

Fall 2010

# A Case Study of Appendicitis at Antanimalandy Lutheran Hospital

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## Recommended Citation

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### **Dedication & Acknowledgements**

I would like to dedicate this to everyone at the Lutheran Hospital in Antanimandy who made my stay such an amazing experience. This especially includes my host parents, Clotilde and André, and their wonderful children, Balsam and Ricken, who made my life exciting outside of the Bloc Opertoire, the surgical team of Fano, Olivier, Fanja, Alphonse, and Meriline, who, with their priceless humor and easygoing nature, welcomed me into the Bloc Opertoire, Dr. Lars Fjose who, with his impressive Malagasy language skills and experience in European hospitals helped me not only understand what was going on in the surgery room, but also gave me insights for this project, and last, but certainly not least, Dr. Francis, who tolerated my endless questions and gave me experience in the surgery room that will prove priceless in my studies to become a surgeon myself.

I would also like to thank everyone who made this ISP possible. This especially includes Jim Hansen, Mamy, and Naina of SIT and my parents. And I can't go without thanking my fellow peers who, throughout the entire semester, have been like family.

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## I. Introduction

The island of Madagascar houses a total of 19,159,000 people who spend only \$34 per person per year on health care (“Madagascar,” 2008). The government claims to have “committed itself to the principle that good health is a right of each Malagasy citizen, and has made significant studies in the area of health care,” according to the country study for the Library of Congress. However, with political corruption, political crisis after political crisis, and lack of international support, the government does not dispense the funds necessary to support this commitment (Metz, 1994). For example, in 1976 the percentage of the national budget spent on medical services was 9.2% and new hospitals and medical centers were being built. By 1994, it had dropped to only 2% (Metz, 1994). Two thirds of the population lives at least 5 km from the nearest medical centers and, according to UNICEF in 1993, 35% of the population completely lacked adequate access to health services.

With lack of health care infrastructure from the government, many Malagasy people turn to private health care providers. One private organization that is found throughout Madagascar is SALFA, which stands for “Sampan’Asa Loterana momban’ny Fahaslamana,” the Malagasy Lutheran Church Health Department. Founded in 1979, these centers used to be run by the American Lutheran ministry, who pulled out in the 1980’s due to lack of funding and the political situation of Madagascar (John Kent, 9 Oct 2010). Today, as a Malagasy organization, its goals are to continually assure education and training to medical care professionals, on-going maintenance of equipment, current medical statistics and literature, and forms of care, especially for women, infants and children. There are a total of 90 certified physicians

and 18 dental surgeons who work for 28 centers around Madagascar (SALFA website, 2010). According to sources at Antanimalandy, however, SALFA is not really functioning any longer due to corruption and bankruptcy; an ineffective organization, just like the government's health care system. Therefore all of the SALFA hospitals are practically disjointed and on their own in terms of acquiring medications which used to be highly facilitated by the SALFA system (Fjose, 19 Nov 2010).

#### **A. Hopitaly Loterana Antanimalandy, Mahajanga**

One of these SALFA hospitals lies eight kilometers from the city of Mahajanga along Route Nationale 4: the Lutheran Hospital at Antanimalandy. It employs 3 doctors and houses 36 beds, an operating room, a pharmacy, a laboratory for tests and exams, an X-ray machine, and an Ultrasound machine. The three doctors conduct consultations, which cost 3,000 Ar, in their offices. Patients first attend to the reception area, where weight and temperature are taken and recorded on their "fiche de maladie." This little booklet, which is kept in files in the reception office, holds observations from the doctors, procedures performed, test results, fees, and other important papers. It follows the patient from the doctor's office to the pharmacy, laboratory, central clinic, where the patients are hospitalized, and surgery room. During consultations doctors receive the patients, hear their chief complaint and perform the appropriate action. This action may include performing an exam, such as an ultrasound, a vaginal exam, or an abdominal exam, scheduling tests in the laboratory, prescribing medication, hospitalizing, sending to surgery, or referring to another hospital. Each morning one doctor also does a tour of the hospitalized patients: consulting, examining, and prescribing medications. Nurses distribute the medications paid for by the patient. It was rare to find a patient without family members or friends at their bedside. They are essential in the care of the patients while being hospitalized. They aid the patients in taking their medications, facilitate communication with the nurses and doctors of the hospital, and cook meals under a tree right behind the central clinic. Although it is apparent that the hospital is short on supplies and often

reuses materials that should only be used once, the hospital does have sanitation standards, especially in the surgery room, that are strictly followed and are effectively providing health care to those who need it.

## **B. Appendicitis**

Appendicitis is the acute inflammation of the vermiform appendix, a small blind-ended tube connected to the cecum of the large intestine in the right iliac fossa, which corresponds to the point on the surface called McBurney's point. It was first recognized as a disease entity in the sixteenth century and was called perityphlitis. McBurney described the clinical findings in 1889. (Mishra). It typically results in abdominal pain and tenderness and it is thought to usually be the result of an obstruction of the appendiceal lumen by either lymphoid hyperplasia, the growth of cells to create lymph tissue, a foreign body, or a fecalith, a mass of feces, but it can also be caused by parasitic infection. This obstruction leads to distention, bacterial growth, and inflammation. Typical symptoms include dull, visceral abdominal pain accompanied with nausea and vomiting that shifts to concentrate over McBurney's point with tenderness as well as a low-grade fever. These symptoms, however, appear in less than fifty percent of the patients and often other diagnostic procedures, such as ultrasound or laboratory tests can never rule out appendicitis. The treatment is surgical removal, but if left untreated necrosis, gangrene and perforation occur (Ansari, 2007).

