

# The Pacemaker

For this Virtual Science fair, my partner and I (Anthony) decided to take on the subject of the Pacemaker. It is a very interesting subject with lots of Canadian history involved. This report will talk to you about the different aspects of the pacemaker; from the inventor, to its recent innovations. Hope you enjoy our project.

## WHAT IS A PACEMAKER?

The Pacemaker is a battery-powered implantable devices that function to electrically stimulate the heart to contract and thus to pump blood through out the body. These devices are used to help patients with very slow heart beats. A regular pacemaker weighs about an ounce, and has an area of 30cm<sup>2</sup>.

## DIFFERENT KINDS OF PACEMAKER.

There are many different sorts of pacemaker. I will tell you about some of them. A single-chamber pacemaker has one lead while a dual-chamber has two leads. Dual chamber pacemakers have two leads: one in the atrium and one in the ventricle. Dual-chamber pacemakers are more complex and sophisticated than single-chamber pacemakers. A dual chamber pacemaker can receive signal from both the ventricle and the atrium. It can also coordinate the signals and contractions of the atria and the ventricles to help the heart beat more efficiently. There is an external pacemaker for people with small abnormalities in their heart rhythm. The body normally has a pacemaker when you are born but some peoples stop working so that is where the man made pacemaker comes in.

Pacemaker systems are often implanted under local anaesthesia in a cardiac catheterization laboratory. Implantation of a pacemaker is considered a minor procedure. Some hospitals with electrophysiology laboratories implant pacemakers there. A pacemaker is implanted just below the collarbone in a procedure that takes about two hours. Each pacemaker can last up to around ten years without a change.

### THE INVENTION OF THE PACEMAKER

The Pacemaker was created by doctor John A Hopps. Dr. Hopps was a medical engineer at the time and was called the father of that type of medicine. No one in the past had ever used this field of medicine for the heart. It is said that he invented the first pacemaker in 1949. Dr. W.G. Bigelow and Dr. J.C. Callaghan were the two other Canadians who helped Dr. Hopps create the first Pacemaker. This invention was created at the Bunting Medical Centre in Toronto. Dr. Hopps Pacemaker was put on the list of top 5 medical innovations in 1999. He also created the first electrical device to be implanted in a Human. Nowadays, the pacemaker is very widely used to remedy a low heart beat count. John Hopps was named one of the greatest Canadians to ever live.

The 1958 surgery, performed in Stockholm by Dr. Ake Senning, changed the life of recipient Arne Larsson, a 43-year-old suffering from a severe heart condition. He lived an active life for another 43 years and received a total of 26 pacemakers during that time. This means that since evolution is always changing and new heart problems arrive which makes it hard for adaptation and that is why new pace makers come out. Most of the new ones are just improvements like the old ones. For example if they ran out of battery power quickly. Or this one time when the man was not informed that his battery was out and after time it leaked which created lots of problems for him and he

eventually died. Permanent Pacemaker: A permanent pacemaker has two parts; the pacemaker chamber and the lead(s). The pacemaker chamber contains a timing device for setting the pacing rate, a circuitry system that detects electrical signals from the heart, and a battery, this was a good pacemaker but it was very complicated which is why you see rarely of those kinds and now we have single chambered pacemakers, also the old types had metal which could be alerted if a magnet was near. (Medicine Net, 1996). Now rate responsive pacemakers are built to adjust to the person's heart rate and physical fitness for people who are fairly young and have a very active life.

#### RECENT INNOVATIONS

The first ever pacemaker was external, because the technology was not advanced enough to allow a person to have an internal pacemaker. This made it very painful to move since there were wires sticking into your body, and sometimes the pain was so great that patients would rather have no pacemaker and live less but pain free. (Medtronic, 2001). The problem was that the patient who had this could go as long as their extension cord would let them, and even then the pain would be too great for the person to keep on moving (Medtronic, 2001).

#### RELATED INNOVATIONS

The heart is divided into right and left sides. Each side has a chamber that receives blood that is returned to the heart (called the left and right atria) and a muscular chamber that is responsible for pumping blood out of the heart (called the left and right ventricles). The heart's normal "spark plug" is an area of specialized heart tissue called the SA node, which is located in the right atrium. Each time this tissue "fires," an electrical impulse is generated that travels first through the right and left atria, signaling

these chambers to contract and pump blood into the ventricles. The impulse then travels down into another small patch of specialized heart tissue called the AV node, which is located between the atria and the ventricles. All this is what the real heart pacemaker is and also this is what a pacemaker tries to recreate. (Pacemaker 2007). The electrical impulse is conducted through the AV node and then through specialized wire-like pathways into the ventricles, where it signals the ventricles to contract and to pump blood out into the lungs and throughout the body. This normal sequence of electrical activation of the chambers of the heart is called sinus rhythm. It occurs each time the heart beats, usually about 60 to 80 times every minute.

#### HOW THE HEART WORKS

A pacemaker comes in if this rate drops dramatically, mostly for old people from 45 and up. The right atrium receives venous blood (blood with no oxygen in, usually is blood coming) from the body and pumps it into the right ventricle. The right ventricle pumps the oxygen-poor blood to the lungs to receive oxygen. (Medicine Net, 1996). The oxygen-rich blood from the lungs then travels to the left atrium and is pumped by the left atrium into the left ventricle. The left ventricle delivers the oxygen-rich blood to the rest of the body. In addition to oxygen, the blood transports other nutrients (glucose, electrolytes, etc.) to the organs.

In order to keep a body healthy, the heart must maintain an adequate heartbeat (heart rate) so that sufficient amount of oxygen and nutrients are delivered by the left ventricle to the body. (Medicine Net, 1996). The oxygen-rich blood from the lungs then travels to the left atrium and is pumped by the left atrium into the left ventricle. The left ventricle delivers the oxygen-rich blood to the rest of the body. In addition to oxygen, the

blood transports other nutrients (glucose, electrolytes, etc.) to the organs. In order to keep a body healthy, the heart must maintain an adequate heartbeat (heart rate) so that sufficient amount of oxygen and nutrients are delivered by the left ventricle to the body. (Medicine Net, 1996). Each individual heartbeat is actually a collection of several muscle movements spurred into action by electrical impulses. (Pacemakers, 2002). The heart has its own pacemaker; it is composed of electrically active cells which is located in the upper right heart chamber. (Pacemakers, 2002). It sends a steady stream of electrical impulses to the heart which keeps it going all the time. (Pacemakers, 2002).

### MISCELLANEOUS

Hopps himself received a pacemaker in 1984. It lasted for 13 years before he informed his doctors that the signal was getting weak and it required a new battery. Hopps died in 1998. (CBC archive, 2006). Abnormally slow heart rates (bradycardias) can result from diseases affecting the SA node, the conduction tissues, and the AV node. Sick sinus syndrome is a disease wherein the SA node cannot generate signals frequently enough to maintain adequate heart rate. (Medicine Net, 2007). Dr. William Bigelow and Dr. John Callaghan invented it (the pacemaker, 2003). When they were studying for open heart surgery the problem was that they could not make a heart restart beating so many patients died (the pacemaker, 2003)

To conclude we both thought that the pacemaker was an excellent innovation. It has saved over thousands of people world wide, and continues to evolve to benefit our life style. The pacemaker we think is a great idea because nothing could ever do what it did and it will never get replaced, just upgraded. It is just like air we all need it but

without it our society would be at a down fall, many people would not live past 40. So even if you think something so small is useless think again.

#### References:

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