MEDICAL IMAGE: IMAGING OR IMAGINING?

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INTRODUCTION

The rapid developments and progresses in medical imaging in the last three decades have radically improved and transformed the way physicians perceive and see the human body. These changes have totally revolutionized medical practice. Many organs and structures, which were in the past invisible to conventional X-ray examinations, are now revealed through sophisticated imaging modalities such as computed tomography (CT), ultrasound (US) or magnetic resonance imaging (MRI). Furthermore, nuclear imaging such as positron emission tomography (PET), is used together with CT or MRI to form “hybrid imaging” (i.e. PET/CT, PET/MRI) and enables a simultaneous study of both structure and function (or dysfunction). The pace and scope of such scientific and technologic progresses have brought a new paradigm to the generation of new knowledge, and resulted in a range of philosophical questions in both epistemic and ethical issues. In this paper, the reflection will focus mainly on these epistemological issues relating to the formation of medical images, which now play a pivotal role in medical decision-making. For examples, such issues are applicable to the diagnosis and therapy in cancer care: i.e. X-rays and MRI are used not only to detect a bone tumour, but also to establish its extension to the surrounding tissues, or to exclude metastasis from its original site to the distant organs such as the lungs or brain.

MEDICAL IMAGE: THE HISTORICAL PERSPECTIVE

The historical roots of this quest to look at the inside of the human body can be found in the ancient story of the Buddhist doctor, Jivaka who was known as “The legend of Jivaka and the King of Physician’s tree”. Jivaka was a physician in the royal court of King Bimbisara (558 BC–491 BC) of Maghada in Ancient India, a thousand years ago. One day, outside the royal palace, Jivaka met a boy carrying a bundle of wood sticks on his back. Jivaka was surprised that he could see the boy’s internal organs through his body. He recalled the magical property of the King-Doctor’s tree, which would make the inside of the body visible. Jivaka bought the wood sticks from the boy, who then dropped the bundle to the ground. Suddenly, the intense light that illuminated the boy’s internal organs faded away and his body returned back to normal. Jivaka pursued an “experiment” by applying each one of these sticks to the boy in turn until he has found the famous King-Doctor’s wood stick. Jivaka kept this stick as a diagnostic tool for his medical practice (De Saint
Firmin 1916). This may be the origin of the “ultrasound probe” as dreamed of by many other doctors of the ancient Buddhist kingdoms of Asia.

In Europe, until the 17th and 18th centuries, a doctor remained “at a distance” from a patient, because visual inspection alone seemed to be the most appropriate way to establish a diagnosis. By the end of the 18th century, this “clinical gap” was reduced as a result of the development of new clinical tools (Foucault 1989: 167), e.g. the auscultation of lungs and heart with a stethoscope. Because there is no disease without a seat (i.e. the origin of the disease), a closer “gaze” is necessary to establish a diagnosis. It was Giovanni Battista Morgagni from the University of Padua, who pioneered this approach, when he published his seminal work in 1761, on the “The seats and causes of diseases”. While the distance between physician and patient was bridged by auscultation in the early 19th century, the pre-auscultation “clinical gap” was restored through medical imaging when radiologist assessed a patient “at a distance” using X-rays examination.

The process as described by Foucault by studying the body from the “symptomatic surface” to the “tissue surface” through the dissection of corpses (Foucault 1989: 166) was no longer necessary following the emergence of medical imaging, which started with the discovery of X-rays by Roentgen in 1896. The internal organs (the subject) are now “visible” by medical imaging. The Foucauldian “medical gaze” from the anatomo-clinical dimension (i.e. the surface of the human body) to a pathological anatomy dimension (i.e. the internal organ as the seat of disease) no longer requires an opening of the body. X-rays, ultrasound, magnetic fields and radio-frequency waves have replaced the scalpel. The invisible part of the human body is now revealed with great details through medical imaging.

**MEDICAL IMAGE: THE PRODUCTION LINE**

Modern medical imaging allows us to study the inside of the body. However, the many complex mathematical and technical processes for image acquisition and manipulation could lead to the generation of other signals, which do not seem (at least a priori) to be a reliable representation of the specimen. Such signals are called “artefacts”. These artefacts could lead to interpretation errors and could increase the risk of making a wrong diagnosis. However, in other situations, these “artefacts” may in fact contribute to diagnosis, e.g. by delineating a blurred anatomical boundary between a tendon and the surrounding fatty tissues, i.e. the “anisotropic artefact” for an ultrasound procedure.

The key question is: “Does the image displayed on the monitor accurately represent reality, e.g. does this truly reflect the structures of a patient’s knee in the MRI room”? The image displayed is the result of an interaction between an X-ray beam or an electro-magnetic and radiofrequency wave and the body. More recently, PET/CT (Positron Emission Tomography/Computed Tomography) was introduced to clinical practice as a major tool for cancer imaging. This innovative technology allows not only an accurate delineation of anatomy, but also an assessment of an organ’s functional and metabolic pattern. A radio-active tracer is injected intrave-
In modern clinical practice, medical imaging plays an increasing role in decision-making, for both diagnostic and therapeutic purposes. It is reasonable to ask whether medical imaging is an “imaging” or “imagining” process from an epistemological dimension. For me, medical imaging includes and relies on the following processes: the appropriate acquisition of images by the machine, the reliable perception of the images by the eyes of the radiologist, and the accurate interpretation of the images by the radiologist. Once these images have reached the brain and the mind of the radiologist, he or she will “imagine”, i.e. form a mental image of the organ that he or she has learned from past anatomy courses. This mental process will project the image within the clinical context, after taking into consideration of the clinical symptoms and the results of laboratory tests. This evaluation by the assimilation of these data (medical images, clinical symptoms and biological results) requires some imaginative skills. Based on the deduction, these data will be considered as normal or abnormal. If abnormal, a most likely diagnosis will be selected from a gamut of diseases that share similar findings. Hence I would argue that medical imaging in clinical setting is a combination of both “imaging” and “imagining”.

The widespread use of images as a “thinking tool” to establish knowledge leads to multiple ethical issues. Indeed, given the complexity of medical image reconstruction and the other questions of accuracy and reality, one can ask what are the ethical issues faced by doctors when they use these images as a basis for important decision-making in daily practice. These ethical issues, although essential to the good practice of medicine, are beyond the scope of this paper.

In essence, lying behind every medical image is a patient. So let’s look beyond these medical images!

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Morgagni, Giambattista. (1761) De Causis et Sedibus Morborum per anatomen indagatis. Venice: libri quinque, Remondini
These three exciting new medical scanning technologies have neuroscientists dreaming about the prospects of next generation of medical imaging that is better, cheaper, more affordable, and more accessible to researchers worldwide than existing medical imaging technologies.

1. The first is Openwater by Mary Lou Jepson. Openwater may or may not involve Holography, Lightfields, some variant of Tractography (the technology umbrella