## **C. Objectives**

As a pre-medical student who hopes to become a surgeon, my first objective of this project was to perform participant observation in a surgery room in Madagascar. Before I was exposed to the expensive and extravagant world of surgery in the United States, I wanted to see how surgery functioned in a country where the average inhabitant only spends \$34 on their health care per year.

My second objective was to do a case study of one disease or medical problem that required surgical intervention. The appendectomy presented itself as a procedure performed all over the world that I saw

performed from day 1 of my time in the field. I could look at the clinical and surgical procedure as well as learn about the issues and discussions that doctors still discuss all over the world. For being a medical problem known about for hundreds of years, the diagnosis is still tricky and the surgical procedure is still developing, utilizing new techniques and technology. I wanted to look at how this hospital, Hopitaly Loterana Antanimalandy, performs the appendectomy and handles the issues surrounding this little appendix.

## **II. Methodology**

### **A. Participant Observation**

Participant observation was performed at this hospital over 18 days supplemented by informal interviews with the surgeons, doctors, and surgical team. Most of my time was spent in the Operating Room observing surgery, following the surgical team in their preparation of patients, and giving a helping hand if possible. Twice I had the opportunity to assist in an appendectomy. Other times I attended consultations in the doctor's office, which gave me the opportunity to become familiar with patient diagnosis and the actions of the doctor. Informal interviews were also conducted in the laboratory, the central clinic, where the patients are hospitalized, and the small surgery room, where bandages are replaced, in order to acquire information about the activities of the patients when they are not in the operating room. By conducting research in the field, I could gain an understanding of how the hospital operates as well as the diagnosis and treatment of appendicitis through direct observation or by actively asking questions in informal interviews.

The most important challenge was the language barrier, which made the events, at times, very difficult to follow. Although the surgical team and surgeons knew French, in communication with their coworkers, they always used Malagasy. I soon learned that I just had to excuse my nervousness of being annoying and ask questions whenever I had a chance. One bias that slowly dwindled away during my research, but should still be considered by the reader, is how my experience in American hospitals and my

lack of experience in a surgery room formed how I interrupted my observations. My interest in this project not only stemmed from my own goals to become a surgeon, but also from my inability to imagine how surgery can function in hospitals that do not have access to materials like those of America do. I, therefore, tended to emphasize the shocking in my observations. Realizing this, I have tried to objectively present my observations.

## **B. Case Studies**

By reviewing patient records and conducting a structured oral questionnaire on the appendicitis patients post operatively, I could collect case studies that I could later analyze and compare. Patient records, the “fiche de maladies,” gave information about the patient’s age, sex, and occupation, their chief complaint, the consultation with the doctor, the actions of the doctor, the test results, and, in some cases, information acquired from the place that referred the patient to Antanimalandy. These records give important information about the patient’s history and background as well as the diagnostic procedure performed by the doctor. The structured questionnaire was a way I could get similar information directly from the patient while following observing the patient post-surgically. These two methods culminated to give detailed case studies that covered the events before and after the surgery.

Once again, language proved to be a challenge in my attempt to gain information from the patient in my questionnaire. Translations during the questionnaire tended to be less detailed than I had hoped and the questionnaire had to go through revisions in order to direct the questions towards more detailed answers that could not be misinterpreted or changed depending on the translator. Although one translator for all of the patients would have been ideal, it became impossible with the more pressing events in the hospital that made the employees who spoke French busy.

## **III. Research**

Throughout the 18 days of fieldwork I saw a total of 46 surgeries. In twenty of these cases appendectomies were performed. Twelve cases out of the twenty were solely prospective appendicitis

patients. The other eight cases involved patients who had appendectomies performed while undergoing another abdominal surgery. First, I will present the general diagnostic, clinical and surgical procedures I observed. This information is what I could gather from participant observation in the hospital and informal interviews with employees and patients. The surgical procedure is as performed by Dr. Francis. He was consistent in conducting the procedure in the same way, with slight variations if the appendix had ruptured or another problem presented itself. I will then present the twelve case studies in more detail, highlighting three of them.

### **A. Diagnosis of Appendicitis**

- a. The patient's chief complaint always involved pain in the right iliac fossa. An abdominal exam performed in the consultation usually exemplified sensitivity to palpations to the area. Other chief complaints that are common are nausea, vomiting, and constipation (Dr. Francis, 18 Nov. 2010).
- b. A fever is a common sign of a perforated appendix as the body attempts to rid itself of infection (Dr Francis, 18 Nov 2010).
- c. The C-Reactive Protein test is always scheduled by the doctor in the consultation if appendicitis is possible. According to the instructions provided with the test, this test is a "rapid slide test for the qualitative determination of C-Reactive Protein in human serum" and involves the CRP reagent, which is "a suspension of polystyrene latex particles coated with the gamma globulin fraction of antihuman CRP specific serum. When CRP is present in the sample, presence of agglutination indicates a content of CRP equal or greater than 6 mg/l, without previous sample dilution" (Cypress diagnostics). This test, therefore, may indicate inflammation or a bacterial infection (Dr Francis, 10 Nov 2010).
- d. A complete blood analysis is also scheduled by the doctor. Often with appendicitis patients, a high white blood cell count is found, indicating that the body is attempting to fight off a disease.

