

Heart in anatomy history, radiology, anthropology and art

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Background: Anthropologic, artistic and medical significance of heart inspired us to undertake this multidisciplinary study.

Materials and methods: Amongst the 24 obtained echocardiograms and phonograms, 1 was used for a Photoshop processing. In addition, over 20,000 artwork reproductions were examined in this study.

Results: Artistic and symbolic presentation of heart started some 15,000 years ago. First heart models were made by the Egyptian and Olmec civilisations. Ancient cultures regarded heart as the seat of the soul, spirit and intelligence. First anatomical and artistic images of heart were created by Leonardo da Vinci in the 15th century, and first wax models by the Italian anatomists in the 17th century. Mediaeval religious symbolism of heart was replaced in the Renaissance and later on mainly by its role in the romantic love. Anatomical heart art continued in the 18th and 19th centuries through the works of Sénac, Cloquet, Hirschfeld and Bourgeroy. Some modern artists, such as Dalí, Kahlo, Rivera, Warhol, Ivanjicki, Vital, Kober and Mastrova, created the anatomical heart images or sculptures, whereas some others, such as Duchamp, Klee, Miró, Matisse and Dine, presented heart symbol in their artworks. New radiologic technologies produce fine images of heart, some of which are similar to the works of modern artists.

Conclusions: Heart biology and symbolism have had a tremendous influence on our culture, including art and medical sciences. New radiologic techniques and computer technology have produced such images of heart, which substantially improved diagnosis, but also enhanced the heart aesthetics. (Folia Morphol 2014; 73, 2: 103–112)

Key words: anatomy, anthropology, culture, fine art, heart, history, radiology

INTRODUCTION

Human *heart* (Sansk. *krd*; Gr. *kardia*; Lat. *cor*; Ital. *cuore*; Fr. *coeur*; Ger. *Herz*; Pol. *serce*; Serb. *srce*; Rus. *сердце*) has been in the focus of attention from the ancient times to the present day [13, 47, 65]. The heart was, and still is, of tremendous biological,

symbolic, artistic, mythological and religious significance [6, 9, 25, 52]. Due to a shortage of literature in some of these domains, the aim of our study was to present the heart from the anatomical, radiologic, anthropologic and artistic aspect.

MATERIALS AND METHODS

In this study we have used the heart symbol, certain radiologic images, and a large body of literature.

Seven compositions with the heart symbol were created and photographed, and 1 of them has been included in this study. Twenty-four echocardiograms and phonocardiograms were collected from the Department of Cardiology. One of them was selected for processing in Adobe Photoshop C4 Extended.

In addition, over 20,000 reproductions of the artworks and more than 300 artistic and scientific publications were examined. The reproductions were used to find heart drawings, paintings, installations or sculptures. The literature enabled us to write corresponding descriptions and give certain explanations in the present study.

RESULTS AND DISCUSSION

First we have presented a short history of the heart anatomy, symbolism and art, and then its significance in modern art, anthropology and radiology.

A short history

The heart art started some 15,000 years ago, when our Palaeolithic ancestor made a drawing of a mammoth's heart on the wall of the Pindal cavern in Spain [64]. This hunter was intelligent enough to realise that heart is a vital organ, which should be struck by an arrow to kill the animal and thus to provide food for his survival. Moreover, his abstract thinking was so developed [35], that it enabled him to select and present the crucial outlines of the anatomical image of heart (Fig. 1). In this way, the Palaeolithic man designed the first heart artwork and, at the same time, the first symbol of heart.

Ancient civilisations, such as the Egyptian and Mesopotamian, accepted heart as a vital organ, but also as a centre of the body and personality, which houses the soul or spirit, the will, understanding and conscience [9, 59]. At the same time, the Edwin Smith Papyrus of 1,700 years BC mentioned heart as the centre of distributing system of pulsating vessels [59]. It is obvious that the concept of heart was a compilation of anatomy, function, art, mythology, religion and early philosophy. This is why heart, such a crucial organ, was the only one to be left inside the mummies of the pharaohs in order to enable them an afterlife in the Osiris' Kingdom of Eternity. As an additional help in the underworld, the Egyptians designed numerous heart amulets, which shape passed later into the hieroglyphic system [59, 64]. Later on, the Olmec civilisation in the

