decades of his life, and by the time of his death, his reputation had already vanished. Overshadowed by the establishment of Michelangelo's and Raphael's style in the High Renaissance period, which Vasari renamed the *modern manner* (2), Sandro Botticelli's reputation and contribution virtually melted away until his rediscovery in the 1890s. At the end of the 19th century, he was greatly acclaimed, especially in England, by the Pre-Raphaelites, who found that he legitimized their style, which combined the sensuous and the immaterial (8).

Embedded lung anatomy in The Primavera and The Birth of Venus

In a mystical environment interpreted as the realm of Venus, as sung in *Le Stanze per la Giostra* by Poliziano (9) and as referred to by the Roman poets Ovid and Lucretius, Botticelli depicted the unfolding of the first spring of the world in the allegorical painting *The Primavera* (Figure 1a). On the right, the painting depicts Zephyr (the blue-faced man on the right), the mythological god who embodies the first wind of Spring, kidnaps the forest nymph Chloris (on his left), and fecundates her with a breath; he later marries her and transforms her into the deity Flora (to the left of Chloris), the elegant woman who can be seen scatter-

Figure 1a. *The Primavera* (c.1478), by Alessandro di Mariano di Vanni dei Filipepi (1445–1510) better known as Sandro Botticelli, tempera on panel, 202 cm × 314 cm (80 in × 124 in) [from the Uffizi Gallery, Florence, Italy]

Figure 1b. The lung-shaped peculiar clefts of the vegetation framing the Venus is compared with a medical illustration of a pair of lungs

ing her flowers all over the world, who is a symbol of spring and its fertility. In the center of the painting, in the middle of two quaint-shaped openings of the vegetation and somehow isolated from the other figures, stands Venus (the woman draped in red), the Goddess of Love, who represents the "Humanitas" (the benevolence), which protects men. Above her, the blindfolded Cupid can be seen shooting one of his phallic arrows of love at the central of the Three Graces, a symbol of Chastity, who are dancing in the left foreground. On the left of the three Graces, Mercury can be seen dissipating the last clouds with his caduceus.

According to Blech and Doliner, *"Botticelli has embedded his biggest secret in the painting, one that is the key to understand the whole work. Looking carefully at the shape, angle, and juxtaposition of the two openings, a very clear anatomical image appears, a pair of human lungs, just as they would appear during an illegal dissection in a secret Renaissance laboratory"* (5) or in a typical Renaissance anatomical drawing (Figure 1b). The masterpiece was interpreted several times throughout the century. Blech and Doliner agreed with the most accepted rendering: the painting is an allegorical *"celebration of the cycle of life that was originally created, according to Judaic and Kabbalistic lore, by ruach HaShem, the Divine Wind, or Breath – the same breath of life that created Adam, the first human"* (5) [Genesis 2:7, *Then the Lord God formed a man from the dust of the ground and breathed into his nostrils the breath of life, and the man became a living being*]. Moreover, Blech and Doliner suggest that the canvas be removed from its frame and the left and the right margins be rolled back to form a cylinder. This view of the painting clearly depicts the cycle of every spring, beginning with the advent of Zephyr that overlaps with the departing of spring with the same cloud-dissipating wind generated by Mercury (in whose month May the season turns to summer). This reveals the hidden allegorical meaning of the cycle of life in which "*the Divine Wind, the Breath of Life, has no beginning and no end*" (5). In the center of the composition, slightly behind the other subjects, Venus is inscribed perfectly between the lung-shaped peculiar clefts of the surrounding vegetation, to highlight again the connection between Love (Heart, Venus) and Life (Lungs, Divine Wind, Breath). Therefore, the sublime allegorical meaning deployed in this painting shows the strong influence of the Humanism and Neoplatonic ideals of the Renaissance in the De' Medici court. The author of the present investigation highlights the position of the upper extremities of all the figures. On the right, the arms of Zephyr, Chloris, and Flora are placed along the body as if to represent the act of expiration; all the figures on the left, starting with the central figure of Venus to the composition the three Graces and then Mercury, have one upper limb outstretched as if they were in the act of inspiring.