A normal white blood cell count is between 4,500 and 10,000 mm<sup>3</sup> (Andrianandraina, 16 Nov 2010).

- e. Ultrasound can sometimes be used to view an inflamed appendix, but sometimes the appendix cannot be viewed in the Ultrasound. The Ultrasound, along with other exams, such as the vaginal exam, is also useful in diagnosing other problems that could cause abdominal pain, such as gynecological problems. A normal ultrasound can hint at appendicitis because there appears to be nothing else wrong with the patient (Dr. Francis, 18 Nov 2010).

## **B. Clinical Treatment and Surgical Procedure**

### a. Pre-Operational Care

Once the doctor diagnoses appendicitis, the patient is hospitalized to have an appendectomy performed the following day. The doctor gives a few instructions and prescribes certain clinical care prior to surgery:

1. NPO: This indicates that the patient cannot eat or drink prior to the surgery.
2. The patient is usually given antibiotics to protect the patient from infection. This is especially crucial if the appendix has ruptured. Antibiotics can also reduce mild cases of appendicitis (Joso, 18 Nov. 2010).
3. For every patient to be operated on, the anesthesiologist must perform an exam prior to the surgery. This assesses the general state, airway, respirations, thorax, abdomen, blood flow, heart activity, and other important information about the patient for the surgery. The anesthesiologist must then decide if the patient has any significant contraindications for anesthesia (Joso, 13 Nov. 2010)

### b. Patient Preparation

1. IV Liquid (Ringer Lactate, Glucose, or Sodium Chloride) is opened and tube is attached. Enough liquid is brought through the line to fill so there are no air holes.
2. Rubber strip is tied tight around the arm between the elbow and wrist. Patient is asked to hold a fist.
3. Anesthesiologist finds the vein with the aid of a few slaps to the area. The IV can either be inserted into veins of the hand, the wrist, or the forearm.
4. To clean the area, cotton swabs soaked in alcohol are rubbed on the area.
5. IV needle is inserted into the vein and the IV liquid is hooked up and opened to flow.
6. IV equipment is bandaged in place.
7. Medicines can be inserted via syringe into an alternate opening in the IV equipment. Ampicillin, an antibiotic, is inserted just prior to the surgery to prevent infection during the incision. Other antibiotics, such as Gentamycin or Flagyl (Metronidazole), are injected during the surgery. Atropine, Dexamethazone, and other medications the anesthesiologist or surgeon thinks are appropriate can also be inserted via IV.

#### Vital Signs

During the surgery, it is the job of the anesthesiologist to observe the patient's health during the surgery. To do this, equipment is necessary to watch respirations, the activity of the heart, and other vital signs. The patient is hooked up to the Cardiocap II machine in three different ways, providing multiple ways to watch the status of the patient.

1. Heart Monitor: 3 pads are placed on specific places on chest. Clamps hooked up to these pads in a specific order.
2. Oxygen Saturation: Apparatus that clamps onto thumb and can read the amount of oxygen in the blood.

3. Blood Pressure Pump: Put between elbow and shoulder on arm that is not being used for the IV

These three ways make it possible for the Cardiocap II machine to show the heart activity, breathing pattern, blood pressure, pulse, and oxygen saturation in the bloodstream while the patient is undergoing surgery.

#### Lumbar Anesthesia (See Figure 1 in Appendix)

1. Patient is asked to sit up and sterile towel is placed on bed where lower back would lie.
2. Cotton swabs soaked in iodine, an antiseptic, are used to clean skin in the middle and lower back via clamp.
3. Anesthesiologist places syringe, spinal needle, Fentanyl, and Bupivacaine on sterile towel and then puts on sterile gloves.
4. Anesthesiologist fills syringe, with no air bubbles, with 50 gamma grams of Fentanyl and 15 mg of Bupivacaine.
5. Using the Iliac, or hip bone to find the space between lumbar vertebrae 2&3, the anesthesiologist goes up one vertebrae to find the space between lumbar vertebrae 3&4, where the anesthesia will be inserted.
6. Inserts spinal needle into this space so that the needle is about half way inserted. Inner stylet is removed.
7. Syringe is attached to spinal needle and anesthesia mixture is inserted slowly.
8. Needle is removed and area is pressed to stop any bleeding.

#### Local Preparation

1. Area from ribs to knees is covered in iodine
2. Four sterile blankets are clamped together to form a box around right lower abdomen.