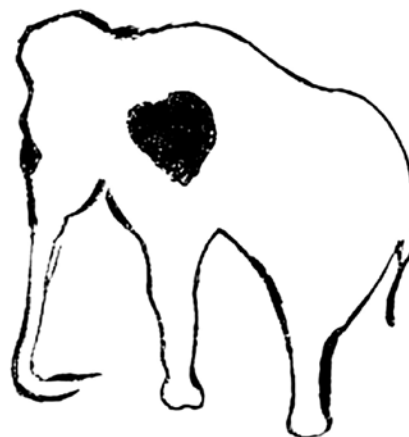


Figure 1. Cave drawing of a mammoth's heart (from: Singer C. A Short History of Anatomy from the Greeks to Harvey, Dover Publications, 1957; credit: Dover Publications Inc.).

Meso-America also modelled the heart, usually as clay figures of a man holding a heart [3]. The ancient Jewish did not present the heart, but they created one of the most beautiful love poems, the "Song of Songs", written in the Old Testament.

Ancient Chinese considered heart as the source of intelligence [52]. In addition, physiology of heart was surprisingly well-known to that civilisation. Huang Ti of the 26th century BC, father of Chinese medicine, stated that "all the blood of the body is under the control of the heart", and that "the heart is a king, who rules over all organs..." [55]. Probably a similar situation was with Hindu civilisation.

Ancient Greeks appreciated beauty of the human body, but not of the internal organs. The philosopher and scientist Alcmaeon of the 5th century BC, who dissected animals, was more interested in brain and some other organs than in heart [14]. Empedocles in Sicily regarded heart as the centre of the vascular system, but also of the *pneuma* (the Greek *pneuma* for breath and soul) [65]. Hippocrates described heart as a muscular organ with 4 cavities [55]. The ingenious philosopher and scientist Aristotle, contrary to the view of Alcmaeon, Hippocrates, Pythagoras and, later on, of Herophilus and Erasistratus who believed in the 'encephalocentric' theory, accepted the mentioned 'cardiocentric' theory, i.e. the heart as the seat of life and intelligence. Aristotle, who was the first to mention the aorta, considered "the heart the first to live and the last to die" [64]. Herophilus of the 3rd century BC attributed the pulsation of arteries to the beating of heart, whereas his contemporary Erasistratus regarded heart as a pump, which distributes the vital spirit through the arteries. The famous Roman physician Galen of the 2nd century AD

also believed in the latter theory. Nevertheless, Galen's compatriots respected the god Cupid or Amor (Gr. *Eros*), whose arrows compelled love and desire in the heart of a shot person [25].

The Middle Ages showed a decline in science and, based on the Church dominance, a devotion to the Lord, Christ and the Virgin. This is why heart was rarely presented in the early Christianity, for example in 2 crude drawings stored now at the College in Cambridge and in the library of Oxford University [55]. At the same time, the Arab scholars, including the famous physician Avicenna in the 11th century, relatively correctly described the heart and discovered the pulmonary circulation [55]. Although drawing of the human body was forbidden by the Quran, the Persian physician Mansur ibn Ilyas managed to publish the first colour atlas of anatomy [34]. Heart, which according to the Islamic doctrine surrounds the spirit, was presented as a pine-shaped organ in this book. The progress in European anatomy was started only in the 14th century by Mondino de Luzzi. However, first drawings of dissections showed a scattered heart and other organs [55].

At the same time, some Meso-American civilisations, especially the Aztecs and the Maya, performed bloody rituals with human sacrifices. Thousands of their war prisoners were sacrificed by having their hearts ripped out from the chest. As shown in some Aztecs' illustrations, the victim's heart was flung skyward to honour the god of sun [56].

In addition to its crude anatomy, heart in the mediaeval times was described or presented in 3 domains: romantic love, religion and superstition [47, 71]. The pine-shaped heart with a rounded base was depicted in the 13th century as an illustration of the French poem "Romance of the Pear" [71]. On the German casket "Minnekästchen", a young man was shown presenting his heart to Lady Minne, the German Goddess of Love. The Italian poem "Documenti d'amore" by Francesco Barberino showed Conscientia holding a heart in her hands. This was one of the first scalloped hearts in the art with a fold in the base where normally the aorta and pulmonary trunk take their origin.

