**Postmortems**

The postmortem is the final investigation.

When someone dies considerable discussion takes place amongst family members. Statements such as: “Thankfully he did not suffer. Why did he die? He was doing so well,” are common. We have all heard these statements. In some families it is very important to have finality and to know the answers and a postmortem is one way that the answers can be provided. In some families, there may be dissatisfaction with the medical care and litigation may be a future possibility. A postmortem gives strength to either the litigator or defendant depending on the autopsy findings

I tend to ask for an autopsy if one of my patients die. Postmortems were commonly done during my training as a medical student and we were encouraged to attend. I learnt a lot from these dissections, and it is generally accepted then that in about 20% of instances the cause of death was different from what was assumed. I also ask for a postmortem because it demonstrates to the family during a very traumatic time that we have been honest in our management and have nothing to hide. Despite this statement, Medicine has progressed since my medical career started; virtually every critically ill patient in the USA, has had investigations such a CT scans, angiograms and MRI’s, such that in most instances we have a very good idea of the cause of death.

There are some who go overboard in these requests. A colleague related this story to me. When doing his surgical residency, he worked for an oncologic surgeon, who did not do much surgery: in fact, he concentrated on the medical side of oncology.

This oncologic physician always wanted an autopsy. I guess he wanted to know for certain the cause of death. Perhaps he used the data for publications. It was a standard rule for those working for him to do everything possible to get an autopsy. If the resident was unable to get permission, he was instructed to call the consultant, who himself would come in and try and get permission. One evening one of his patients died. My colleague tried everything possible to get permission for an autopsy, but the family was adamantly opposed. He called his consultant who, as expected, came in. He was also strongly opposed by the family despite being as persuasive as possible. At last he stated: “I understand fully what you are feeling and your attitude, but I would just like you to know that if it was my family member, I would not like them to be buried with cancer within their body.” The family agreed and gave consent for the postmortem.

Postmortems in South Africa were a legal requirement for any patient who died within 24 hours of an anesthetic and this requirement allowed critical review of the surgical procedure. Sometimes we learnt to our dismay where we had made an error; we were obviously disappointed to be made painfully aware, but we learnt from these experiences.

In the USA postmortems in soldiers who have died in combat are routine. In fact, the process goes further using modern technology. Computerized tomography is used in every deceased soldier. This technology enables the bullet tracts and injuries to be carefully documented. This data is useful in devising strategies for protective armor and treatment of specific injuries.

Pathology, in its various forms, anatomical, chemical and forensic was studied during my 3rd year in Medical school. This subject was one of my favorite preclinical subjects. I remember vividly the first postmortem I attended. Having worked on a cadaver for a year during my second year I was used to dead bodies, but the bodies having postmortems were different. These bodies were kept cold in refrigerators and did not have the pale grey color or the smell of a person who had been preserved in formaldehyde. They had skin color that was close to real life, rather than the grey color of tissue soaked in formaldehyde. Postmortem lividity was present at dependent surfaces.

Postmortems were conducted in a large oblong room. Along the length of one side was a small door leading to the refrigerated area. Here, stacked on stainless steel boards supported by rollers that could facilitate movement in and out of the freezer, were kept the deceased. The body was usually placed headfirst on the board and tied around the big toe was a label indicating identity. When doing a postmortem, the mortuary attendant simply opens the door to the freezer, checks the identity and slides the stainless-steel board with body out onto a gurney. The body can now be wheeled to the cadaver table where the postmortem is performed. The postmortem table is basically a wide flat metal sink, with raised sides. At one end is a drain hole for body fluids and water. At the other end are taps and hoses. A wooden block which was notched in the middle, much like an early African tribal head rest, was available to extend the head of the body and allow the arms to fall backwards. This position facilitated the procedure. There were four cadaver tables in the room, all similar in appearance. To the side were a scale and a table on which were placed scalpels, scissors and large flat knives. An electric saw is also present.

At the end of the room was the teaching area. Here students sat on curved tiered benches closely around a stainless-steel table where organs were commonly placed for examination. About twenty students could be accommodated at a time.