3. Another bigger sterile blanket with a rectangular hole over the area of incision is laid to cover the entire body. There is a metal bar situated above the patient's chest, which the blanket is laid on to block the patient's view.
4. Just prior to incision, the patient is asked to lift their legs and are squeezed with tweezers to see if anesthesia has effectively numbed area. If it has not, general anesthesia, such as Ketamine, is injected intravenously

c. The Surgery (See Figure 2 in the Appendix)

Incision

1. Scalpel used to make first incision. This incision is about 1 inch long and lies right above the iliac bone. The area is called the McBurney's point.
2. Electrode and scissors are used to cut through skin layers and fat, or superficial fascia. This electrode can also be used to clot blood by either touching directly to tissue or touching a metal object that is touching tissue.
3. Two retractors are placed in either end of the incision to fully expose the opening.
4. Blunt skinny forceps are used to find and pull out the appendix.
5. Sterile cloth sponge is inserted up higher in the stomach to control bleeding

Extraction

1. Appendix is found in the mess of intestines and other organs. Clamps used to isolate.
2. Curved, narrow clamps are used to pierce hole in the mesentery connecting the appendix to the large intestine.
3. A second clamp is inserted into this hole. Vicryl is clamped within it and pulled through the hole in the mesentery.
4. Vicryl is wrapped and tied around the mesentery
5. Scissors are used to cut the mesentery above the vicryl tie.

6. A long straight clamp is clamped right at the base. Just below this, vicryl is tied around the base. Another clamp is clamped right above the first clamp. The first clamp is removed, flipped, and clamped again above the second clamp. The second clamp is removed.
7. The scalpel is covered in iodine and used to slice through the appendix just above the vicryl tie.
8. The electrode is touched to the opening created by the scalpel to coagulate blood and close up the opening.

#### Susurration

1. All sponges are removed from inside abdominal cavity
2. Single interrupted stitches are used to suture up the peritoneum, the muscles, and the fascia.
3. A cotton swab soaked with iodine is spread in and around the wound. Iodine is then wiped off with sterile towel.
4. The superficial fascia, or fat layer, is sutured in a similar fashion.
5. The skin layer is sutured with a continuous intracutaneous stitch that runs underneath the skin parallel to the incision.

#### d. Post Operational Care

1. Area is cleaned with sterile IV liquid and iodine.
2. Gauze and bandage tape is placed on the wound.
3. The patient is placed on a wheeled hospital bed and moved to a hospital bed in one of the rooms of the central clinic, where they will stay for at least 3 days
4. While being hospitalized, the patient receives bandage replacements at least once every 2 days in the small surgery room (Josoa, 17 Nov 2010)

5. The patient also is prescribed more IV liquid, antibiotics, and pain medication.
6. After leaving the hospital 3 days later, the patient will return to receive bandage replacements every two days.
7. They will attend a follow up consultation within the next week.

### C. Case Studies

In this section I will present the 12 case studies but elaborate on 3. Information was gathered from participant observation in the surgery room, the oral patient surveys, or the patient records.

<b>Patient</b>	<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	<b>E</b>	<b>F</b>
Sex	F	M	M	F	M	F
Age	16	15	22	16	20	15
Occupation	na	Student	Fisherman	Student	farmer	student
#1	2 Days	1 week	1 year	1 year	3 years	2 years
#2	100 km	150 km	36 km	120 km	120 km	15 km
#3			sport	sport	farming	sakay
RIF Pain?	+	+	+	+	+	+
Sensitive to Palpitations?	+	+	+	+	+	+
CRP Results	NA	-	+	-	NA	-
WBC	NA	8850	8750	9000	8650	6150
Temperature	NA	NA	37	36.9	37.2	NA
Eosinophil	NA	25	0	9	6	5
#4		Yes	No	No	Yes	Yes injections
Anesthesia	Bupi/Fent	Ketamine Acute: retrocecal	Bupi/sufentanil	Bupi/Fent	Bupi/Fent	Bupi/Fent
Surgeon's Diagnosis	Acute	retrocecal	Acute	Acute	Acute	Acute
#5	Incision	Incision	Incision	Incision	Incision	Incision
<b>Patient</b>	<b>G</b>	<b>H</b>	<b>I</b>	<b>J</b>	<b>K</b>	<b>L</b>
Sex	F	F	F	M	F	M
Age	16	16	30	21	12	44
Occupation	student	student	na	farmer	student	farmer
#1	2 weeks	3 years	2 months	2 months	2 days	since Feb
#2	110 km	10 km	here	150 km	1 km	here
#3	sport&sakay	sakay	work,fisherman	work	NA	walking/work
RIF Pain?	+	+	+	+	+	+
Sensitive to Palpitations?	+	NA	NA	+	+	+
CRP Results	-	NA	-	-	+	-
WBC	6750	NA	14750	6200	10200	8100
Temperature	36.9	NA	37.5	39	38	37
Eosinophil	15	NA	NA	6	7	4

#4	Yes	A little	No, it will heal	No, it will heal	yes strange	No
Anesthesia	Bupi/Fent	Bupi/Fent	Bupi/Fent	Bupi/Fent	General	Bupi/Fent
Surgeon's Diagnosis	Acute	Acute	Not appendicitis	Acute-retrocecal	Perforated Stomach & Head	Acute Point of Injection
#5	Incision	Incision	Stomach & Head	Incision		

Table 1: This table summarizes the 12 case studies. The numbers correspond to the survey conducted to each patient: 1. For how long did you have the pain before the surgery? 2. Where were you diagnosed with appendicitis? 3. What do you think caused the appendicitis in your case? 4. Were you scared of the surgery? 5. Where do you have pain now? RIF stands for Right Iliac Fossa. CRP stands for C-Reactive Protein test, while WBC stands for White Blood Cell count. The Eosenphil count is a section of the Complete Blood Count.

