

First heart transplant: An untold story about images

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Abstract. This article explores the intersection between the history of medicine and medical illustration. It emphasizes that any account of medical history remains incomplete without acknowledging the role of images in the transmission and understanding of medical knowledge, with its origins dating back to early physicians such as Vesalius. The golden age of medical illustration, marked by the work of Max Brödel at the end of the 19th century and the beginning of the 20th century, and the formalization of academic training, set the stage for future illustrators to make immeasurable contributions to the field of medicine. The research focuses on one of Brödel's exceptional students: Mary Maciel (1906–1990).

Maciel's underrecognized but essential role in visually documenting the innovative procedures of heart surgeon Christiaan Barnard, after his world-renowned transplant in 1967. Newly revealed archival sources, including original illustrations and correspondence, show how Maciel's artwork played a pivotal role in disseminating complex surgical knowledge to international audiences. Even as medical imaging technologies advanced, Maciel's drawings continued to serve as irreplaceable pedagogical tools in medicine. By synthesizing rarely seen materials from institutional archives, this article demonstrates how Maciel's collaboration with Barnard and her broader influence as an illustrator and educator reaffirm the importance of medical illustration for scientific communication in the history of science and as an art form meriting recognition in art museums.

Key words: heart transplantation, Mary Maciel, Christiaan Barnard, medical illustration, portuguese school of angiography



Introduction

If we want to tell a story about the history of medicine, we have to tell a story about images. Any narrative of medical history is incomplete without consideration of the images by which it has been understood and transmitted. The year 1543 marks a turning point in the history of medicine and in the history of humanity itself due to the publication of *De Humani Corporis Fabrica Libri Septem* by Andreas Vesalius (1514–1564) (1). The human body became far more accessible to surgeons, fundamentally transforming the practice of surgery and forever altering the trajectory of both medical knowledge and human understanding. However, it took more than three centuries for surgery to evolve from a dangerous and often fatal practice into one of the most remarkable and reproducible arts and sciences in our world (2). Consequently, the demand for images to communicate new medical advances opened doors for artists to be employed by hospitals and medical schools to create educational illustrations (3). As a result, the need to establish an academic program where artists could receive formal education in the medical sciences became increasingly apparent (2).

By the late 19th century, medical illustrators began to gain recognition and professional status (2). To fully realize the potential of this new discipline, its educational preparation had to meet the same rigorous standards as other specialized branches of medical education. Arriving from Leipzig, Germany, a city renowned in the 19th century for its scientific excellence (3), Max Brödel (1870–1941) started a new era in medical illustration at Johns Hopkins in the late 1800s and early 1900s (4). His groundbreaking work established medical illustration as a vital instrument for depicting and communicating complex surgical and medical concepts. Brödel collaborated with many distinguished clinicians, such as Howard Kelly, Thomas Cullen, William Welch, and William Osler, whose mentorship profoundly influenced his techniques and professional growth (5). Through their skill, surgeons, including William Halsted, Harvey Cushing, and later Walter Dandy, achieved international recognition, not only for their medical advancements but also because Brödel's illustrations made their procedures and discoveries accessible and understandable to a broader audience (6). Despite these achievements, Max

Brödel's greatest legacy was the founding of the School of Medical Illustration, the world's first program of its kind (7), and a pivotal chapter in the history of medical illustration. In 1911, Max Brödel founded and became the first director of the Department of Art as Applied to Medicine at Johns Hopkins University, designing a rigorous two-year curriculum aimed at training artists to visually communicate complex medical and scientific concepts effectively (6,7). Of the 160 students Max Brödel trained throughout his career, only seven went on to establish their own medical illustration programs. They became directors at other institutions, thus spreading the discipline throughout North America and the rest of the world (8). Mary Maciel (1906–1990), a member of the class of 1929–1930, was one of these seven students. This woman, Mary Maciel, defied the social norms of her time and overcame the odds. At a very young age, and without support, as the daughter of Portuguese immigrants (9), she began her journey from New Bedford, her neighborhood and roots, to Johns Hopkins, and later established herself in the University of Cincinnati College of Medicine as a medical illustrator (10). This profession would define her entire life and become the means through which she positioned herself within her professional circles until the end of her days (11). In 1968, Maciel met the world-renowned surgeon Christiaan Barnard (1922–2001), the pioneer of the first heart transplant in Cape Town (12).

