

Where is the pacemaker in the womb?

In our body, we have several types of muscles to perform many types of activities, such as moving our skeleton (i.e. walking), pumping our blood around (heart and vessels) or absorbing and propelling our food in the stomach and the intestines. Also the uterus (= the womb) in woman consists of muscles that have to contract when delivering a baby.

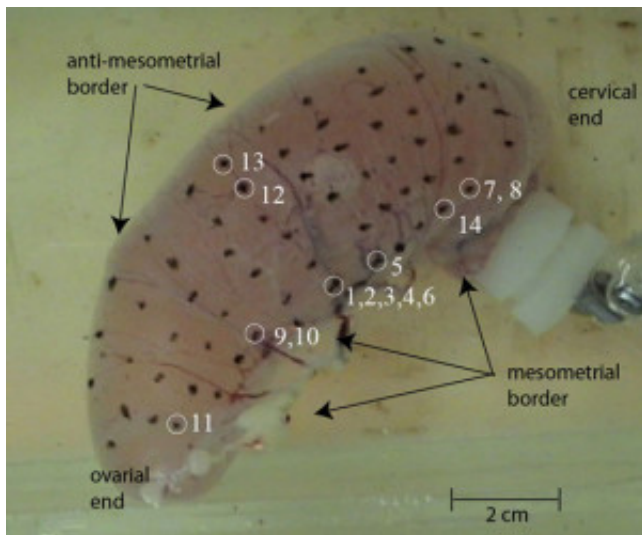


Fig. 1. The origins of 14 spontaneous contractions (i.e. pacemakers) are indicated on the surface of an isolated guinea pig uterus. The vast majority of pacemakers were located close to or on the mesometrial border.

Contraction in these muscles is always started by an electrical impulse, called an action potential. These action potentials originate from various sources. In the heart for example, there is one specific location, the pacemaker, which generates automatically these action potentials. Once generated in the cardiac pacemaker, the action potentials propagate through the heart and initiate a contraction. The same is true in the stomach. The stomach also has a specific location that initiates action potentials that propagate through the stomach and makes it contract. The question in this study was, where is the pacemaker in the pregnant uterus?

To study this question, we examined the behavior of the pregnant uterus in two different species: the guinea pig and the rat. Both animals were made pregnant. Then the animals were properly anaesthetized, the pregnant wombs removed from the body and placed in an organ bath filled with a fluid that kept these uteri alive.

Then we did two things. With the uterus from the guinea pigs, we simply watched where the contractions started as this would indicate where the pacemaker was located. We did this by

recording the contractions on video so that we could replay the movies time and time again (see videos). To our surprise, we saw that the contractions did not always start from the same location but could change from one site to another. In other words, there was not one single pacemaker, such as in the heart and in the stomach, but multiple pacemaker locations (see figure 1). Second, we saw that most pacemaker sites were located close to the mesometrial border. This border is important because this is the connection between the uterus and the rest of the body where blood vessels and nerves go in and out of the uterus. Apparently, this area is also important for generating action potentials.

With the uterus from the pregnant rats we did something else. We opened the uterus, which looks like a tube, and spread it flat in the tissue bath, again filled with a nutritious fluid to keep it alive (see figure 2). On top of the muscle, we placed an electrode array of 240 electrodes. Remember that the pacemaker generates action potentials that propagate through the uterus. All these 240 electrodes pick-up a signal from the action potential as it propagates through the tissue underneath the electrodes. The very first electrode that picks-up a signal is therefore located at or close to the pacemaker. And again, we saw not one but several pacemaker sites and, again, most were located close to the mesometrial border (see figure 2).

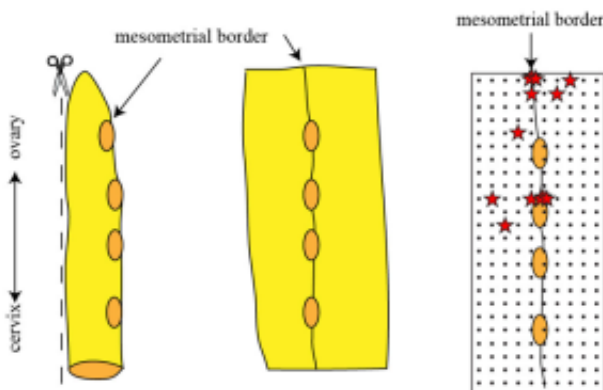


Fig. 2. Pacemakers in the rat uterus. In the left diagram, it is shown how the uterus was cut open. The second diagram shows the opened uterus sheet with the mesometrial border running down the middle. In the right panel, every red star indicates the location of a pacemaker. As you can see, most of them are located close to the mesometrial border. Every black dot indicates the location of 1 of the 240 recording electrodes.

What does this tell us? Well, it is probably safer to have more than one pacemaker in the uterus. After all, if you only have one pacemaker, and there is something wrong with it, then the uterus will no longer work properly. This is for example the case in the heart. If there is something wrong in the cardiac pacemaker then you either die or, if you are lucky, you can get an artificial pacemaker. In the uterus, this is not really necessary as other pacemakers are already there to take over.

But of course, we need to do more work, also to study this behavior in other animals that are more like humans and hopefully one day we could make those measurements in humans. In fact, there are now research groups that are trying to detect electrical signals through the skin of the belly of a pregnant woman. If this approach is successful, we could one day locate the pacemaker of the womb in humans!

Several videos related to this work can be seen on YouTube:

Major contraction - <http://youtu.be/moCqbJTuuRw>

Local Contractions – <http://youtu.be/kZSwof2Nh7c>

Publication

[The Location of Pacemakers in the Uteri of Pregnant Guinea Pigs and Rats.](#)

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Am J Physiol Regul Integr Comp Physiol. 2015 Sep 16