Although Botticelli's *The Birth of Venus* (Figure 2a), in which the goddess, already emerged from the sea, is carried out floating on a shell at the seashore, should be the prelude to *The Primavera* story, the painting was depicted a few years later. Again, as in the previous masterpiece, Botticelli's most important

Figure 2a. *The Birth of Venus* (c.1484), by Alessandro di Mariano di Vanni dei Filipepi (1445–1510) better known as Sandro Botticelli, tempera on canvas, 172.5 cm × 278.9 cm (67.9 in × 109.6 in) [from the Uffizi Gallery, Florence, Italy]

source of inspiration was the epic poem *Le Stanze per la Giostra* in which Poliziano described this scene (9). The springtime advent of Venus is depicted, with the God of Winds Zephyr carrying Chloris on the left and blowing with a gentle breeze Venus, the Goddess of Love, ashore. As the legend narrates, when Venus was born from the foam of the sea, a rosebush blossomed on land. Therefore, the rose became a symbol for Venus, who are created from Zephyr's warming breath and fall to the earth. On the right, the white floral dressed Goddess of Spring, Flora, displays the flowered mantle that the goddess will wear. The subject is the same as that in *The Primavera*, and the Divine Wind or Breath theme is repeated again to celebrate the cycle of life. Although there are different interpretations about the allegorical meaning of this work, no scholar has focused entirely on the shape of the mantle and its meaning. With the aid of a computer program, the figure of Flora was removed and the mantle virtually reconstructed, revealing its shape to actually represent that of a lung (Figures 2b). Indeed, the cloak is portrayed in its typical roughly cone-shaped form with the superior end forming the tip of the cone and the inferior end forming the base. The lack of a lateral indentation that usually accommodates the heart may suggest that it represents the right lung, but according to the previous lung imagery embedded in *The Primavera*, it is difficult to confirm which lung it is. The color of the mantle is dark pink/pink-grey, and it is a near-rendering of that of the normal pulmonary parenchyma. Computer-assisted removal of the flowered pattern makes the color more conventional and further highlights the similarity with the shape of a lung (Figure 2b). The irregular and almost odd ripple of the mantle margin just above the left hand of Flora may not have been accidentally depicted by Botticelli. It resembles the hilum of the lung, the entry point for the root of the lung, including the bronchi and pulmonary vessels, enclosed by a reflection of the pleura. The resemblance becomes evident when the embedded image is compared with that of a medical illustration of a lung (Figure 2c). While the similarity may be accidental, it probably does imply that Botticelli intentionally tried to use his knowledge of the macroscopic anatomy and function of the lung in depicting the shape and color of Flora's mantle.

Figure 2b. Computer-assisted removal of the figures of Flora showing lung shaped mantle of the Goddess. The removal of the flowered pattern made the color more conventional and similar to that of a lung

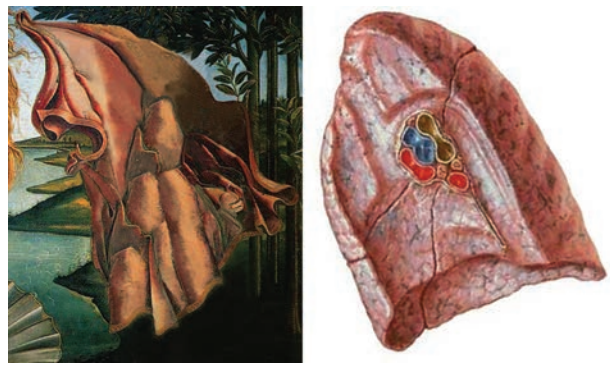

Figure 2c. The lung-shaped mantle in *The Birth of Venus* is compared with a medical illustration of a lung

When this masterpiece is also curled into a cylinder by making the two edges (the lung as the origin and end of the breath and Zephyr as the creator of the breath) overlap each other, the allegorical meaning is the same as that of *The Primavera* – the Divine Wind, the endless Breath of Life, with no beginning and no end. Again, the underlying neoplatonic meaning is clear: similar to *The Primavera*, this work celebrates the birth of love and spiritual beauty as the driving force of life generated by the Divine Wind or Breath of Life.