At a time when medical imaging was highly advanced, X-ray films were widely available to depict chest anatomy (13), tomography had already been introduced (14), and angiographic images were in use since the 1950s (15). Echocardiography also became an important tool, providing valuable insights into the anatomy of the cardiac chambers (16). This article highlights the pioneering career of medical illustrator Mary Maciel, whose collaboration with cardiac surgeon Christiaan Barnard significantly influenced the documentation and dissemination of the heart transplantation technique through images. Drawing on her original illustrations from Barnard's heart transplant publications and on previously unpublished correspondence between the two, it reconstructs how Maciel's visual work communicated this surgical innovation at a pivotal moment in medical history.

Material and Methods

According to the ENTREQ (Enhancing Transparency in Reporting the Synthesis of Qualitative Research) guidelines (17), this investigation was conducted as a meta-study employing document analysis of several qualitative materials. It was carried out by systematically collecting and synthesizing data from a diverse range of archival sources. These sources included documents, letters, correspondence, drawings, and published articles, including “Maciel”, “medical illustrator”, “medical illustration”, “Cincinnati”, “heart surgery”, “heart”, “heart transplantation”, “cardiac surgery”, “Mary Maciel”, “Barnard” and “Christiaan Barnard” as keywords to ensure maximal capture of relevant data. All the authors participated in the screening process to minimize selection bias and reduce errors.

The materials were sourced from several institutions onsite, including the Chesney Medical Archives, Johns Hopkins Medicine, Nursing, and Public Health; the U.S. Library of Congress; Smithsonian Institution Archives; the National Museum of Women in the Arts in Washington, D.C.; National Museum of American History Library, Smithsonian Institution, Cincinnati & Hamilton County Public Library and the University of Cape Town Libraries - Special Collections. Additional important sources included the National Library of Medicine; the Henry R. Winkler Center for the History of the Health Professions from the University of Cincinnati Libraries; two significant government archives in the Azores islands: the Biblioteca Pública e Arquivo Regional Luís da Silva Ribeiro in Terceira Island, Azores, the Biblioteca Pública e Arquivo Regional João José da Graça in Faial Island, Azores. Furthermore, materials were also collected from The São Jorge Genealogical Society, a registered non-profit organization dedicated to assisting individuals researching their lineage on the island of São Jorge, Azores. Online searches were conducted using ProQuest, Ancestry, and PubMed databases, applying the same keyword combinations to identify publications authored by Christiaan Barnard and illustrated by Mary Maciel. The search was pre-planned, initially aimed at identifying all available studies. The inclusion criteria encompassed publications of any type, newspaper

articles, journals (academic and non-academic), and photographic material, dated between 1906 and 2002, corresponding to the birth of Mary Maciel and the death of Christiaan Barnard. This timeframe was selected to capture relevant press notices and publications reflecting such collaborations.

Findings

Amid early twentieth-century transformations, Mary Maciel bridged art, medicine, and international exchange. U.S. entry into World War II in 1941 restricted transatlantic voyages, redirecting her to the war effort. Archival records show that she applied to serve on naval vessels as a medical illustrator or clinical assistant, highlighting her skills, experience, and proficiency in Portuguese, as noted in Women’s Army Corps correspondence (18).

Following the war, Maciel contacted leading Portuguese surgeons António de Sousa Pereira and Reynaldo dos Santos (19), who advanced her trajectory and supported her first international summer school for medical illustration in Lisbon and Porto in 1948 (20). This occurred during a period of major medical innovation in Portugal, particularly through the pioneering work of the Portuguese School of Angiography (21). Archival records from the Chesney and Smithsonian Archives document her travels to 82–150 countries, marking the launch of her international career. The Porto Medical School was central to her network, connecting her through the Angiography school’s extensive contacts (20). Portugal served as a springboard for Maciel. Strasbourg was a key destination where she spent several months on a 1956–1957 Fulbright scholarship, which profoundly influenced her artistic and professional development (22). She went on to establish or collaborate with medical illustration schools worldwide, including in Finland, Sweden, Italy (8), and South America (23).