Postmortems are done in a very routine manner so that nothing is missed. A forensic autopsy is much more thorough than one done to determine a cause of natural death. The forensic autopsies were done by state forensic pathologists in a building that was some distance away from the Medical school. There, bodies would be examined for residue under fingernails, be photographed and radiographed and the skin would be inspected using an ultraviolet light for subtle signs of injury. In addition to standard autopsy, sites of other injuries may be opened and examined. Only later in our training did we visit the forensic pathology building. What goes on in these types of buildings is well-known to fans of detective novels, television series and movies. This form of training was important is that many members of the class would end up practicing medicine in a rural community and would be expected to also function as a district surgeon,

The pathologist will first examine the naked body from the front noting on preprinted sheets of paper with drawings of the front and back of a human torso any skin changes, scars or pathologic process. The mouth, nose, ears, teeth and eyes are inspected. The body is turned over and the posterior aspect is inspected. Today much of the documentation is dictated into a microphone which hangs over the postmortem table; in the 1970’s pen and paper were used. Once the external examination is completed the pathologist proceeds with opening the body. If the brain is to be examined an incision is made across the crown of the head extending from just behind one ear to the other. The skin with hair is then pulled forwards and backwards exposing the white shiny skull. The skull is then sawed approximately four inches from the top in a complete circle and the cap of bone is removed. Underneath a thin layer of tissue, the meninges, are the convoluted gyrations of the brain. The cranial nerves, the carotid arteries and the spinal cord at the base are cut and the brain carefully removed and weighed. The brain will then be carefully sliced looking for any pathologic process. Sometimes, if a neurologic process is suspected, the brain is fixed in formalin for about a week to make it firmer before cutting. After the procedure the cap of bone is returned to its original position and the skin edges sewn together. It is frequently difficult to know that the skull has been opened, unless there is baldness.

The chest and abdominal cavity are opened via a vertical incision extending from underneath the jaw to the pubic bone. The incision extends underneath the skin and jawbone and around the tongue. The posterior pharyngeal wall is opened allowing the neck contents to be withdrawn downwards by sweeping the tissue off the vertebra. The subcutaneous tissues in the chest are dissected laterally over the ribs, where they are divided. The front of the chest wall is removed exposing the chest contents. The incision lower down into the abdomen will expose the abdominal contents. Any fluid within the cavities of the heart, lungs and abdomen is removed and measured. In most instances the body contents are removed and examined outside the body. Specimens or organs demonstrating pathologic findings will have tissue removed for later histologic examination under the microscope. By convention if a specimen was removed from a paired organ such as kidney or lung, the right sided specimen will be cut as a triangle; the left as a square or oblong. At the end of the procedure most of the body organs were replaced back within the body cavity and the skin closed. Some organs were retained for further examination or teaching purposes.

The first postmortem I and my medical school group saw was memorable for many reasons. The first was that the approach to the body was so completely different from the exposure we had had with our cadaver. Our cadaver in the anatomy laboratory was exposed with deliberate care with the emphasis on preservation of muscles and tissues. Here, the emphasis was not on anatomy, but on pathology; to find out what had happened to cause the patient's death. The autopsy was memorable because I saw something that I had never seen before and will never see again. Contemporary physicians will never ever get to see what we saw. The postmortem also brought a message that sometimes patients die in relation to a surgical procedure. Previously I had thought surgeons omnipotent and that patients survived surgical procedures. Now I knew differently.

The patient had an abdominal aortic aneurysm and had recently had surgery to try and prevent rupture of the aneurysm. When the abdominal aorta was opened a bird’s nest of fine wire which could have stretched for a mile or two was exposed. It was bizarre seeing so much wire.

We asked many questions. “How was the wire put into the aorta? What was the purpose of the wire? Why did the patient die?”

Dr Birkenstock, the surgeon who had done the procedure was present at the postmortem to find out the cause of death and he elaborated. “Most aneurysms are excluded from the circulation by ligating or tying off the artery going into the aneursym and ligating the artery going away from the aneursym. The aneurysm thromboses and the risk of rupture becomes less.” What he was expunging was the Hunterian approach to aneurysms coming off small vessels. John Hunter, a Scot was probably the most distinguished scientist and surgeon of the late 18th Century. He was a friend of Jenner of smallpox vaccination fame and surgeon to George III.

The surgeon who had done the wiring procedure continued. “The problem with large arteries is that you cannot simply ligate the vessels above and below the aneurysm. The patient will not survive.” This fact was obvious to me and my fellow third-year medical students. We were all thinking: ‘What about the blood supply downstream, to the legs? Would we not cause gangrene?’

He elaborated. “One way to get around this issue is not to ligate the artery above and below, but to cause thrombosis within the aneurysm. We initiate thrombosis by placing foreign material such as wire within the aneurysm. Clot forms gradually and collateral vessels develop. Eventually the clot will recanalize and small channels will traverse the clot to allow blood flow to be restored. The wall of the aneurysm will become thicker and the risk of rupture will be less.” I do not believe one of the medical students looking in awe at this spectacle of such a large amount of wire believed him. It sounded too far-fetched. But who were we to argue at such an early stage of our careers?