Botticelli and anatomy

Major scholars of Botticelli agree that his work progressively showed elements of Leon Battista Alberti's treatise entitled Della Pittura (1,6), which was a

doctrine about paintings in the early Renaissance. The main example is the portrait depicting the martyrdom of *Saint Sebastian* (1474) in which "*the structure of bone and muscle that underlies the flesh is emphasized to display Botticelli's knowledge of anatomy*" (1). In his other two works, too, Mars (*Venus and Mars*, 1483) and the Centaur (*Pallas and the Centaur*, 1482) are portrayed as heavenly, muscular males. Although Botticelli did not share Pollaiuolo's passion for anatomy (1,2), like all the other artists of that period, it is likely that he was involved in or at least exposed to the resurgence in interest in anatomical knowledge by direct dissection of cadavers.

Indeed, at that time, Italian Renaissance artists considered it a necessity to become anatomists, in their attempt to produce a more life-like, sculptural portrayal of the human body, as "…*having seen human bodies dissected one knows how the bones lie, and the muscles and sinews, and all order of conditions of anatomy*…" (2). According to the new Renaissance wave, art should not just be a copy of the classic nudes of antiquity, but a bearer of a new spirit for which anatomical dissections were crucial to better reproduce the body, its movements, and functions as well as its supporting structures in art (4). The reformation of art teaching was so drastic that courses on anatomy became mandatory at the Academy of Art, and the Florentine academy was the first to allow artists-in-education to use cadavers and skeletons. This led to the formation of the Florentine Guild of Physicians and Apothecaries, which was composed of artists with medical knowledge obtained during public anatomy lessons (4,10,11). With the exception of a few artists who performed actual dissections independently against the strict laws of the Catholic Church, despite the limited number of cadavers available, most artists attended public autopsies carried out by physicians who were already trained in the craft of dissection (4,11-13).

There are very few details about Botticelli's life as an anatomist. Unlike Michelangelo Buonarroti (1475-1564) and Leonardo da Vinci (1452-1519), who acquired their vast understanding of human anatomy by constantly performing cadaver dissections independently, there is no written record of human or animal dissection or anatomical drawings in any of Botticelli's biographies (1-3,6). Therefore, it is most likely that Botticelli participated in public demonstrations of the human anatomy during his career, probably orchestrated by the Averroist physician-philosopher Elia del Medigo, who worked in Lorenzo de' Medici's circle, which Sandro joined early in his life (1,4,13). In his Lives of the Artists, Giorgio Vasari stated that Antonio del Pollaiuolo (1431/32-1498) was the "*first master to skin many human bodies in order to investigate the muscles and understand the nude in a more modern way*" (2). Del Pollaiuolo's contributions to Florentine paintings lay in his analysis of the human body in movement or under conditions of strain. It is known that Sandro was a student of del Pollaiuolo, and it is possible that he was highly influenced by him and most likely exposed to anatomical knowledge imparted during cadaver dissections by del Pollaiuolo.

Botticelli might have been aware of Leonardo's extensive collection of anatomical drawings (>750) (14), given their good friendship and mutual admiration, and may have studied his works carefully. Indeed, it is known that Sandro, who was 8 year older than Leonardo da Vinci, became intimate friends with da Vinci in the early years of his career, when he was already distinguished for his genius, and some features of da Vinci's early art may have been of interest to Botticelli (1,2). Even though the temperament and personality of their art was substantially different in many aspects, both artists were alike in their unwavering attempt to pursue the ideal beauty and to give expression to the inner life of the soul. They definitely had a reciprocal influence on each other, but the precise nature and degree of that influence can only be speculated upon.

Botticelli and pulmonary diseases

Interest in a disease or an organ may arise from personal episodes or peculiar situations in an artist's life. As elegantly reported by Eknoyan, the renal disease that Michelangelo suffered from influenced not only his life in terms of progressive health impairment, but also become an obsession in his poetry, correspondence, and paintings, which contained explicit, subliminal, or hidden references to the anatomy of the kidney and stones (4).