Meanwhile, Christiaan Barnard launched an open-heart surgery program at Groote Schuur Hospital in Cape Town. In the early 1960s, when heart surgery could already correct most congenital defects and valve diseases but not coronary artery disease, Barnard began concluding that heart transplantation

would be essential to treat end-stage heart failure (24). Then, he took a three-month sabbatical to gain experience in immunosuppressive therapy for patients with kidney transplants under the guidance of David Hume in Richmond, Virginia (25). Returning to South Africa, Barnard asked cardiologist Velve Schrire to identify a suitable patient, leading to the selection of Louis Washkansky, a 53-year-old diabetic in terminal heart failure. Because of the racial conflict under the apartheid regime and the sensitivity surrounding medical ethics, they chose a Caucasian recipient and donor: Denise Darvall, age 25, became the donor after a fatal brain injury and her father's consent (26).

Louis Washkansky's story was widely transmitted around the world shortly after his surgery. The historic heart transplant performed by Christiaan Barnard placed Cape Town prominently in medical history. Across all cultures and civilizations, the heart has held a powerful place as both an anatomical organ and a universal symbol. Its image, whether anatomically accurate or stylized, appears in the art, mythology, and spiritual traditions of all societies. This deep cultural resonance of the heart added symbolic significance to the first heart transplant: the intervention was not only medically pioneering but engaged with representations that, for centuries, have stood for what is most vital and meaningful in the human experience. Barnard gained worldwide celebrity status and travelled extensively, giving lectures and meeting medical professionals and the public. In 1968, he visited Portugal and met surgeons from the Porto Angiography School (27). Later, during a visit to Cincinnati's Department of Surgery, Barnard met Mary Maciel, who was already Head Professor at that time.

After their personal meeting in Cincinnati, correspondence between the surgeon and medical illustrator began with exchanged drawings and shared bibliography of anatomy books, with Barnard providing notes to improve the accuracy of the visualization of certain cardiac structures. Subsequently, Christiaan Barnard invited Mary to attend a summer school of illustration at Groote Schuur Hospital in Cape Town.

The findings of this study revealed that between 1906 and 2002, there were 119 documented references to Mary Maciel and Christiaan Barnard in North American newspapers, which document Barnard's

visits to Cincinnati during which he met Maciel. Only seven references to Mary Maciel and Dr. Christiaan Barnard in American newspapers are from outside the Ohio state area, where the city of Cincinnati is located.

In 1968, following his groundbreaking first human heart transplant in December 1967, Christiaan Barnard invited Mary Maciel to collaborate with him in visually documenting the surgical technique for his subsequent transplants (28), as he sought detailed medical illustrations to accurately depict the procedure for wider dissemination and teaching. This collaboration, along with the related illustrations, can now be accessed online at the Henry R. Winkler Center for the History of the Health Professions at the University of Cincinnati Libraries (29). Barnard commissioned Mary Maciel to make a series of anatomical drawings to document the historic 1967 operation in which he performed the world's first human heart transplant on Louis Washkansky at Groote Schuur Hospital in Cape Town, South Africa (25). These original illustrations, which have never been made public before, are now presented in this article: Figure 1.

In Figure 1, the mechanism of donor heart cannulation for myocardial perfusion is shown. The heart is being oxygenated and perfused through the extracorporeal circulation system before being implanted into the recipient. The vessels are displayed with dashed lines indicating the proposed excision margins. The donor heart, with the suggested excision lines, is shown during the perfusion process.

The schematic drawing in Figure 2 illustrates the extracorporeal circulation system, which simultaneously perfuses both the donor heart and the recipient patient. Perfusion of the donor heart is achieved through the ascending aorta, with blood drainage via the apex of the left ventricle. This maintains coronary perfusion to preserve myocardial integrity. Through the same Y-shaped system, the recipient patient also receives blood through the ascending aorta above the aortic cross-clamp, while venous blood is drained from the two venae cavae into the reservoir. The blood then passes through the oxygenator before being circulated to the donor heart and the recipient patient. The heart of the recipient patient that will be excised and discarded is, at this time, ischemic with no coronary perfusion.