“How do you put the wire in the aorta?” one student asked.

“We place a large-bore needle into the aneurysm through which we pass the end of the wire. The wire is on a spool. We turn a handle and the wire is introduced. When we cannot insert any more wire, we pull the needle back and cut off the wire where it goes into the aneurysm.” He said with some pride.

I cannot remember why the patient died. I believe the images of such a large quantity of wire clouded any thinking that I had that day. Within only one or two years the procedure described became obsolete. The procedure was replaced by one in which the aneurysm was excised, and the intervening aortic ends connected by a dacron tube graft, but even this procedure is being done with less frequency. Many abdominal aortic aneurysms are now being managed percutaneously by placing the graft through the groin vessels. Coiling of aneurysms with fine wire has not disappeared however. Small aneurysms elsewhere in the body, particularly within the brain, are managed by placing coils of wire within them to cause clotting. The wire in this instance is not introduced by an open operation, but by a small steerable catheter introduced through a groin artery and positioned using radiologic imaging.

There were two other autopsies at Medical School that I vividly remember. The first was of a young woman in her twenties who died soon after admission to hospital. She had had a diarrheal illness. We took our seats on the benches around the display table. The organs were lying on the table for the pathologist to discuss with us. Behind lying on the postmortem table with the body cavities open was a beautiful naked woman. It seemed a pity that death had occurred to such a young person.

When we were seated the pathologist came over and gave us a brief history. “There is not much clue to what caused this patient’s death I am afraid. She was admitted with a 5-day history of passing bloody stools and having abdominal pain but died soon after admission without having many investigations. What are the possibilities?” he asked.

We suggested possibilities based on the diarrheal illness. “Crohn’s disease, ulcerative colitis, typhoid fever, shigella dysentery, cholera and amoebiasis” were mentioned.

“And what would cause someone to die from one of those illnesses?” he asked.

We had not at this stage been exposed to deductive thinking before, but it was the obvious next step in our medical training. This deductive thinking would from now on be pushed on us by consultants and residents who taught us and with whom we met the next three years. In retrospect looking back at my training and comparing this training with other physicians, who had trained using different systems, it is apparent that this approach, for this length of time, had prepared us in an excellent manner. The second year had concentrated on anatomy and physiology, a basic groundwork to the third year where we were introduced to the pathology of disease. Possibilities of dehydration and renal dysfunction were suggested.

“But how would dehydration and renal failure cause death?” he asked, taking the argument further.

“Dehydration may cause a drop in blood pressure.” One answered.

“Renal failure would cause coma.” Another answered.

The pathologist continued taking us further along the path we had directed by our answers. “How does a fall in blood pressure cause death? How does coma cause death?”

It was getting more and more difficult to answer these questions and clearly at this stage we did not have enough knowledge to answer all questions posed, but later with experience we could deduce the answers reasonably well. I have been fortunate that I retain, when seeing a patient, an ability to think about possibilities while taking a history. I believe experience over time has honed this ability, possibly because of being continually reinforced by clinical examples. I direct further questioning based on the answers I receive. This ability to think outside the box is what makes good clinicians.

We were answering some of the questions reasonably well, but we were not giving him the answers he was looking for.

“Well” he said, “It could be an electrolyte imbalance. If you had a lot of diarrhea you may have lost of lot of potassium and you would have been prone to arrhythmias such as ventricular fibrillation and death. Alternatively, if the diarrhea caused dehydration, the dehydration may have resulted in renal failure and elevated potassium. Elevated potassium can also cause arrhythmias and death.” He was correct. An injection of potassium is what is used to execute those condemned to die. It is also used to stop the heart during cardiac surgery.

“Let us look at the organs. Perhaps they can give us the answer.” With that he picked up a long knife with a flat blade and a sponge. With his left hand covering the sponge on the top of the large liver to stabilize it, he swept the blade of the knife through the liver horizontally and parallel to the surface of the table. We were unprepared for what happened next. About two liters of blood tinged pus egressed and rolled out the cut sides of the liver like lava flowing over the sides of a volcano.

There was a loud “ahhh” while this was happening and then a mad rush for the exit. About half the class rapidly left the room. I, like my fellow students, was feeling squeamish and nauseous but did not rush out like the others. I did not wish to show any signs of weakness. I was told that about five of my fellow students had vomited into the small hedge that was at the entrance to the building.