Sandro Botticelli's major biographies did not narrate about any disease, especially in the years before

and during the depiction of his two masterpieces. However, the choice of models in his painting may reveal some useful information.

Simonetta Cattaneo Vespucci, called La Bella (the beauty) Simonetta, was a beautiful young noblewoman of Florence at the time of Botticelli, who portrayed her several times in his works. She contracted pulmonary tuberculosis and died without bearing any children at the young age of 22 years, in 1476. She was an inspiring muse to Botticelli, who idealized her renowned beauty by rendering the courtly ethereal figure of mythical and literary constructions that he needed for his paintings. Although *The Primavera* and *The Birth of Venus* were painted 2 and 8 years before her death, respectively, Botticelli adopted Simonetta's face for the central of the Three Graces and, above all, for Venus in her birth. It is possible that Botticelli was obsessed by tuberculosis and lung diseases because of their significance in the life of his muse who passed away at a young age. Although there are some accusations of sodomy and homosexuality, Botticelli was most probably secretly in love with his muse Simonetta, because he asked explicitly to be buried, 34 years after her death, in the vault of the Ognissanti Church in Florence, beside her.

Pulmonary anatomy and physiology at the time of Botticelli

To support the hypothesis herein reported, it is worthy to consider the level of understanding of the anatomy of lungs and their function at the time of Botticelli's working years.

The philosophical and medical teachings of Aristoteles (384/383-322 B.C.) and Galen (129-c. 200/c. 216 AD) regarding the anatomy and function of the organs influenced for centuries the thoughts of medical investigators and were considered almost incontrovertible dogmas (15). The Church played a primary role in this, as prohibiting any form of dissection or investigation into the inner organs elevated the consideration of the human body as an object of divine mistery. With this doctrine, the Church banned representations of perfect bodies of the human and mythological figures, thus avoiding the risk of the birth of any kind of spiritual recidivism and pagan idolatry. Although the resurgent Renaissance interest in new knowledge of the anatomy including the lungs and the respiratory system resulted in innumerable discoveries and results through anatomical observation, all the previous beliefs were swept away with difficulty (15). Indeed, Renaissance scientists deciphered the function or at least the connection between the lungs and respiration and consequently their importance in survival and breathing, but the basic ideas of the new anatomical information were still entrapped in the notion of maintaining the balance (for example, the lungs had to maintain the balance of the human body by counteracting the temperament of the heart) and empiricism of the ancient medical authorities. Early Renaissance progress in knowledge was limited because a galenic *pneuma*, a sort of hidden energy coursing throughout the body, was still considered as the source of life, and there was still a lack of understanding regarding the primary role of oxygen as a chemical element. It should however be reported that the role of the lung as a purifier was well understood. In particular, Leonardo da Vinci annotated in his notebooks: "*From the heart, impurities or 'sooty vapors' are carried back to the lung by way of the pulmonary artery, to be exhaled to the outer air*" (15). Moreover, the macroscopic anatomy of the lung was quite well investigated, based on Leonardo's conclusion that "*The substance of the lung is dilatable and extensible like the tinder made from a fungus. But it is spongy and if you press it, it yields to the force which compresses it, and if the force is removed, it increases again to its original size*" (15).

Discussion

The debate about the commissioners of *The Primavera* and *The Birth of Venus* is still without answer because of the absence of documents associated with the painting. Botticelli was most probably commissioned to paint the works by the less famous branch of the de' Medici family, specifically Lorenzo di Pierfrancesco de' Medici, as a wedding gift (6). In the 1550 edition of Life of Artists, Vasari was the first to identify both paintings, which were described as being exposed together at the de' Medici villa in Castello (2).