Heart was also considered as a source of religious love: God's love reaches the believers through their heart, as shown later on in the beautiful sculpture "The Ecstasy of St. Teresa" by Bernini in St. Peter's Cathedral in the Vatican [68]. The flaming heart, usually with a cross and a wreath of thorns, suggested the utmost religious fervour [18]. Religious symbolism inspired the brilliant Italian fresco painter



Figure 2. 'Cardioperforation' as a metaphorical 'vampire destruction'.

of the 14th century, Giotto di Bondone, to depict the personification of virtue Caritas, or Divine Love, who offers her heart to the Almighty in a mural in the Arena Chapel in Padua [71].

Superstition was very expressed in the Middle Ages. People were scared of devils, witches and, later on, of vampires and similar magical and powerful supernatural beings, which were a frequent subject of the fine art [9, 49]. It was believed, amongst other things, that witches, beautifully presented later in several paintings and "Caprichos" by Goya [24], are heart eaters, and that the vampires used to suck the blood of their victims, as shown in a fine artwork by the expressionist Edvard Munch [45]. Pagans, but including Church authorities, were convinced that vampires or devils can be destroyed by presenting the crucifix or by staking through their heart as shown in Delacroix's painting "St. Michael Defeats the Devil", and in our image (Fig. 2).

A revolutionary breakthrough in the heart art was made in the 15th century by the ingenious Renaissance artist and scientist, Leonardo da Vinci [48, 58]. He made both artistic and anatomical illustrations of heart, including the valves, papillary muscles and coronary arteries. The most distinguished anatomist of that time, Andreas Vesalius, presented illu-

strations of heart in his book “De humani corporis fabrica”, which are correct anatomically, but less valuable artistically [62]. Berengario da Carpi gave an excellent description and good illustrations of the heart interior [19]. It was the same case with Bartolomeo Eustachio in the 16th century [55]. Volcher Coiter examined and illustrated living heart in various animals, whereas Giulio Caserio of the 17th century made fine illustrations of heart and large vessels. William Harvey described the function of heart and circulation.

An original kind of art was started by Italian anatomists and artists in the 17th century, who made wax models of heart and other organs (Fig. 3). Many specimens reached a high aesthetic value, as can be seen in the “La Specola” museum in Florence [16].

The religious heart symbolism was also present in the humanistic period and later on. The artists, such as Phillipe de Champaigne, depicted the flaming heart. Some others, like Pompeo Batoni and Odilon Redon in the 19th century, presented the sacred heart of Christ, which metaphorically spreads love all over the world [18].

Heart as a symbol of romantic love equally attracted artists, writers, composers and public. Thousands of poems, novels and compositions were written on the loving or suffering heart, from the Petrarch’s “Sonneti d’amore” in the 14th century and Shakespeare’s “Romeo and Juliet” in the 16th century, to Beethoven’s “For Elise”, Baudelaire’s “The Flowers of Evil” and Tolstoy’s “Anna Karenina” in the 19th century, and many others in the 20th century [2, 63, 67].

Anatomical art continued through the post-Renaissance period and the following centuries. Beautiful illustrations of the surface and internal anatomy, coronary arteries, conducting system and other structures of heart were depicted in the 18th and 19th century, particularly by Sénac, Cloquet, Hirschfeld and Bourgey [4, 38]. Amongst the best 20th century images are those in the Pernkopf’s and Netter’s atlases [51, 54].

Modern art

In the 20th century and the new millennium, a special attention to the heart was drawn by artists, writers, composers, photographers and film makers. In addition, numerous amateurs presented heart in many different ways. Contemporary folk and popular arts are often a combination of tradition and modern ideas. Pure rural home-made products are popular only in some nations (Fig. 4). On the other hand,



Figure 3. Wax model of a sectioned heart in situ (credit: Museo di Storia Naturale Università di Firenze, sez. Zoologica “La Specola” — Italia; photo credit: Saulo Bambi — Museo di Storia Naturale/ /Firenze).



Figure 4. A popular folk art product in Serbia.