#### Case I: Jean-Jacques (B)

Jean-Jacques was a 15-year-old student who came to the hospital on the 3<sup>rd</sup> of November after being referred to Hopitaly Loterana from his public hospital nearly 120 km away in Mampikony. That hospital was not capable of performing an appendectomy. He had been having abdominal pain for a week that had, in the last two days, worsened. During the consultation the right iliac fossa was sensitive with palpations. The doctor proceeded to hospitalize the patient for surgery, an appendectomy, the next day and scheduled exams with the following significant results: negative C-Reactive Protein test and an analysis of blood showed a white blood cell count of 8850 mm<sup>3</sup> and a eosinophil count of 25%.

On the 4<sup>th</sup> of November, the patient, who was scared of the surgery in general, underwent the appendectomy, performed by Dr. Francis. The patient was fully prepared for the surgery and spinal anesthesia was given to the patient. Just prior to the surgery, the surgeon tested if the patient could feel the area with tweezers and Jean-Jacques replied that he could not. The surgery proceeded, and the appendicitis was difficult to find. The surgeon had to increase the size of the incision. During the search, the patient, after many grimacing looks of pain, informed the surgical team that he could feel the actions of the doctor. The anesthesiologist quickly prepared general anesthesia, 50 mg of ketamine, to introduce intravenously as the patient groaned from pain. Within 30 seconds, Jean-Jacques was unconscious, and the surgeon found the appendix, lying retrocecale, or behind the cecum, soon after. Post surgery, the patient is woken up from the anesthesia while still on the operating table.

The surgeon diagnosed this as acute retrocecale appendicitis post surgery and wrote in the documents that it was a laborious ectomie. He remained in the hospital until the 6<sup>th</sup> of November and complained of slowly dwindling pain from the point of incision. On the 11<sup>th</sup> he returned to the hospital for a follow up in which the doctor diagnosed that the incision was cicatrice and starting to heal.

#### Case II: Claire (I)

Claire was a 30-year-old female who came to the hospital with a temperature of 37.5°C. She complained of having pain in the ears that moved to the right iliac fossa radiating towards the epigastric region. During the consultation a vaginal exam is performed, to make sure it is not a gynecological problem and the doctor notes that the cervix is long and closed, the uterus is of normal volume, and there is white secretion. The doctor schedules exams with the following significant results: a negative C-Reactive Protein test, and a white blood cell count of 14750 mm<sup>3</sup>.

On the 16<sup>th</sup> of November, Dr. Gustave performed the appendectomy on Claire, who was not scared because she was confident this would heal her. Dr. Gustave was disappointed to find that Claire did not have an inflamed appendix (See Figure 3.A.). In the following days after the surgery, Claire proceeded to have slight pain in the abdomen, from the incision, and especially had pain in the head from the anesthesia.

#### Case III: Julienne (K)

Julienne was a 12-year-old student who came to the hospital on the 14<sup>th</sup> of November after being referred from a private practice in the area. She complained of abdominal pain near the pelvic area with vomiting and a temperature of 38°C starting 2 days ago. The abdomen was supple and sensitive to palpations. Dr. Francis noted that acute appendicitis is probable and schedules tests and exams to be done the next day. The ultrasound is performed by Dr. Justine, who notes that the results are normal. The results of the C-Reactive Protein test were positive. The White Blood Cell count was 10,000 mm<sup>3</sup> with an eosophil count of 7%. Julienne is hospitalized and given antibiotics. The following day she retakes the C-

Reactive Protein test, whose results were still positive, and the blood test resulted in a rise of the amount of white blood cells at  $10,200 \text{ mm}^3$ . Dr. Francis reevaluates and sends to surgery that day.

Dr. Francis operates on Julienne, who is very scared because surgery seems “strange” to her. She is fully prepared with lumbar anesthesia, which ends up being ineffective and general anesthesia is needed just prior to surgery. Dr. Francis finds the appendix, which has ruptured (See Figure 3.B.). After removing the appendix, he rinses the area with iodine and then 500 mL of saline to prevent further infection due to the perforated appendix. When suturing the skin, Dr. Francis uses single stitches instead of intracutaneous stitches in case further intervention is needed due to infection. The patient is woken up and transferred to her hospital bed.

On the 19<sup>th</sup>, she is found in her hospital bed still exhausted and complaining of pain in her upper stomach. She is taking Ampicillin, Mebenazole, and Paracetamol, but whenever she tries to take medicine in pill form, she vomits. She has yet to get out of the hospital bed. On the 20<sup>th</sup> she is found awake and still complaining of pain in her upper stomach and a headache

