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Embedded Chip Implant at Bone Marrow to Monitor Immunity Levels for AIDS and Tumor Patients

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Abstract. The paper aims at providing accurate count of the WBC cells in our body by implanting micro-embedded chips at eight bone marrows in our body. The present systems used to count the WBC's can only be performed at hospitals by a well trained professional. But the system devised by us can even be used by ordinary citizens in their homes, which might improve the comfort factor. Also it will be pain-free. There will be no need for waiting for results since it will be processed within a few seconds. All these are performed at real time.

Keywords: Bone marrow, Embedded chips, WBC's

1. Introduction

Blood, the fluid running in our body acts as a fuel to the man-machine. When we have a closer look at blood, it has three different cells-RBC (Red Blood Corpuscles), WBC (White Blood Corpuscles), Blood Platelets.Among these three, WBC's can be called as the security system of our body. They defend our body against infectious diseases and foreign materials. So they can be referred to as the 'Important to the Important'. In medical terms, they are called Leukocytes.

So when there is a decrease or increase in these important cells, our body may be under the threat of attack by diseases. So it is important to know about its count. There are two count procedures followed by hospitals worldwide-Manual count and Electronic count. The Manual count is performed by taking out a blood sample of 3.5ml through Vein puncture. It is performed by a trained 'phlebotomist'.But there are high chances of error since there may be dilution of sample and variations in the distribution of cells in the chamber. In the electronic counting, cell counter and image analysis procedure is used. Then for differential in blood cells, the sample is spread on a thin film, which is placed on a glass slide for microscopic analysis. There may be interference, caused by small fibrin clots, clumped platelets and unlysed RBC's. Also a common drawback in both these methods is they take a sample from our body, where the phlebotomist can see the veins. There maybe a case that the WBC's maybe concentrated more in other areas than the one, where vein puncture is performed. Our idea provides an alternative to the above mentioned drawbacks. It can also complement with the present system.

2. Architecture

Our implant chip consists of a micro chamber with a micro membrane, an Analyzer with micro counter, a power supply and a micro transmitter. Before detailing about the process of each one, let's see about the positioning of the chips.

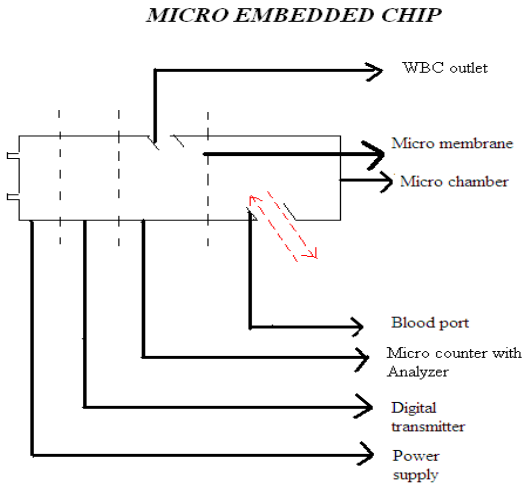

Fig. 1: The Micro Chip

2.1. Positioning of the Chip

We previously mentioned that the main drawback of the current system is that the doctors don't know the exact area where the WBC's are concentrated. So the chips should be positioned where we are confident that the concentration is more. There is only one position like that. It is the Bone marrow, where the WBC's are produced. We implant 10 chips totally- eight at the eight bone marrows and the other two at left arm triceps and right forearm. We can justify our positioning. The WBC's are produced at the multi-potent cells in bone marrow called as 'hematoprietic stem cells'. The count at this area is 36,000-42,000.If we find that the count is low in this area itself then there is a big threat waiting to attack our body. So, after confirming the bone marrow produces correct number of cells, we have to check whether the flow of the WBC's in the other parts of the body are precise. So to check this case, we have to place my chips at areas where there is a high-blood flow. That's the reason why we positioned our two chips at triceps and forearms, where there is a high blood flow. Now let's see about the working concept.

2.2. Working

After the successful positioning of the chips in our body, lets see how it works when it is implanted inside our body.

2.2.1. Micro Chamber with Micro Membrane

The Micro Chamber is the part where the blood enters the chip. There is a port made for the blood cells to enter the chip. It is designed in such a way that it allows only a micro liter of blood to come through. The pressure is provided by our body pressure. Once it had entered the chamber, it encounters a micro membrane, which has holes about 14 micro meters in diameter.

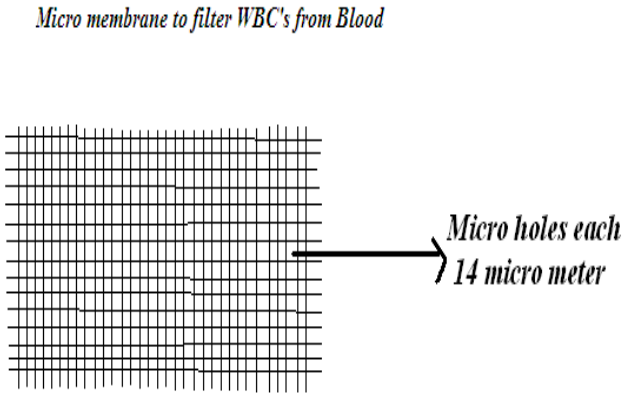

Fig. 2: The Micro membrane in the Micro Chamber

It is used to filter the WBC's from other parts viz., RBC, platelets. We can be sure that only WBC passes through this membrane.