Figure 5. Digital artwork “Adam and Eve” created by Matt Hansel (credit: Grant J, Vysniauskas A. Digital art of the 20th century; Renderosity, AAPPL, London, 2003, c/o info@aappl.com).



Figure 6. “Icarus”, a cut-out by Henri Matisse (credit: © Succession H. Matisse; photo: Archives Henri Matisse).

millions of modern heart works are designed every year for the Valentine’s Day all over the world.

Modern professional artists most frequently use the symbol of heart, which they depict in various techniques — from drawings and watercolours, through oil and acrylic paintings, to the sculptures and digital art (Fig. 5). The heart symbol is most often the main subject of their artworks. It was presented in various ways, usually as a single symbol, red in colour, and rarely yellow, green, blue or purple. Some authors, however, depicted multiple heart symbols, either close to each other or partially superimposed. Even the concentric symbols were presented, e.g. in the “Fluttering Heart” depicted by the French dadaist Marcel Duchamp [46]. It is interesting that the pop artist, Jim Dine, devoted almost his entire opus to the heart symbol: he created hundreds of heart images and sculptures [41].

Some authors made combinations of heart symbol and human figures. The symbol in those artworks was commonly presented in the thoracic cavity, and rarely on the chest, as painted by the German realist Georg Grosz and by the contemporary author Devin Slattery [42]. Certain artists, e.g. Matrial Rayse, placed the symbol onto the face, whereas Paul Klee depicted heart-shaped lips in a girl portrait [53]. Finally, some artists used the symbol only as part of their compositions, e.g. Joan Miró in “The Dancer” and Peter Blake in “The Love Wall” [5, 41].

The majority of authors used a standard heart symbol. However, the famous French artist, Henry Matisse, in addition to his typical “Le Cuoer”, presented a round heart in “Icarus” (Fig. 6), whose intense red colour potentiates the frightened heart of Dedalus’s son when falling down into the sea near an island, which was later named after him [25, 50]. The round symbol was also used sporadically by the mentioned Spanish master, Joan Miró.

Several artists designed the heart symbol as a sculpture, e.g. Jim Dine, Jean Tinbuely, Jeff Koons and Keizo Ushio. These sculptures decorate the squares of San Francisco, Strasbourg and some other cities, several cardiovascular clinics, and some universities. The modern artist, Christian Kober, showed certain originality when created in China a sculpture of 2 slim human figures, which form a heart symbol.

On the other hand, anatomical images of heart were used less frequently in fine art. Salvador Dali was amongst first modern artists to paint such an image on Christ’s chest. The Mexican painter, Frida

Kahlo, presented the anatomical heart in "Memory" and "The Two Fridas" [33]. Her husband Diego Rivera depicted almost a dozen of hearts in his mural entitled "The History of Cardiology", which he used to decorate the walls of the National Institute of Cardiology in Mexico City [40]. The distinguished American pop artist, Andy Warhol, made a dozen of screen prints of heart in various aspects [31]. The Serbian-Russian painter, Olja Ivanjicki [32], inspired by the famous Dutch artist, depicted "Vermeer and Models", where she included a few anatomical images of heart. In 2005, the artist Richard Phillips presented a girl holding a heart in her hands in the painting entitled "Herzausreisser" [30].

A few authors designed sculptures of the anatomical heart, either realistically or metaphorically. Thus, the artist Franz Sheriff connected "Mind and Heart" and placed this sculpture in front of the University of Hawaii. Renate Hattinger produced the small "Golden Heart Sculpture", and Barbora Mastrlova created a large heart sculpture in bronze (Fig. 7). A fine, bronze heart in a longitudinal section was designed by Not Vital. Maria Koshenkova made the "Collapsed Heart" in ceramics, whereas Dimitri Tsykalov created a wooden heart model. Pepon Osorio produced a heart sculpture of mixed media. The artist Jan Fabre and designer Justin Parker created glass heart sculptures [28]. Jean Arp designed in marble a simple, but fine sculpture "The Heart of Monument" [41].

No matter what material and techniques they used, modern authors considered heart in a symbolic, metaphorical or allegorical manner, i.e. with a certain conceptual background.