#### **IV. Analysis**

##### **A. Diagnostic, Clinical and Surgical Procedures**

In this section, I constructed a model procedure of the care prospective appendicitis patients receive before, after, and during the treatment: the surgical removal of the appendix. The diagnosis is based on the chief complaint of the patient and also exams done both by the doctor, such as the abdominal exam, and in the laboratory, such as the C-Reactive Protein test. It is apparent, as seen by the chart of case studies, that all patients who were suspected for appendicitis had pain in the right iliac fossa region and that, for those verifiable, all prospective patients were sensitive in the area with palpations during an abdominal exam in the consultation. The laboratory results, on the other hand, are not trusted sources to the surgeons. For example, only 2 out of the 9 patients who had results available for the C-Reactive Protein test had a positive result. This test, according to both Dr. Francis and the lab technician, is the test that

accompanies prospective appendicitis patients and a positive result indicates appendicitis (Dr. Francis 18 Nov 2010). Only three patients out of the 8 who had results available had bodily temperatures higher than or equal to 37.5°C. A high white blood cell count also only accounted for two patients that were operated on, one of whom, the surgeon informed me, did not have appendicitis. These results indicate that at least half of the patients operated on had contradictory results from the laboratory tests. It seems that the surgeon's top sign for appendicitis is the patient's chief complaint: pain and sensitivity in the right iliac fossa. Even so, it is important that prospective appendicitis patients were hospitalized quickly, prescribed antibiotics, and operated on the day after, in fear that it was appendicitis. If the appendix would perforate, infection throughout the abdominal cavity is a major concern.

Local lumbar anesthesia was always the first choice for the anesthesiologists in the operating room. "Its cheap, easy, and safe," Dr. Lars, an anesthesiologist from Norway explained to me. It requires two medications, Fentanyl and Bupivacaine in most cases, takes about 5 minutes to perform, is effective after only 3 minutes, and lasts approximately 6 hours (Fano, 4 Nov 2010). It is the most important step in patient preparation for the surgery and was tested prior to each incision. Two of the twelve appendicitis cases required general anesthesia after unsuccessful spinal taps, which shows that, although there could be more success, lumbar anesthesia is effective in most cases. It is interesting to note that in other countries, such as the United States, spinal anesthesia would not be given to children under the age of 18 (Fjose, 16 Nov 2010).

The laparotomic appendectomy is invasive, but the surgical crew takes many precautions in their care and preparation of the patient. Sterility is meticulously followed in the surgery room, between the tools, tabletops, and area around the incision. Iodine is used liberally to clean the area before the surgery and clean the incision before it is sutured completely. Antibiotics are also provided to the patient just prior to the incision and the suturing to prevent infection. Probably following French sanitation standards, Dr. Lars explained, there are surprisingly low levels of infection here in Madagascar (Fjose, 16 Nov 2010). The

more pressing problem for this hospital is its lack of resources. Many supplies that are instructed for one time use end up being sterilized and used again. Near the end of my stay, the hospital ran out of Fentanyl and was not certain when they would be restocked (Fjose, 22 Nov. 2010). Fentanyl, although not essential to the spinal anesthesia, plays an important role in pain control for the patient.

In other countries, such as the United States, appendectomies are often performed using Laparoscopy. In a laparoscopic appendectomy, the patient is given general anesthesia and three or four little incisions are made around the abdominal cavity. These holes are approximately one third the size of the incision made in the traditional laparotomic appendectomy and hold a miniature camera and surgical equipment. The abdominal cavity is filled up with carbon dioxide, which is termed pneumoperitoneum, so that the surgeon has full visibility and the appendix is removed in a similar fashion. (“Laparoscopic Appendectomy,” 2010). This minimally invasive surgical technique has several advantages: cosmetically, it has a better outcome, there is less tissue dissection and disruption of tissue planes and there is less pain postoperatively with few complications (Mishra). The most important advantage, however, is the capability of exploration that this technique provides to the surgeon. By using the camera, the surgeon can inspect other organs in the abdominal cavity, such as the ovaries, uterus, or intestines, to see if the patient’s abdominal pain is due to another problem. This is especially important in women of childbearing age. But here in Madagascar, Dr. Lars explains, it is not cost effective. A normal laparotomic appendectomy only requires sterile surgical equipment and vicryl. Laparotomy with the use of spinal anesthesia is “perfect” here in Madagascar; cheap, easy, and safe.

## **B. The Case Studies**

Accounting for approximately 26% of all of the surgeries I witnessed while in the field, the appendectomy is a common procedure in this hospital and also around the world. From the summary of case studies (see Table 1), certain trends can be seen in the patients who tend to receive appendectomies. (Note that in the following analysis, nonapplicable patients to certain information are not included in the

statistics). Seven patients out of the twelve were women, which although following, does not indicate findings that more women than men acquire appendicitis (Langenscheidt, 1999). Seven patients were students (all between the ages of 12 and 16), three were farmers, and one was a fisherman. Only two patients were over the age of 22 at 30 and 44, which correspond with studies showing that children between the ages of 15-20 are the most likely to acquire appendicitis (Langenscheidt, 1999).

This hospital received patients from all over the area. Six of the patients came from at least 100 km away and were referred to this hospital for the procedure. Many of the patients came from dispensaries in more rural areas without surgical capabilities. The patient surveys show the perceptions of the patients. Five patients claimed to have been having the pain for one to three years while only 3 claimed to have been having the pain for under 1 week, which is more commonly found in appendicitis patients. While five patients thought the appendicitis was provoked by exercise or physical activity, three imagined the pain caused by sakay, a traditional Malagasy hot sauce made out of hot peppers. These results are especially interesting because they show how much the patients are aware of the medical causes of appendicitis. Whether the pain comes on gradually or all of a sudden, the human mind seems to associate the cause of the pain to an action. Because those were the only two possible responses to the question, it also might indicate that culturally, it is accepted that sakay and physical activity are the causes of appendicitis or, at least, pain in the abdomen.