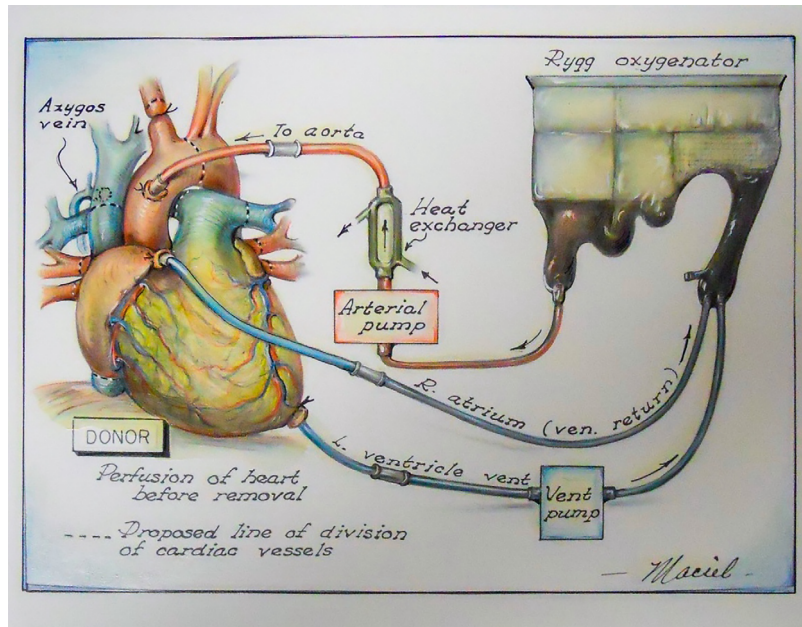


Figure 1. Donor Heart. Preparation. Preparation of the Donor Heart for Perfusion and Excision. Heart Transplant of Louis Washkansky in 1967, South Africa. Gouache, charcoal and ink on paper. Courtesy of the National Museum of Women in the Arts, Washington, DC.

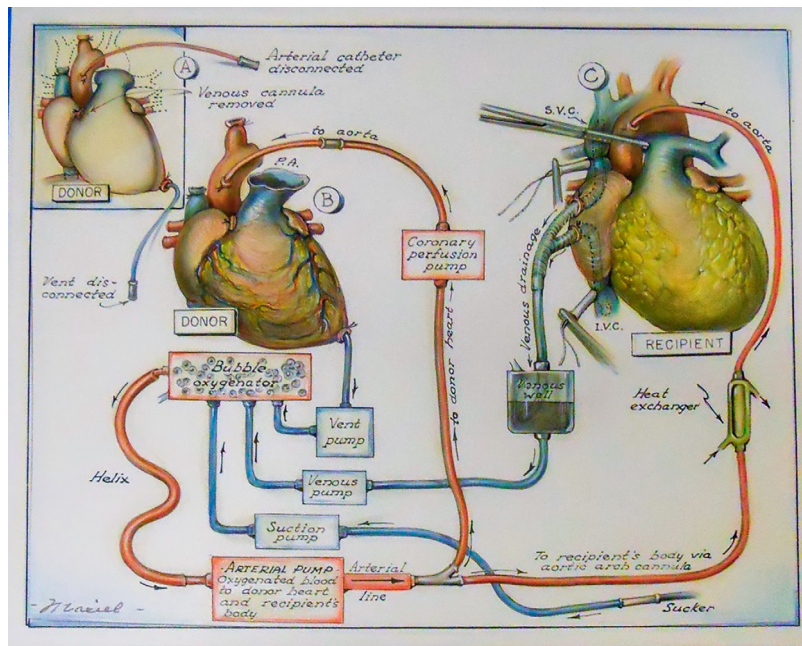


Figure 2. Extracorporeal Circulation System for Donor Heart and Recipient Patient. Gouache, charcoal and ink on paper. Courtesy of the National Museum of Women in the Arts, Washington, DC.

Excision with preparation for the biatrial technique is used, which is no longer the recommended technique. Initially, the schematic shows the heart still on extracorporeal circulation, with both the aorta and pulmonary artery cross-clamped and transected. Then, excision of the right and left atria is performed. The pulmonary vein orifices and superior and inferior vena cavae remain in the recipient, as well as remnants of the right and left atria. Figure 4 illustrates this step, showing the pericardial sac only, without the heart.

The posterior wall of the left atrium is removed along with the pulmonary vein ostia. This corresponds to the remaining region left in Figure 3.

