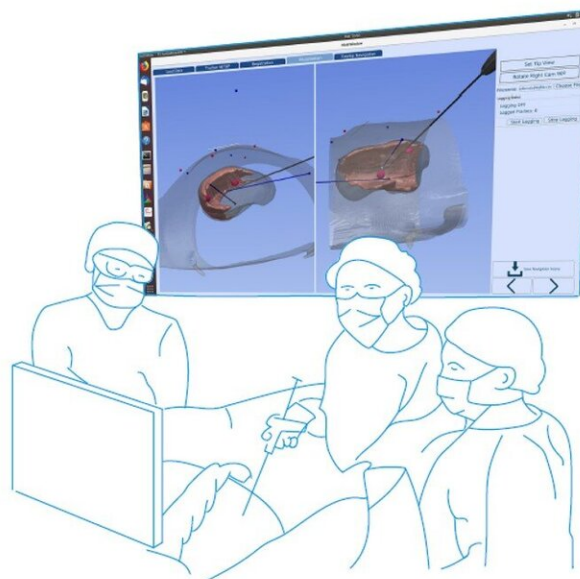


Research team creates a surgical navigation system for fetal surgery

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The new surgical GPS provides greater precision, shortens the duration of surgery and reduces mortality rates. Credit: BCNatal

The placenta of every expectant mother is located in a different place, its blood vessels are never the same, and its connection to the fetus and the umbilical cord also varies from one pregnancy to another. Moreover, the

fetus is also always in a different position in each case and floating in amniotic fluid. The fetus is surrounded by highly delicate membranes that can only be perforated once so as not to risk losing the pregnancy. So, when a fetus has a life-threatening condition and requires an emergency intervention in the womb, the fetal surgeon faces a huge challenge because he/she has to decide very precisely where to enter the uterus and, once inside, has very few references to navigate safely.

To date, the surgeon could only resort to an ultrasound to guide the entrance to the uterus and the movement of surgical tools to the [fetus](#). Now, a team of professionals from BCNatal, a consortium formed by Hospital Sant Joan de Déu and Hospital Clínic in collaboration with the team of M.A. González Ballester, ICREA research professor with the Department of Information and Communication Technologies (DTIC) at UPF, has developed for the first time, a system of three-dimensional surgical planning and navigation for [fetal surgery](#) that offers many advantages: greater precision for the surgeon, shorter operating time, and in the future, it is set to improve the results by making fetal [surgery](#) more accessible.

The system provides a virtual reconstruction of the placenta based on MRI and ultrasound. With this 3-D map of the placenta, before the procedure, the fetal surgeon has a much more accurate understanding of the status of the placenta and the [umbilical cord](#), and can analyse which is the best entry point to the placenta to gain access to the fetus.

Once in the [operating room](#), the surgeon uses a 3-mm endoscope especially designed for fetal surgery. "Fetoscopic" vision is very limited and therefore requires continuous guidance on its position within the uterus. Until now, this was done using ultrasound, but the new system allows additional 3-D navigation that gives information that was not available until now. This is because the endoscope incorporates a sensor at the tip that is detected by external antennae and, using complex

algorithms and mathematical formulas, it allows synchronizing the virtual reconstruction of the placenta with the actual movements of the surgical instruments.

This is a major breakthrough, achieved for the first time for fetal surgery, and illustrates how new technologies will prove essential to achieve safer surgeries using systems that continuously assist the surgeon by minimizing risks

Twin-to-twin transfusion syndrome

The new navigator is especially useful for extremely complex fetal surgeries such as those conducted to correct the twin-to-twin transfusion syndrome, which occurs in 10-15% of pregnancies involving monochorionic twins (that share the placenta). In these cases, one of the fetuses passes blood to the other constantly, almost always leading to the death of the twins. Fetal surgery can reverse the situation and achieve the survival of at least one of the fetuses in over 90% of cases.

"The new surgical GPS helps guide the surgeon and identify the best entry point, the exact location of the start of the umbilical cords and [placenta blood vessels](#), so that surgery can be conducted more easily and with higher chances of success," explains Miguel Angel González Ballester, project coordinator at UPF.

Today, at a press conference, the case was presented of twins who had recently undergone fetal surgery with this new surgical navigator.

So far in 2019, BCNatal has conducted a total of 20 fetal surgeries with this new system. The results of the technological innovations have been accepted in several international scientific journals dealing with bioengineering. This clinical innovation was presented at the world congress of fetal medicine in June this year and the first series is being

prepared for publication.

According to Eduard Gratacós, director of BCNatal, "this is one of the research projects in technological innovations we have been working on for four years thanks to funding from the Cellex Foundation, and are opening the way to a new generation of techniques that will revolutionize how we perform fetal surgery and other surgeries requiring great precision that still depend greatly on the skill of the individual surgeon."

BCNatal, a consortium formed by Hospital Sant Joan de Déu and Hospital Clínic, is one of the pioneering centres in clinical research in fetal surgery, has developed and performed for the first time in the world a number of current techniques, it receives physicians from all continents for specialized training and performs more than 100 fetal surgeries a year on national and international patients having conducted a total of 2,000 operations of this type.

Provided by Universitat Pompeu Fabra - Barcelona

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