Several modern artists associated our heart with some ancient beliefs. For instance, Paul Klee put the heart in the centre of the body on his canvas "Has a Head, Hand, Foot and Heart" [53]. He also depicted "A Spirit Serves a small Breakfast". Designer Matjaz Valentar produced a poster with the fluorescent brain and heart images, entitled "Meet the Idea! Meet the Spirit!", referring to the ancient belief that heart is the seat of the spirit and soul. This traditional belief is sometimes mentioned even in the scientific literature [17].

Crucial biological and anthropological significance of heart inspired several artists to present it metaphorically as a king. Thus, Fernand Legér painted "Kings of Heart", and de Kooning depicted "The Queen of Hearts" [41]. The eccentric artist Salvador Dali designed the piece of gold jewellery "The Royal Heart", decorated with 46 rubies, 42 diamonds and 4 emeralds.



Figure 7. Heart sculpture "I Feel It" designed by Barbora Mastrlova (courtesy of Barbora Mastrlova).

Although the heart's religious symbolism was weaker in the 20th century than in the past, there are still some master-pieces in this domain, for instance, "The Sacred Heart of Christ", which was painted by the mentioned surrealist Salvador Dalí [15]. The same subject was also depicted by modern artist Vicky Tomayko.

Heart as a symbol of purity, chastity and honesty was shown in several images of the Virgin Mary created by some modern designers and artists, but also in the artworks entitled "Maiden with the Heart" by Edvard Munch, and "As Pure As Her Heart" by Salvador Dalí [15, 45]. A reflection of the psychological state on our heart was shown by Francis Picabia in his anthropomorphic work "Heart Face". Psychological interconnection in twins was illustrated by Paul Klee in the "Siblings", who share a single heart. Our loneliness and alienation are illustrated in the Nam June Paik's electronic installation "TV is New Heart" [41].

Music itself also has found its place in the heart art. Thus, Alexander Calder, founder of the kinetic art, created his mobiles "Harps and Heart". Claes Oldenburg, Pita Ibrahim and David Bushell presented "Musical Hearts", whereas Jean Tinguely designed an appropriate heart sculpture to decorate the Stravinsky fountain in Paris. The ingenious pianist and composer Chopin loved so much his home country and was so appreciated by his compatriots, that after his death in the 19th century his musical heart was transferred from Paris to Poland and buried in Warsaw's Church of the Holy Cross. A Beethoven's romantic piece of music and slow heart beating inspired us to create an appropriate artful composition (Fig. 8). Finally, it is fascinating that, according to some recent reports,

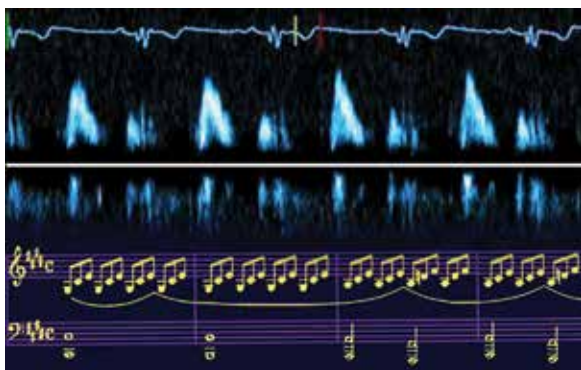


Figure 8. "The Heart Moonlight Sonata".

music exposure may induce a prolongation of heart allograft survival [69].

Human heart as a symbol of romantic love, happiness, passion, sorrow, suffering and similar emotions, as well as truth, honesty, bravery or sin, was also accepted by modern creators [12, 15, 41]. The heart housing love, but also the love sickness, is still the most frequent theme in the heart art, as shown, for instance, in the Andy Warhol's heart symbol with the inscription 'I love you'. Richard Lindner presented a man with a girl figure in his heart. The surrealist René Magritte painted "The Women with a Rose in Place of a Heart", Peter Blake "The Love Wall" and "Mending Broken Hearts", and Georg Grosz the "Lovesick Man". The symbol of love was also presented in the digital image "Adam and Eve" (Fig. 5), created by Matt Hansel [23]. Numerous lyric poems, novels, movies, classical compositions and popular songs were devoted to heart, love, passion and suffering.

