Denise Juppé

When Your Patient is a Mummy
A Little Paleo-Gastroenterology in the Night

Strolling through the Science Museum of Minnesota on a pre-pandemic Sunday, a friend and I arrived at the Human Body Gallery. This is where the museum's only mummy, a little nut-brown husk of a human, was laid out on permanent display. "That's where we cut the hole," my friend, Dr. Oliver Cass, said excitedly, pointing to a small plug-shaped area on the left side of the mummy's torso. I was mesmerized by the brief story he told me and asked if we could sit down later for an in-depth interview. When we did, Dr. Cass described his role in a curious project, one that demonstrates how modern medicine has increasingly intersected with ancient history.

These two disciplines have not often been talked about in the same breath. But since the mid-1970s, medical imaging has undergone an evolution. Medicine has seen the development of increasingly sophisticated technologies capable of unearthing a wealth of information about the health and lifestyles of ancient peoples. As never before, mummies can provide clues about which medical conditions have plagued mankind for centuries, and which are new. They enable researchers to see patterns in human health and leverage that knowledge to improve our own health. Dr. Cass might not have realized it at the time, but the project he had joined was at the cusp of this research revolution.

Dr. Cass is a tall, rangy man with a full moustache and a calm manner. In 1983 he was a young gastroenterologist working at Hennepin County Medical Center when a colleague walked into his office and asked him if he'd like to perform an endoscopy on a mummy. "Naturally, I said yes," he recalled. "It sounded like fun." An endoscope, for which the procedure is named, is a long, thin, flexible tube with a tiny light and camera attached. It's often used to examine the esophagus, stomach, and duodenum of patients experiencing gastrointestinal problems.

The mummy was, of course, experiencing no gastrointestinal distress, having had almost all its organs extracted from its body thousands of years ago. So why, one might ask, would an uncomplaining mummy be a worthy subject for an endoscopy?

The answer lies partly in history. An Egyptian mummy is, to paraphrase Winston Churchill's famous description of Russia, a riddle wrapped in a winding sheet inside a sarcophagus, whose secrets every generation has attempted to unravel with the tools at hand. Beginning with the Renaissance, mummies have consistently been the subject of intense curiosity and fascination. During the Victorian era, mummies were plentiful in Egypt; travelers could— and did— bring them back as souvenirs. Mummy "unwrappings" were performed both at public events and in private parties. For centuries, mummies were ground up for medicine, given full autopsies and taken apart piecemeal for study. These practices horrify present day scholars, who regard mummies as priceless artifacts to be preserved, studied and often as not displayed in museums.

Fortunately for mummies, change was on the way. Beginning in the late 19th century a series of imaging technologies was developed, each more accurate than the last. With the advent of each new innovative technology, someone quickly considered how to apply it to mummy research. The first x-ray of a mummy was taken in 1896. It was a good beginning, but x-ray images can be fuzzy; it's often difficult to discern much internal detail from them. Nearly a century later, both magnetic resonance imaging (MRI) and the computed tomography (CT or CAT) scan came into general use. A CT scan is produced by using a computer to process many cross-sectional x-ray images of a scanned object. The images reveal details that cannot be seen on a simple x-ray. A British electrical engineer invented the first commercial scanner in 1972; by 1976, a pair of researchers in Canada had performed the first scan of an Egyptian mummy.

Where did Dr. Cass fit into all of this? His work colleague was a member of the "Minnesota Mummy Project," started by a group of radiologists who proposed to use CT scans to examine the four mummies housed by institutions in the area. Another member of the group, Thomas Aufderheide, knew Cass from medical school. It so happened that Aufderheide was the son of Dr. Arthur Aufdeheide, one of the world's leading authorities on mummies, who was based in Minnesota.

By the time Cass was invited on the project, all four local mummies had received CT scans. The scan of the mummy at the Science Museum revealed that he had likely died in his 30s. He was thought to have lived during the 18th Dynasty, which spanned the years 1550 - 1295 BCE. One monarch who reigned during this dynasty was Tutankhamen, the famous "King Tut." The CT scan had also revealed a lump in the mummy's chest cavity that the doctors thought might be the heart. These were the early days for CT scans; they wanted confirmation that the lump in the mummy's chest was indeed this organ.

So, one wintry night after the museum had closed, Cass joined a small group of doctors and museum curators in the darkened museum. "It was spooky," he recalled. Arthur Aufderheide himself cut a small, 2x3 cm piece out of a rib with a bone saw. Cass then threaded the smallest endoscope available through the hole and took a look. A video camera had been attached to the eye piece of the scope so that everyone in the room was able to see the images that appeared. (In the 1980s, endoscopes were fitted with eye pieces rather than the TV screens in current use.)

I asked Cass what was different about looking around inside the mummy instead of a live human being.

"The mummy's chest cavity was dry and yellowish brown and the mummy itself smelled musty," he said. "The tissue of a live person is pink and moist. With a person, you're threading the endoscope down a discrete tube, the gastrointestinal tract, that technically runs from the mouth to the anus." A gastroenterologist is typically interested in examining a specific area along the way, like the esophagus or the stomach.

Cass went on to describe the challenge of "scoping" the mummy." An endoscope can often twist around," he said, "making it hard to know which way is up or down. In a live person you know where you are because there is fluid in every cavity, which pools downward whether you are lying flat or sitting." The mummy was a different story.