Why should these two masterpieces of Botticelli be of interest to health professionals? The author spec-

ulates that having used for both canvases the allegorical theme of the Divine Wind or Breath of Life, mostly influenced and enlightened by the neoplatonic philosophy of the humanist teachings in the De' Medici's circle, Sandro Botticelli embedded lung imagery in the iconographically critical *The Primavera* and *The Birth of Venus*. There is no record stating that Sandro performed cadaver dissection independently, participated in public autopsy, or developed a passion for practical anatomy. In some figures such as Saint Sebastian, Mars, and the Centaur, Botticelli showed evidence of interest in the rendering of muscles and supporting structures as inspired by human anatomy seen during dissection, shown in a magnified manner by Michelangelo and Leonardo in their works. The scenes of both paintings discussed herein are highly idealized, and the style of depiction is spiritual and philosophical rather than anatomically driven. There is also a certain discrepancy between the weightless and intangible figures portrayed without shadow (absence of material concreteness), whose feet are not touching the ground but are immersed in a mythological atmosphere, and the possible embedded anatomic imagery that is mostly a symbol of a more materialistic practice such as dissection; however, this is no good enough reason to ignore the anatomical inclusions.

This investigation is not the first to highlight possible concealed anatomical imagery in Renaissance works. In 1990, Meshberger asserted that Michelangelo concealed the image of the brain in *The Creation of Adam (*16). Later on, Eknoyan (4) argued that in the *Separation of Land and Waters*, Michelangelo incorporated the image of a bisected right kidney in the mantle around God. Finally, Suk and Tamargo presented evidence that Michelangelo embedded further neuroanatomic structures in the *Separation of Light From Darkness*, specifically, a ventral view of the brainstem and perisellar and chiasmatic regions (11). Luccarini and colleagues (17) interpreted the shape of the robe of God in *The Creation of Adam* as a post-partum uterus with adjacent anatomical structures, and this was supported by the later paper by Di Bella and coworkers (18): both groups of researchers agreed that Michelangelo concealed the rendering of the birth of mankind. According to Ambrogi (19), Piero della Francesca (1415-1492) depicted in two paintings the necklace of coral beads of the infant Jesus following the anatomy of primary and secondary divisions of the lower respiratory system with the trachea, the main and the lobar bronchi. These findings, corroborated by strong supporting evidence from analyses of the artist's life, diseases, production, and influences, are gaining the assent of art historians. Recently, Blech and Doliner (5) reported a concealed image of a pair of lungs in *The Primavera*, which inspired the author of the present investigation to conduct a systematic research on Botticelli's production, with successful findings.

In the present investigation, the author speculates about the depth of Sandro Botticelli's anatomic knowledge and influences in this field, because there is no written record of human or animal dissection or anatomical drawings in any of Botticelli's biographies (1-3,6). Given his friendship with da Vinci, Sandro may have been aware of Leonardo's extensive collection of anatomical drawings and may have been exposed to the resurgent Renaissance interest in the anatomic knowledge of the time. Although the author admits that his interpretation may be provocative and may be desecrating the ethereal and mythological atmosphere of the work by relying on a sublime allegorical meaning, the anatomic incongruities in Botticelli's masterpieces cannot be accidental and the striking similarities between the paintings and the anatomical details require a deeper analysis. *The Primavera* was so accurately planned and faithfully realized that more than 500 plant species with about 190 different flowers have been identified within the painting (20), and it would be almost offensive to think that Botticelli left to chance the shape of the vegetation openings framing Venus, who is the main subject of the canvas. The same applies to the shape of the mantle and its wrinkles in *The Birth of Venus*. In addition, both allegories rely on the celebration of the cycle of life originally generated by the Divine Wind or Breath, and the embedded lung imagery seems to apparently enhance and reinforce the iconographical meaning.

Conclusion

Art history is characterized by disputes about the attributions and meanings of artists because the inter-

pretation of an artist's intention is speculative, unless there are written documents that reveal the real intention of the masters. Therefore, art historians need to sustain their theories with circumstantial proof supported by experience and cumulative analyses, as do professionals in the medico-artistic field.

The above interpretation of Botticelli concealing elegant lung imagery in his masterpieces is personal and speculative and will remain unproved because of the lack of clear documentation, but according to the available evidence, it should be considered plausible in the least.

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Correspondence:
Davide Lazzeri, M.D.
Plastic Reconstructive and Aesthetic Surgery,
Villa Salaria Clinic, Rome, Italy
E-mail: davidelazzeri@gmail.com