The surveys also show information about the patient's situation and experience. While it is hard to determine if these patients did have appendicitis or not because the appendices were not histologically examined, post-surgical examination can determine if there is still a health problem with the patient. The surgeon claimed that the appendices were inflamed with appendicitis in all but one case. The inflammation varied from "a little inflamed" to "very inflamed." Two appendices were located retrocecal and one appendix had perforated. Nine of the patients complained of just the incision still causing pain or discomfort at the time of the survey, while one complained of pain at the point of injection for the spinal

anesthesia. Two patients complained of a headache, which occurs often with spinal anesthesia. The patient, Claire, that did not have appendicitis, according to the surgeon, Dr. Gustave, still had abdominal pain, presumably because there is something else causing her discomfort. In the consultation she explained her pain differently than other prospective appendicitis patients, explaining that it started in her ears and was radiating towards the epigastric region. She also had negative results to the C Reactive Protein test. The appendix was not inflamed, according to Dr. Gustave, but the white blood cell count indicates inflammation. Since it is not the appendix, there must be another organ that is inflamed and still causing her pain in the abdomen (Andranandraina, 16 Nov. 2010). Jean-Jacques, on the other hand, was diagnosed with appendicitis, and his high eosinophil count might indicate that he had a parasitic infection.

The patient with the perforated appendix, Julienne, Case III, was in the worse shape at the time of the survey and complained of upper abdominal pain, which could be caused by infection or complications of the perforation. Necessary precautions were made to attempt to clean the abdominal cavity with iodine and saline, but it was possible that there would still be complications, hence the reason why Dr. Francis sutured the incision with single stitches, which are easier to remove if further intervention is needed. Julienne, and especially Jean-Jacques, also presented the problems of ineffective anesthesia. In Julienne's case, the ineffectiveness was caught before the surgery could commence, but for Jean-Jacques, serious pain was endured. Spinal anesthesia might be safe and cheap, but further precautions need to be taken to assure the effectiveness of the anesthesia.

### **C. The Issues**

#### **a. To Take or Not to Take**

The two surgeons at Antanimalandy exemplify the two sides of an age-old discussion about the appendix: to take or not to take. Dr. Gustave is of the opinion that the appendix should only be removed if it is inflamed with appendicitis. He believes in the "recent evidence that suggests that the appendix may have a role in the immunological functions of the body, especially in the maturation of B lymphocytes"

(Gupta, 1989). During my stay at the hospital I saw him remove only 2 appendices. In the case of Claire, he was not happy to remove her healthy appendix, but he found it difficult not to remove it midway through the surgery. Dr. Francis, on the other hand, is of the opinion that it is better to remove the appendix in order to not risk appendicitis in the future. “As the appendix has come to be regarded as a functionless organ which can cause morbidity and mortality, surgeons have tended to resect it at the first possible opportunity” (Gupta, 1989). As seen by the case studies and laboratory exam results, the decision to remove the appendix is often made after only a single clinical examination. Dr. Francis also performed many appendectomies on patients who were undergoing abdominal surgeries for other reasons. In this discussion, many questions remain for both sides of the argument: Is an increase in maturation of B lymphocytes worth risking death due to appendicitis in the future? Should an appendix be removed when the patient is over 25, since, most of the time, appendicitis seems to present itself in a younger age group? These are all questions that make appendectomies a hot topic, but I cannot determine if Dr. Gustave or Dr. Francis does it correctly: it is always up to the surgeon and the patient. It is always case specific.

#### b. Epidemiology of Appendicitis

One of the most interesting discussions I encountered during my research was the contradictory information about the epidemiology of appendicitis. With high levels of appendectomies, many health care providers in Madagascar, including members of the surgical team at Antanimalandy and Dr. Francis, believe that there is a high rate of appendicitis in Madagascar due to parasites and high rates of infection. According to records, 63 out of 396, or 16%, of the surgeries performed at the Lutheran Hospital at Antanimalandy in the last 5 months were documented as acute appendicitis. A study in Nigeria found similar results, saying that appendicitis was the most common cause of acute abdominal surgery (Ajao, 1979). The problem is the methodology in acquiring this information: were these sources measuring the number of appendectomies or measuring the amount of histologically researched extracted appendices that exemplified appendicitis?

Although the hospital did not have the resources available to histologically examine appendices at Antanimalandy, I believe that there is a high level of negative appendectomy at Antanimalandy. The appendectomy of Claire represents a negative case: the appendix was removed, but, according to Dr Gustave, did not have appendicitis. Although there is no way to determine the rate of negative appendectomy in the 12 case studies outlined in this paper due to lack of resources, a similar study, published in 1999, that did have the capabilities was performed at a teaching hospital in Mahajanga. This study histologically examined 130 appendices extracted for appendicitis at this hospital and found that although there are high rates of appendectomies performed, only 14% of the appendices showed signs of acute inflammation. The researchers commented that “it was also interesting to note that most appendectomies in Mahajanga were recorded as being done for ‘acute appendicitis’ by the local surgeons” (Langenscheidt). Similarly, even though Dr. Gustave was aware that Claire’s appendix was not inflamed, he recorded that the surgery was done for acute appendicitis. No indication is made to distinguish between the appendectomy patients who did have appendicitis and those who did not.