"I was hunting for the heart," he said, "but I didn't know which way was up or down. The mummy," he went on, "had a chest cavity that was just open space, so the endoscope had complete freedom of movement. I had to lock the left-right control and try to establish which way was up by twisting the scope." He eventually succeeded.

Once oriented within the cavity, Cass began exploring. He saw membranes hanging down ("they looked like cobwebs") that were possibly remnants of the embalming fluids. After threading the scope about 30 cm (12 inches) into the chest cavity, he saw the lump that had been detected by the CT scan and took tissue samples. Subsequent biopsies revealed that this tissue was likely from the pericardium, the membrane enclosing the heart. Cass then maneuvered the scope into a deeper chamber, presumed to be the left ventricle. The “lump” was almost certainly the heart.

Why would the ancient Egyptians retain the heart when all other organs were removed during the embalming process? One reason is that they thought that the heart—not the brain—was the center of thought, memory, and emotion. They also thought the heart recorded all the deeds done during the course of a lifetime. Embalmers left the heart in the body because the deceased would need it in order to be admitted to the afterlife.

Egyptians believed that after death the deceased person traveled through the underworld until he or she arrived at the Hall of Ma’at, the goddess of justice. There Anubis, the jackal-headed god of mummification and the afterlife, led the deceased into the presence of Osiris, Lord of the Underworld, and a number of judges. Anubis then weighed the heart of the deceased on a large scale against the “feather of Ma’at,” which represented truth. If the heart balanced against the feather, meaning that the deceased had led a good life, he or she was allowed to enter into the afterlife. The heart was returned to its owner. However, if the heart was heavy with the weight of wrongdoings, it was promptly eaten by Ammit “the Devourer,” a fearsome demon who waited by the scales. If Ammit devoured the heart, that was it—the deceased would die a second death and be obliterated from existence for all time.

Knowing about these funerary practices, the Minnesota Mummy Project doctors had a good idea of what they might find. But since their pioneering work of the 1980s, there has been an explosion of research studies exploring mummy physiology; with discoveries that have been anything but expected. Nor is the CT scanner now the only tool of choice, Medical researchers have utilized recently developed dual-energy CT scanners, infrared imaging, and tissue culture to probe deeper into mummies. It has even become possible to harvest ancient DNA (aDNA) from a few mummies, though this is quite difficult.

Manchester University, in Britain, is home to the Egypt Mummy Project. Researchers there have been able to employ the same endoscopic techniques used by Cass to take tissue samples from mummies. Ancient Egyptians suffered from parasitic diseases, as well as arthritis, pleurisy, and a variety of infections. The bacteria and parasites they harbored were preserved along with them. Modern Egyptians still suffer from one disease in particular – schistosomiasis -- that also afflicted their ancestors. Researcher Rosalie David hopes to determine whether “the genetic make-up of the causative parasite [of schistosomiasis] has changed over that 5,000 year time span,” which maybe help doctors develop preventative treatment methods in modern patients. Manchester is also establishing a “mummy tissue bank” that will be available to medical researchers globally.

Dual-energy CT scanners, which utilize x-rays at two different wavelengths, can capture details of both thicker and thinner parts of a mummy and its wrappings. In 2016, researchers went to the British Museum and used a scanner of this type on mummies that had never been unwrapped. They produced 3D visualizations to create astonishingly accurate “virtual mummies,” whose muscles, skeletons and even arteries could be perceived.

This study revealed plaque deposits on the arteries of some mummies suggesting that cardiovascular disease is not a new phenomenon. Daniel Antoine, British Museum curator, says, “We hope in the future to image the soft tissues at the cellular level; to look at whether there's any changes or to find evidence, for example, of cardiovascular diseases but also things like cancer."

Cancers are rarely detected in mummies, but pathologist and anthropologist Dr. Michael Zimmerman says that "tumors [in a mummy] are easy to spot." This low incidence is not necessarily because Egyptians died young; many mummies evidence diseases of aging. Zimmerman believes that cancer might be tied to modern environments. He and a colleague, geneticist Mary Daly, propose that smoking—not practiced by ancient Egyptians—and obesity partly account for the higher cancer rates found today. Zimmermann, incidentally, also identified tuberculosis in a 3300-year-old mummy, the oldest case ever recorded.

Not all of the new technologies reveal disease. Sometimes they provide new insights into a culture. Archeologists at the University of Missouri performed infrared imaging on the bodies of seven female mummies found in the Egyptian village of Deir-el-Medina. The imaging revealed a range of previously hidden tattoos. Numerous tattoos on one particular mummy depict motifs sacred to the Egyptians, such as lotus flowers, scarab beetles, and baboons. These tattoos suggest that the woman was likely a priestess or healer.

The Minnesota Mummy Project disbanded soon after the doctors had scanned the four local mummies and published their findings. As for the mummy at the Science Museum, his biography has been updated. Thanks to radiocarbon testing done in 2016, we now know he did not live during the 18th Century Dynasty. Instead, his remains date from the Greco-Roman era, a period spanning from the 1st century BCE to the 1st century CE. This means he lived 1000 years later than was previously thought. He may have been a contemporary of Cleopatra rather than King Tut.

Mummies are now yielding up valuable medical information. But they have always had a rich history of associations with the occult and the mysterious in Western culture. They're creepy, perhaps because they represent a kind of bridge between the living and the dead, an immortality of the flesh after that which animates it has disappeared. Unraveling their secrets will continue to instruct us on what it was, and is, to be human.

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