Figure 5 illustrates the anastomoses performed during heart transplantation surgery. Panel A shows the anastomosis of the left atrium, while Panels B and C depict the anastomosis of the right atrium. Anastomoses are created between the donor's aorta and pulmonary artery with the recipient's corresponding vessels (Panel D). Upon completion of these vascular connections, the cannula used for extracorporeal circulation is removed, completing the surgical procedure.

Their correspondence began in 1968, with Mary Maciel sending slides and drawings by mail to

Christiaan Barnard. Maciel's first extended stay in Cape Town was in July and August of 1969, during which she observed Barnard's surgeries. In her correspondence, Maciel expresses that she was well prepared, requests cardiac anatomy manuals, and asks Barnard which references she should acquire. This program was repeated in 1972. During her time in Cape Town, Maciel developed relationships with several departments at Groote Schuur Hospital. Marius Barnard, Christiaan Barnard's brother and also a cardiac surgeon, was the main facilitator of Mary Maciel's contacts. He maintained extensive correspondence with various departments at Groote Schuur Hospital and throughout the University of Cape Town, notifying them of her visit and organizing her agenda.

Mary Maciel's time in Cape Town coincided with a period of intense activity. She conducted drawing sessions with fellow medical artists and interviewed surgeons across multiple specialties. Additionally, she engaged with bacteriology, radiology, and psychiatry departments to explore the use of medical illustration as a tool for disseminating scientific knowledge. Correspondence from this period reveals that her interaction extended beyond Groote Schuur Hospital to

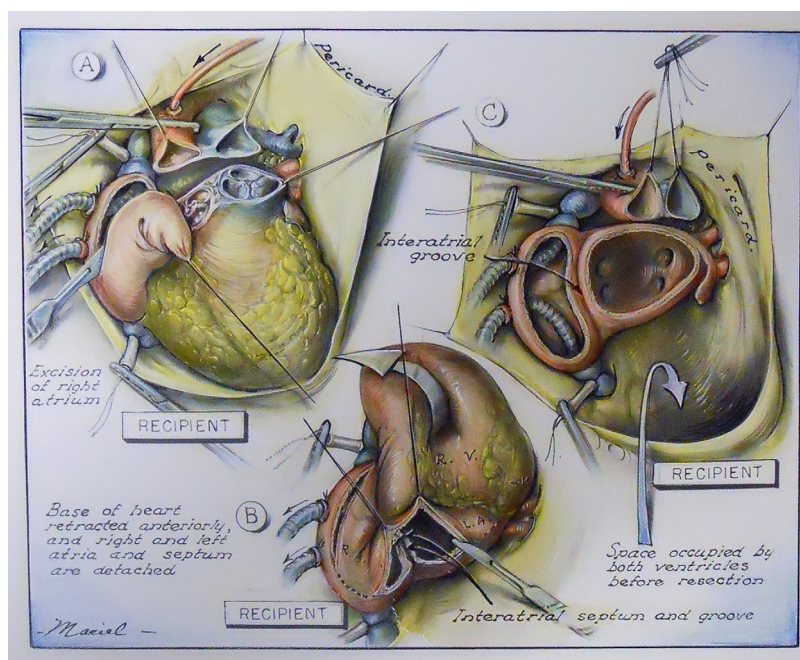


Figure 3. Recipient's heart explantation. Courtesy of the National Museum of Women in the Arts, Washington, DC.