Having the appendix histologically examined is not only essential in identifying the appendices that have appendicitis and those that do not, it is also helpful in discovering the cause of the inflammation of the appendix and treating the patient post surgically. In a study in India, only 2.5% of the appendices were found to have parasitic infestation. This further draws from the support that appendicitis is common in countries like Madagascar, because even though there were cases of appendicitis caused by parasitic infection, 2.5% is not significant enough to explain that appendicitis is much more common in tropical countries. It should be noted, however, that this statistic might change in the case of Madagascar according to the prevalence of parasitic infections in comparison with India. High levels of eosinophil in the blood could indicate a parasitic infection. It is possible that some of these cases outlined in this project have parasitic infection, such as Jean-Jacques. The normal eosinophil count is 1-3%, but Jean-Jacques had an eosinophil count of 25%, and patient G had a count of 15%. Six of nine of the cases have an eosinophil

count of 6% or higher. It is important that appendicitis patients with parasitic infection be treated with certain medications after the surgery.

In the same study, 2.4% of the cases were found to have tuberculosis of the appendix. Tuberculosis is a curable disease that can be dangerous if left untreated. It is a major problem all over the world and was a very common disease in the area of Mahajanga, as seen by the amount of patients the hospital received with Tuberculosis. Tuberculosis localized around the appendix also has similar symptoms as acute appendicitis. Tuberculosis of the appendix shows “no definite pattern or distinguishing features to differentiate it from the ordinary acute or recurrent appendicitis” (Drissen). This means that often times, appendicitis could be mistaken as tuberculosis of the appendix. Isolated tuberculosis of the appendix is rare and parts of the intestines are almost always involved (Gupta, 1979). If the appendix is removed and the surgeon assumes that the cause of the inflammation was solely appendicitis, the tuberculosis could remain neglected by the health care professionals who thought it was regular appendicitis.

According to one study, tuberculosis of the appendix is difficult to differentiate from regular acute appendicitis, but there are trends. Some of the observed symptoms include longer duration of symptoms, known exposure to pulmonary tuberculosis, and absence of vomiting. Considering the prevalence of pulmonary tuberculosis in the area and the fact that 8 of the 12 case studies at Antanimalandy complained of pain for more than two weeks, sometimes up to 3 years, and little vomiting, it is possible that some of these cases had acute tuberculous appendicitis. With both tuberculosis and parasitic infection, which are common in Madagascar, specific post surgical care is required to heal the patient. It is therefore important to send extracted appendices to be histologically examined so that the diagnosis of the patient can be determined.

## **V. Conclusion**

In this study, the diagnostic, clinical and surgical procedures performed at the Lutheran Hospital at Antanimalandy were described in detail. Case studies were also presented to exemplify these procedures and see how every case is unique. In this way, appendicitis and appendectomies were fully explored by

using methods of participant observation, informal interviews, and case studies. These two methods of results also explore the issues that doctors at this hospital, and all around the world discuss: Should the appendectomy be performed Laparotomicly or Laparoscopicly? Is the appendix a vestigial organ? Should negative appendectomy be avoided? How important is histological examination? This project merely scratches the surface of these issues.

Although this is a thorough examination of appendectomies and appendicitis, this project could not possibly capture my experiences in the operating room. The most significant lesson I learned throughout the study was the ambiguity of diagnosis and medicine. The results of my study with interpretations made with secondary sources reveals that there are two actions this hospital can take to better their diagnosis of prospective appendicitis patients: construct an effective procedure for diagnosing the patient for appendicitis and histologically examining samples of the extracted appendix. I've learned, however, that, though both of these things may aid in improving the rate of negative appendectomies and improving post surgical care, there will always be a level of ambiguity when diagnosing appendicitis. This only leaves one very important lesson doctors and patients must realize: each case must be taken as its own. An assembly line approach to diagnosing and treating appendicitis is not the solution: no appendicitis presents itself in the same way.

## VII. Glossary of Medications

**Ampicillin:** an antibiotic in the penicillin group of drugs

**Metronidazole (Flagyl):** an oral antiprotozoal and antibacterial

**Gentamycin:** An antibiotic used to treat severe or serious bacterial infections

**Fentanyl:** a narcotic (opiod) pain medication that is closely related to morphine, but is 100 times more potent.

**Bupivacaine:** an local anesthesia used in the spine that blocks nerve impulses that send pain signals to your brain

**Atropine:** Relief from spasms of the gastrointestinal tract; reduction of secretions from the nose, lungs, salivary glands, and stomach; maintenance of proper heart function

**Dexamethazone:** a steroid that prevents the release of substances in the body that cause inflammation

**Ketamine:** a general anesthesia used to preven pain and discomfort during certain medical tests, procedures, or minor surgeries

**Mebendazole:** an antihelminic, or anti-worm, medication that prevents worms from growing or multiplying in your body

**Paracetamol (Acetaminophen):** a pain reliever and fever reducer

**Sufentanil:** a narcotic (opiod) analgesic that works in the brain and nervous system to cause anesthesia and decrease pain; an analogue of fentanyl

Note: All information received from medication profiles on drugs.com

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