2.2.2. Analyzer with Micro Counter

Now after a filtration, there is a small tube, radius of 14 micrometer, where the WBC's flow outwards (i.e.) from chip to body. The tube is provided with a micro counter so the number of cells entering the tube is counted. So, in Analyzer we have predefined the number of WBC (i.e.) 36000-42000 for Bone marrow chips, 4500-11000 for the other 2 chips. We are producing two analyzers for our system. It compares the predefined value with the counted value got from the micro counter.

2.2.3. Digital Transmitter

Now, the Digital Transmitter is brought into process. Both Analyzer and Digital Transmitter are connected to each other. When the count is normal, it transmits "10" . If count is less than normal (or) higher than normal, "00" and "11" are transmitted respectively. In the case of the two chips implanted away from bone marrows if the count is less than 1000, then it clearly implant that the concentration of WBC's is not uniform and transmits a "01" meaning an error in the sample.

2.2.4. Power Supply and External Circuit

We can't use single usage batteries (or) rechargeable batteries. So, we implement concept of Wireless power transmission. These are normally implemented in Super Markets to detect theft of goods; we are using the concept here.

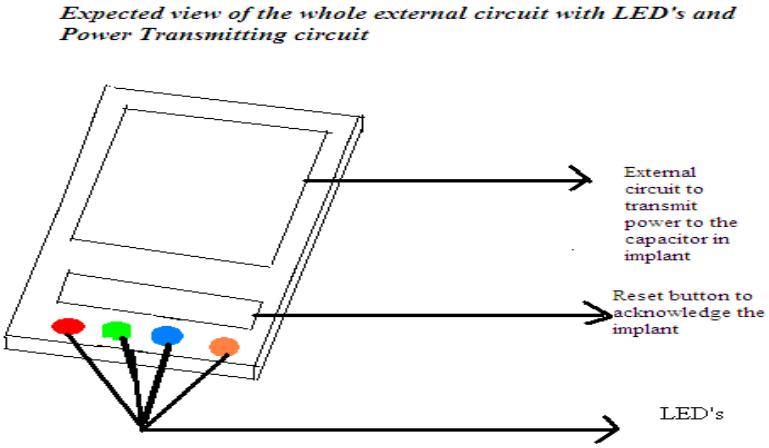

Fig. 3: Power Transmitting External Circuit

Here the External Circuit is recharged as we do in a mobile phone. The circuit in implanted chip consists of a capacitor. We use a parallel plate capacitor. So after charging the external circuit, if we rub it near the areas where the chips are implanted the power will be transmitted wirelessly to the circuit inside the implanted chip. The power will be stored as energy inside the parallel plate capacitor.

$W = 0.5\ C\ (V^2)\ J$

Where,

C- Capacitance of the Capacitor

V- Electric potential

W- Energy stored in the capacitor

The rubbing against the chip is to be done about eight times a day, so that there will be enough power to carry out the process in real time.

BLOCK DIAGRAM SHOWING THE EXTERNAL ALERT SYSTEM

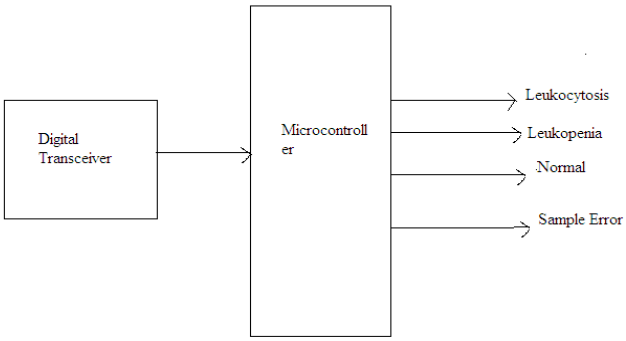

Fig. 4: Block diagram of the external Alert System

Now, other than the wireless power transmission circuit, we have a digital transceiver, a microcontroller with memory and some LED's. The transceiver receives the transmitted data from the digital transmitter in the implanted chip and sends it to the microcontroller. This microcontroller analyses the received data. If any "11" is received, the yellow LED burns, signaling it as a sign for Leukocytosis, medical term for high WBC count. If there is any "00", then red LED burns. It says Leukopenia, meaning low WBC count. If there is normal "10", then green LED burns. As said earlier if there is a sample error, blue LED burns implying "01" had been received from the implanted chip.

3. Sterilization

Sterilization is the important aspect. We have to sterilize any electronic chips before implanting it in the human body. Normally all equipments will be sterilized at about 300 degrees. But since we are talking about electronic embedded microchips here, it can't withstand heat or humidity. So we are using an alternative method. The chips are put in a sealed container and exposed to Ethylene oxide. It is placed inside the box for two days. After two days, it can be taken out to implant. We call these two days as Incubation period.

4. Chip Specifications

The size of this chip will be slightly longer than a single wheat grain. The length specifications are (0.75x0.5x0.75) inches.

5. Implanting Chip

So after seeing about the working and chip specifications, we now see how we implant these chips. At the eight bone marrow, we perform bone marrow biopsy to implant the chips. For the other two chips we perform normal surgery. The patient will be in bed for a couple of days after the surgery.

6. Conclusion

This implanted chip system provides accurate information regarding the WBC count. It will have an important say in medication of AIDS affected (or) Tumor affected patients since their WBC rate will always be under the normal rate. If we get to know about their WBC count details and the exact time when the rate decreases even slightly, we might be able to give them medications at that time which will be better-off than giving medications when the patient comes to hospitals once in a few weeks, when the WBC count would have decreased even more and the patient in death bed. In case if the WBC count is high, it will also be indicated by our device. But as many think higher WBC count is a dangerous condition. Bone marrow tumors maybe a cause for this situation. It will be important that doctors diagnose this condition. We wouldn't say that our chip will be able to save people lives but it will provide vital information to save people.