The most expressive and most touching heart suffering was presented by the mentioned artist Frida Kahlo, especially in the paintings "The Two Fridas" and "The Heart or Memory" [27, 33]. Frida experienced polio as a child, multiple fractures following a bus accident as a teenager, and several miscarriages and abortions as a woman, which profoundly influenced her art. In the painting "The Two Fridas" she exposed to us her 2 hearts, the intact healthy one and the opened wounded one, which are symbolically interconnected by an imaginary subclavian vein. The painting "The Heart" was an expression of Frida's desperation caused by the affair of her famous husband Diego with her sister. In this self-portrait, there is a hole in the chest, while her expelled heart is laying down on the sand soaked with blood.

Some authors made a connection between the heart and creativity. Thus, Dan Turner designed a digital image "The Artist's Heart", whereas the poetic surrealist Marc Chagall once said: "If I create from the heart, nearly everything works; if from the head, almost nothing" [1].

Several authors crossed the local boundaries and raised their heart works to a global level. Thus, the surrealist painter René Magritte depicted a metaphorical image of an unicorn with human eyes, which he entitled "Heart of the World", whereas Roberto Matta depicted the composition "Look at the Heart of the World" [13, 41].

It is interesting that great medical and anthropological significance of heart was artistically expressed in postal stamps all over the world [11, 12]. Heart was presented either symbolically or anatomically, isolated or in combinations with electrocardiographs or phonographs, or with certain radiologic images or devices.

Radiologic art

Due to the new medical technologies, radiology and cardiology have made the fantastic progress in the last few decades [7, 8, 10, 21, 26, 36, 60, 66, 70, 72–74]. These techniques, such as colour echocardiography, invasive coronary angiography, computed tomography (CT) or angiography (CTA), multislice CT (MSCT), magnetic resonance imaging (MRI) or angiography (MRA), diffusion-tensor MRI (DT-MRI), positron emission tomography (PET), and single-photon emission tomography (SPECT), enabled accurate and precise diagnostics. At the same time, they contributed to the beauty of some heart images, which attracted certain creators, including professional artists.

The aesthetics of the radiologic images is based, firstly, on the aesthetic values of the heart itself: its specific form, the golden ratio of its diameters, arrangement of its large vessels, and its 'texture', mainly produced by the coronary network [29, 54]. Secondly, on the type of the applied radiologic techniques and computer software. For instance, CTA, MSCT, MRA and DT-MRI scans can be visually very attractive (Fig. 9), as well as some of the hybrid pictures obtained by the image fusion software, e.g. PET/CT, PET/MRI and SPECT/CT. In addition, due to volume-rendering software application, fine 3-dimensional (3D) images of heart are produced from the serial CT and MRI scans, or echocardiographic images [22, 61].

Many of those visual products are artful images *per se* (Fig. 9). Besides, some of them resemble the

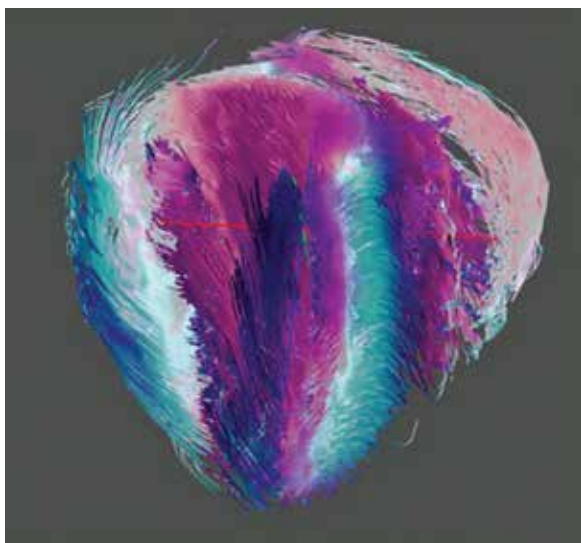


Figure 9. Diffusion-tensor MRI of heart (from Hoffman J.I. et al. *Heart Fail. Clin.* 2008; Copyright Clearance Centre, Elsevier).

pop artworks [31]. The simplicity of some images reminds us about symbolic paintings by Joan Miró [5]. Due to intense artificial colouration of some others, there is a similarity with fauvistic artworks and abstract paintings of Kandinsky [39]. Radiologic images labelled with numerals, words or arrows sometimes resemble the conceptual artworks [43]. The DT-MRI images of heart (Fig. 9) are often similar to brush strikes of certain creators, such as the Italian painter Boldini [57]. Many other radiologic heart images resemble modern digital artworks [23].

