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THE HISTORIC STRUGGLE FOR DOMINANCE BETWEEN THE HEART, LIVER, AND BRAIN

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Abstract

Throughout history, people have always attempted to rank objects in order of their importance. The same is true for the organs of the human body. This compulsion to apply order to nature has resulted in interesting theories to explain peoples' beliefs about the relative importance of a particular organ over another. Three organs have stood out in time as the principal players in the body: the heart, the liver and the brain. Each has its supporters and detractors as well as some interesting claims regarding their roles in life.

The heart has always been considered a vital structure but it was Aristotle that really pushed for its supremacy. He thought it was an intelligent organ whose position at the centre of the body made it important. Organs such as the brain and lungs existed simply to cool and cushion it; the source of heat in the body. Galen disagreed with this notion. He argued that the liver must be the primary organ of the body because of its role in the production of the humours, which were the basis of health at that time. Its huge size also helped in its play for the top. In contrast, the brain has had a rough ride over the centuries. Initially thought to be a source of phlegm, it was not until relatively recently that its true complexity has been appreciated. Even today, we have barely scratched its surface.

The interesting thing is that, in spite of this debate over their importance, all organs are essential to life, making them all equally important. Except for the spleen of course; we can all live with out that useless mass!

The human need to categorize and rank objects has been a constant throughout our history. This fact is especially true of the body, which is unusually complicated. People have attempted to understand and apply order to our inner workings since the first dissections. This application of structure to the systems of the body, on reflection, is not

logical. Clearly, there can be no hierarchy of organs because without any we would not survive, making them all equally important. Therefore, it is a curiosity that scientists and philosophers have debated for centuries the merits of each organ and their relative place in the biological chain of command. Three organs in particular have stood out in time as the most critical: the heart, the liver and the brain. This paper will attempt to provide a brief overview of the rise and fall of each of these organs along with their main proponents and the theories used to support their importance.

The Heart

The heart has been a prominent organ throughout history. Only the size of a fist, it has been central to human existence and a powerful symbol. The Egyptians were cardiocentrists who treated the heart with reverence during their embalming rituals (French 1978). They believed it was the seat of intelligence, emotion and sensation (Findlen 1998). These beliefs were built upon by subsequent cultures. The Greeks advanced the field of medicine and anatomy greatly and had many theories that supported the pre-eminence of the heart. Hippocrates of Kos (460-370 BC) believed that the heart was so richly supplied with fluid that it did not suffer harm or manifest pain (Acierno 1994). This fluid, blood, was directly associated with life in ancient times and so it was thought that the heart was protected by its ample supply.

The Greek physician Aristotle (384-322 BC) was the primary supporter of the heart as the most important organ of the body (Van Praagh 1983; Findlen 1998). He based this belief on a number of observations. For example, he found that the heart was the first organ to emerge in his studies of chicken embryos (Clarke 1963). He reasoned that since the heart was at the centre of the body, a place of honour, it must be important (French 1978). He theorized that its location allowed it to communicate with and control other organs and, therefore, was most suited to being the seat of the soul (French 1978). Aristotle believed that other organs, such as the lungs and brain, existed simply to cool and cushion the heart (French 1978). As a firm cardiocentrism, he supported the idea that the heart was the root of intelligence and believed that it was the source of nerves in the body (Findlen 1998).

Galen of Pergamum (129-216 AD), another Greek physician, agreed with Aristotle on many points. Galen concurred that the heart was responsible for heating the body and that it was the organ most likely to contain the soul (Findlen 1998). He wrote that "The heart is a hard flesh, not easily injured. In hardness, tension, general strength, and resistance to injury, the fibres of the heart far surpass all others, for no other instrument performs such continuous, hard work as the heart" (Findlen 1998). Despite this high praise, Galen believed that the liver, not the heart, was the true master of the body (discussed below).