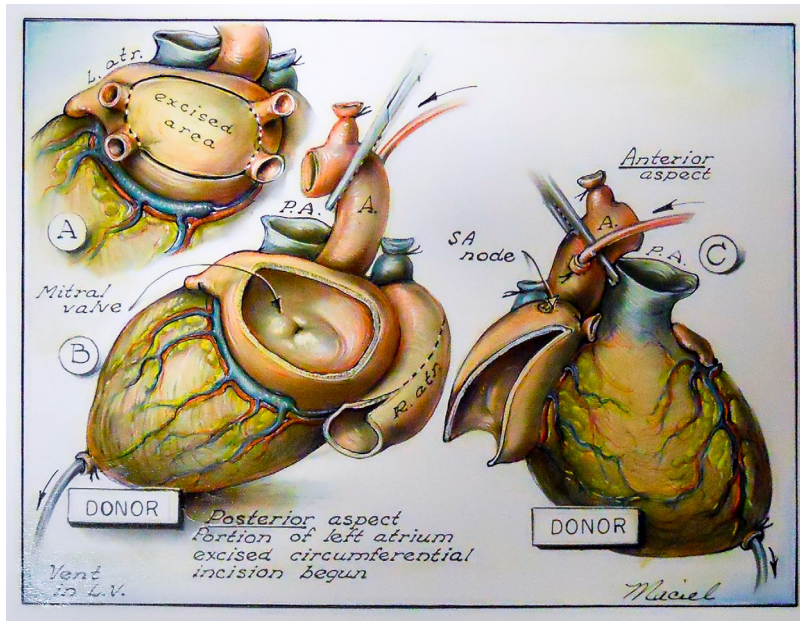


Figure 4. Donor Heart Preparation. Heart of Denise Darvall in 1967, South Africa. Gouache, charcoal, and ink on paper. Courtesy of the National Museum of Women in the Arts, Washington, DC.

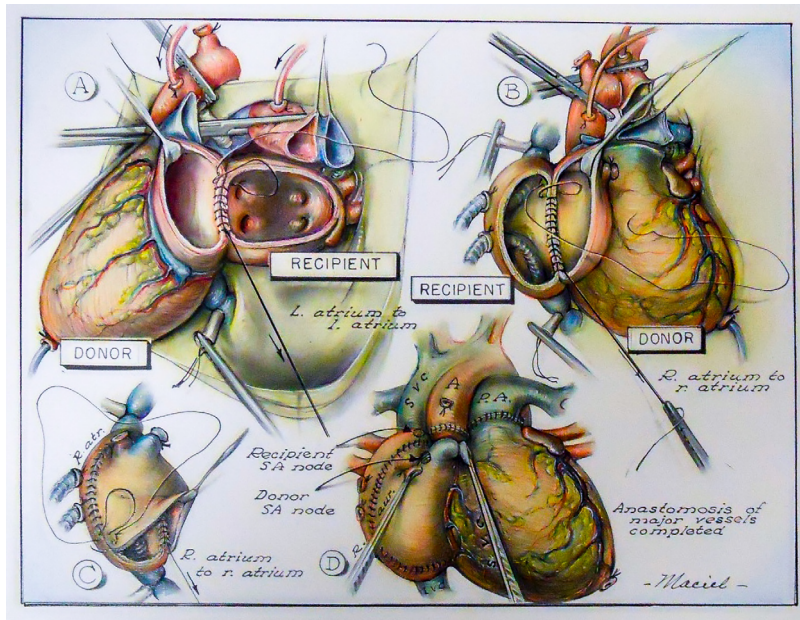


Figure 5. Biatrial and Great Vessels Anastomoses in Heart Transplantation. Courtesy of the National Museum of Women in the Arts, Washington, DC.

include, for example, a communication with the head of the Department of Medical Illustration at the University of Stellenbosch. This interdisciplinary engagement highlights the breadth of Maciel's influence and her key role in advancing medical illustration during her residency in South Africa.

Conclusion

Mary Maciel was a medical illustrator whose work was crucial in visually conveying complex surgical concepts, thereby bridging the gaps in understanding between mentors, students, and peers. Although her contributions remained largely unknown until recently, her legacy highlights the crucial role that medical illustration plays in the transmission of surgical knowledge.

Nowadays, detailed drawings remain an essential pedagogical tool among medical professionals, helping to convey surgical steps and ideas more effectively than text alone. The history of their collaboration is primarily preserved through the fame of Christiaan Barnard, while Maciel's work remains less recognized publicly. Her illustrations are housed in the reserve collections of the National Museum of Women in the Arts in Washington, D.C., and until now, they have not been accessible to the general public.

The present article reinforces the status of surgical illustration not only as a scientific necessity but also as an art form deserving recognition in both museums and science education. The enduring value of medical illustration lies in its ability to visually communicate precise anatomical and procedural knowledge, contributing to medical education and the continuous evolution of surgical practice. Their intertwined legacies emphasize how art and medicine can mutually enhance each other, fostering a deeper understanding and appreciation of both disciplines.

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