Certain artists apply in their work chest radiographs, i.e. the simplest radiologic images. For example, Ben Kruidijk used them to perform etching and thus to get complete artistic compositions. Wim Delvoye combined the chest X-ray with CT scans to create original stained glass works. Tanja Nathasen and some others changed the appearance of the selected coronarographs. Several artistic and designer groups modified selected individual CT and MRI heart scans to get artful compositions.

Some authors use computer processing to produce radiologic-like 2D or 3D images of heart, i.e. those which are digitally generated outside the radiologic ward (Fig. 10). On the other hand, several artists, designers, photographers and medical experts became skilled in computer processing of the true images of 1 or several radiologic techniques. For instance, the Chinese radiologist Kai-hung Fung [20] uses

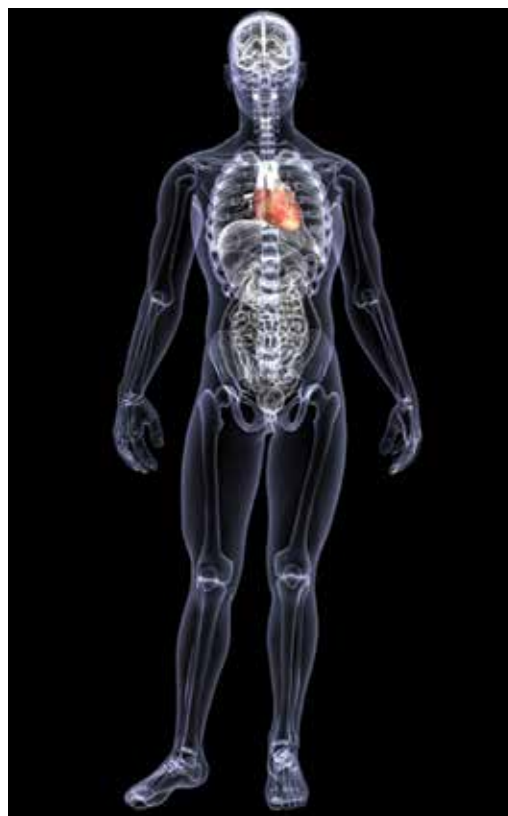


Figure 10. A radiologic-like digital image of body and heart (credit: Shutterstock).

a special software to process CT scans and thus to get original artworks such as “Within One’s Heart”, which represents a fine composition of the papillary muscles (Fig. 11). Furthermore, the photojournalist Alexander Tsiaras and his team use supercomputers and apply complex original software to merge scans of various radiologic techniques, and even of different individuals, and thus to get amazing 3D images [37]. In this way, they create the images of human body and various organs, including heart, which exceed the imagination and the existing Hi-Tech. This is simply cyber art for the next century.

Over 500 million years ago the heart started to beat in the primordial lower invertebrates [6]. It continued to do so in higher invertebrates and in all classes of vertebrates, including mammals and human beings [44]. Human heart enabled life and supported development of the brain and its cognitive functions, especially consciousness, abstract thought, emotions, and scientific and artistic creativity. Thanks to its ‘reincarnation’ in our children, heart will be beating forever, like an eternal micro-pulsar in the infinite universe.



Figure 11. "Within One's Heart" created by Dr Kai-hung Fung (courtesy of Dr Kai-hung Fung).

CONCLUSIONS

Human heart was regarded as a centre of life, soul, will, intelligence, bravery and romantic love. From the ancient times to the present day it has been presenting in fine art, either anatomically or in the form of its characteristic symbol. Anatomical examination of heart in the past was followed by its radiologic presentation in the last few centuries. Due to the high aesthetic value of many radiologic images, certain artists and some radiologists use them to create valuable works of art. Obviously, heart has a great biological, radiologic, anthropologic and artistic significance.

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