As the teachings of Aristotle and Galen grew in prominence throughout medieval times, people began to explore the discrepancies between their points of view. Avicenna (980-1037 AD) attempted to integrate the ideas of Aristotle and Galen. He tried to support Aristotle's position on the primacy of the heart using Galen's physiologic principles. He wrote in his book, *Canon of Medicine*, that "The heart is the root of all faculties and gives the faculties of nutrition, life, apprehension, and movement to several other members" (Acierno 1994; Findlen 1998). He maintained that it was an intelligent organ that directed all others and that it generated the innate heat of the body (Findlen 1998).

With advances in anatomy in the sixteenth and seventeenth centuries the true role of the heart became apparent. William Harvey (1578-1657 AD), an English physician, is credited with being the first to describe the circulation of blood around the body. In his book, *On the Circulation of the Blood*, he described how the heart's chief role was to pump blood through an intricate series of vessels (Khan 2005). This helped end the notion that the heart was intelligent and directed the functions of other organs. However, Harvey continued to refer to the heart as the "king" or "sun" of the body (Findlen 1998). He also maintained that the heart was the seat of emotions and did not challenge its metaphysical role (Findlen 1998). Indeed, to this day the heart remains a symbol of the soul and of emotion and the stylized heart symbol evokes images of love and passion (McDonell 2007).

The Liver

The liver has long been considered an important organ due to its mass, warmth and location in the body (Chen 1984). The equivalence of the soul and the liver was widely held in ancient cultures, largely due to its association with blood (Chen 1984). Warm blood meant life, and its absence, death (Chen 1984). It was believed that the liver made blood and it was therefore assumed to be a primary organ (Chen 1984). The idea that the liver was the repository of life is pervasive throughout ancient writings. The word "liver," or "hepar" in Greek, was often substituted for "heart" in ancient Greek poetry (Chen 1984). For example, the phrase "hit in the liver" is comparable to the modern phrase "struck in the heart," meaning to mortally wound someone (Chen 1984). Interestingly, Berber brides would accept marriage proposals with "you have won my liver," demonstrating an association between the liver and the soul (Chen 1984).

In terms of proponents for the liver as the principal organ in the human body, Galen was by far its biggest supporter. He based this theory on several findings. He observed that it was the first organ to form in the human fetus, concluding it must therefore be the most important (Findlen 1998). The importance of humours in Galen's time also supported his case for its superiority. Humourism was a theory to explain the workings of the human body based on a balance between the four humours: blood, black bile, yellow bile and

phlegm (Chen 1984). Since the liver and its associated organs, the spleen and gall bladder, produced three of the four humours, Galen surmised that it must therefore be the most important (Findlen 1998). For Galen, in contrast to Aristotle, the liver was the source of the veins and it was connected to the heart only so that the blood could mix with the heat of the heart (Chen 1984; Findlen 1998). Throughout the Middle Ages, the liver consolidated its grip on power. It was acknowledged by physicians as the seat of the nutritive faculties and critical to life as the primary centre of sanguification (Findlen 1998).

The liver's reign came to an abrupt end in the seventeenth century with the identification of the lymphatic system. Up to that point, it was assumed that the lymph fluid, chyle, travelled to the liver where it was turned into blood (Chikly 1997; Findlen 1998). However, when Thomas Bartholin (1616-1680 AD) published his book, *Lymphatic Vessels*, in 1653, it became clear that lymphatic vessels do not travel to the liver and therefore the liver could not convert chyle into blood (Chikly 1997). Bartholin declared the "end of the liver's role as ruler of the abdomen" and the "death of the sanguine empire" (Chikly 1997; Findlen 1998). It was clear following this discovery that the liver produced bile not blood. The liver remained a pre-eminent organ for many centuries and only with the development of anatomy was the soul transferred to the heart and then to the brain (Chen 1984). Even after the fall of its empire, the liver remained a "noble" organ (Findlen 1998).