We had obviously been set up by the pathologist who had suspected the diagnosis of an amebic liver abscess and was having some fun at our expense. It was obvious to him at removal and palpation of the liver that there was a large abscess cavity. He had already looked at the large bowel where typical ulcers in the ascending colon had been seen and had fitted the pieces of the puzzle together.

When my fellow students returned the pathologist stated. “The likely cause for the patient’s dysentery and liver abscess is amebiasis. We will know for certain when we examine the pathologic slides.” He then asked, “What is amebiasis?”

We had just finished ‘parasitic infections’ in our microbiology classes and one of us answered that the disease was caused by a protozoan parasite Entamoeba histolytica. At our lectures we had all assumed that this disease was a disease of the Third World and common in tropical climates. It was a shock to us all to find that this disease was present in sophisticated Cape Town and could cause death.

“How does amebiasis cause death? He asked. None of us knew the answer. “Well, think about the organs that the disease involves. The abscess in the liver can rupture. It can rupture into the pericardium, the sac around the heart and cause tamponade. It can also rupture into the pleural cavity or lung and cause an empyema. Think about the bowel. The bowel may perforate and cause peritonitis and septicemia. Death may also be due to the mechanisms already mentioned.”

We were then shown the typical ulcers of amebiasis, characteristically “flask-shaped,” with a wide base, often covered by grey slough, and a thin neck that extends to the intestinal lumen. The patient who we were studying at postmortem had no obvious extension of disease from the liver and bowel and the cause of death was presumed to be electrolyte imbalance.

The next postmortem that I vividly remember as a medical student was that of Peter Smith, Chris Barnard’s 3rd heart transplant done on the 9th August 1968. The postmortem was performed on 22nd May 1970 almost 18 months after the transplant. At the time of his death he was one of the longest surviving heart transplant patients. In those beginning days of heart transplantation there was intense interest in the progress of these patients, and this was especially so for those on the Medical school campus alongside Groote Schuur Hospital, where the World’s first heart transplant had been performed.

The postmortem room was crowded. It was standing room only. Present in the room and conducting the postmortem was the pathologist, Professor James Thompson, a very intimidating person. He had a rotund figure, a squarish face and the bushiest eyebrows I have ever seen. The eyebrows moved up and down like a bird flapping its wings and it was difficult to keep one’s eyes away from them. Three times a week he lectured us as the first lecture at 8 o’clock. He had a loud voice with a Scottish accent and was a stickler for an exact description of disease. Present with him in the room were about five other pathologists. I do not recall Chris Barnard being there. I believe he was overseas, but there were other recognizable members of the team, Marius Barnard, Chris’s brother, Dr Bosman, a registrar (resident in the US), Velva Schirre, Head of Cardiology and Jannie Louw, Head of Surgery. Of course, because of the patient who had died, there were more than the usual number of medical students. The students stood towards the back; we were low on the hierarchal totem pole.

Peter Smith, prior to his death had been active and was frequently photographed with another long-term heart transplant patient, Phillip Blaiberg. They were known as the odd couple because a local film advertiser had arranged for them to be photographed outside a film poster starring Walter Mathau and Jack Lemmon, in the movie “The Odd Couple.” Peter Smith had developed abdominal pain and gastroscopy had unfortunately demonstrated stomach cancer. The diagnosis had been made about a month before his demise. At the postmortem everyone was struck by how extensive the cancer had spread; there were multiple cancerous nodules caking the inside of his peritoneal cavity. The pathologists remarked that it was one of the most extensive examples of spread that they had seen. Only later, have these findings of accelerated cancer in transplanted patients, become better understood. The body has its own innate ability that deals with cancer cells, that slows naturally the growth of the cancer. Immunosuppressive therapy used to prevent rejection unfortunately also interferes with the bodies’ ability to deal with infection and with cancer. In centers doing transplants considerable screening takes place to find sub clinical cancer, because often these cancers blossom and extend more rapidly than one would expect.

I was interested in the heart. When at last I was able to look and examine the heart I was struck by how normal it looked. I was struck by small evenly spaced silk sutures that had joined the atria and the great vessels together. Where the donor and recipient heart were joined, the tissue was incorporated and smooth. Later we were shown, by Professor Thompson, the histologic slides of the heart. He stressed to us the lack of lymphocytes surrounding the intramyocardial blood vessels which were indicative of rejection. With a wagging of his bushy eyebrows, he stated in his booming voice; “this heart was perfect.” The attendance at this postmortem left a lasting impression on me. I realized then that rejection was able to be controlled in some patients. Although I did not think about pursuing the specialty of cardiothoracic surgery at the time this postmortem may have subconsciously directed me in that direction.