The Brain

Unlike the heart and liver, the brain's importance was not clear from the start. Ancient physicians had conflicting views over its role and significance. The Egyptians were the first to provide systematic medical writings regarding the brain (Finger 1994). The Edwin Smith *Surgical Papyrus*, which dates back almost five millennia, is the oldest known medical text and contains the first written recording of the word "brain" (Minagar 2003). However, the Egyptians treated the brain with complete indifference, viewing it as unimportant "cranial stuffing" (Finger 1994; Findlen 1998). It was common practice at death to scoop the brain out of the nostrils and discard it (Finger 1994). Most other organs, including the lungs, liver, kidneys, and especially the heart, received far better treatment at mummification (Finger 1994).

Greek medical theories, based on the four humours, gave new insight into the role of the brain but there remained disagreement over its function. Hippocrates believed that the brain was the control centre of the body, responsible for thought and emotions (Finger 1994). The brain was believed to be the source of phlegm, the humour associated with calmness and apathy (Finger 1994). Linking higher functions with the brain was the first major shift away from the cardiocentric model, but it was not to last. Aristotle

maintained that the heart was the seat of intellectual functions (Acierno 1994; Finger 1994). He argued that since the brain was cool, not warm like the heart, it could not be responsible for thought as warmth was equated to life (Acierno 1994; Finger 1994). Aristotle believed that the brain, being so cool, was instead responsible for tempering the heart (Clarke 1963; Finger 1994). He explained the large size of the brain in humans relative to animals was due to the fact that we are warmer than other creatures (Finger 1994). In contrast, Galen backed the idea that the brain was responsible for cognition (Freemon 1994). He rejected the idea that the brain existed simply to cool the passions of the heart for a number of reasons (Finger 1994). For example, he reasoned that if the brain was indeed designed to cool the heart, then it would be located closer to it (Finger 1994). Galen presumed that the brain was the termination point for the five senses, whose information was organized and interpreted in the *sensus communis*, the origin of “common sense” (Freemon 1994). However, Galen discounted the idea that the convolutions of the brain were associated with intelligence, as Erasistratus had proposed centuries earlier (Finger 1994; Wills 1999). Erasistratus thought that the complexity of the convolutions, relative to animals, helped to explain our intellectual superiority to them (Finger 1994; Findlen 1998; Wills 1999). Galen pointed out that other animals, such as donkeys, have exceedingly complex brains even though they are remarkably stupid animals (Finger 1994). However, despite his rigorous defence of the brain’s role in intellect, Galen maintained that the liver was more important due to its role in humour production.

With the growth of anatomy in the Middle Ages and the Renaissance, the true role and importance of the brain began to emerge. Much focus fell on the ventricles, of which three were identified: anterior (associated with imagination), middle (linked to reason) and posterior (connected with memory) (Finger 1994; Findlen 1998). Despite the large advances made in the description of the brain, the Middle Ages failed to enhance the explanation of its function. The anatomical exploration of the brain culminated in the studies of Thomas Willis (1621-1675 AD). He translated cadaveric brain anatomic features into assigned behavioural and physiologic functions (Grand 1999; Molnar 2004). He also made extensive comparisons between the human brain and the brains of lower animals, helping to explain the differences in their intellects (Grand 1999; Molnar 2004). Willis’s theories laid the foundations of neurology and established the brain as the centre of intelligence. From this point on, the brain played second fiddle to no organ. Its primacy over the others was entrenched and would last for centuries. Only in the modern era has the interconnectedness of all organs been appreciated. We now realize that it is DNA, not individual organs, that truly directs the body and its functions.

Conclusions

The histories of the heart, the liver and the brain are intricately intertwined. Physicians have long attempted to identify their function and rank their importance. However, the debate over which organ is supreme is futile, since without any one we would not survive. The one exception to this rule is the spleen, which one can happily live without, albeit with an increased risk of sepsis. The human need to categorize has driven science and medicine forward but has, in many ways, hampered our ability to see the truth in certain instances. It is apparent now that all organs play a vital role in the body and improving health will only come from understanding the functions of each. However, this point is likely lost on most medical specialists, who passionately support the organ of their profession!

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