

Intrauterine Pressure Catheter

An intrauterine pressure catheter (IUPC) is a device placed inside a pregnant woman's uterus to monitor uterine contractions during labor. During labor, a woman's uterus contracts to dilate, or open, the cervix and push the fetus into the birth canal. The catheter measures the pressure within the amniotic space during contractions and allows physicians to evaluate the strength, frequency, and duration of contractions. Those measurements enable physicians to evaluate the progression of labor and intervene when contractions are too weak to properly dilate a laboring woman's cervix to successfully deliver a fetus. Though IUPCs are not used routinely, they are important in cases where external fetal monitoring is not sufficient to monitor a difficult labor. Intrauterine pressure catheters give physicians an extremely accurate measurement of intrauterine pressure, making it possible to determine whether intervention is needed to progress the labor.

Throughout the nineteenth and twentieth centuries, physicians attempted to monitor the progression of labor through the study of uterine contractions. In the late 19th century, physicians developed a microballoon that could be inserted between the membranes of the uterus and the uterine wall to measure intrauterine pressure. In the early 20th century, physicians began inserting catheters through the pregnant woman's abdomen and the uterus into the amniotic space. However, both these procedures were considered experimental, not performed frequently, and often not reported until later in the twentieth century. In the mid-twentieth century, physicians developed an intrauterine pressure catheter that could be inserted transcervically, or through the cervix. By the late 1960s, catheters placed through the cervix became standard practice in high-risk deliveries that required monitoring.

Monitoring uterine pressure during labor is important because strong uterine contractions are what allows the pregnant woman to safely deliver the fetus. During labor, a pregnant woman's uterus contracts to dilate the cervix and push the fetus out of the birth canal. The uterus, which consists of smooth muscle tissue, contracts during labor. Those contractions dilate, or open, the cervix, the passage between the vagina and the uterus, and push the fetus into the birth canal. During labor, physicians monitor the strength of contractions by measuring the pressure inside the uterus. High contractile strength indicates that the uterine pressure is high enough to push the fetus out of the birth canal. Low contractile strength indicates that the fetus may not be pushed out of the birth canal and that physician intervention is needed.

Another reason physicians monitor intrauterine pressure is because the pressure created by a contraction affects the heart rate of the fetus. The fetus's heart rate during labor is an important indicator of fetal health. Uterine contractions affect the heart rate of a fetus by causing decelerations, or drops in fetal heart rate. As of 2017, the exact mechanics by which contractions cause decelerations is unknown. One theory states that contractions cause decelerations of fetal heart rate by compressing the umbilical cord, which is the fetus's source of oxygen. In that case, fetal blood flow is decreased, causing a decrease in fetal oxygen and a deceleration in fetal heart rate. Another theory states that contractions compress the fetus's head and cause a deceleration of the fetal heart rate. Not all decelerations are harmful, but physicians monitor uterine pressure with the IUPC, as well as fetal heart rate, to determine whether interventions, such as surgical delivery, are necessary.

Physicians can measure intrauterine pressure externally, on the abdomen, or internally, in the uterus. External monitors placed on the abdomen can detect the length and frequency of contractions during labor. However, the readings obtained by external monitors are influenced by the movement of the pregnant woman during labor, gestational age (the number of weeks a woman

has been pregnant) and the position of the monitor on the abdomen. Physicians must also reposition external monitors throughout labor. Internal monitors, such as the IUPC, are able to gather more accurate readings because they directly detect conditions within the uterus. IUPCs can also quantify the strength of a contraction, unlike external monitors that only measure duration and frequency of contractions.

Before a physician can place an IUPC, the membranes of the amniotic sac must rupture, indicating the start of labor. Then, a health care provider examines the patient to ensure her cervix is dilated, or opened, enough for placement of the catheter. If the amniotic membranes have ruptured and the cervix is sufficiently dilated, the health care provider can place the IUPC by inserting it through the vagina and into the cervix. A physician then secures the other end of the catheter to the patient's leg.

IUPCs measure uterine contractions in one of two ways. One type of IUPC has a column which connects a balloon in the amniotic cavity to an external pressure monitor, a device that translates pressure into an electrical signal. With the second type of IUPC, physicians place the pressure monitor directly into the uterus and to record the intrauterine pressure electronically.

Physicians can quantify the intrauterine pressure using Montevideo units, a type of measurement used to determine whether labor is progressing adequately. In 1949, Roberto Caldeyro-Barcia, an obstetrician in Uruguay, developed Montevideo units in Montevideo, Uruguay. Montevideo Units are calculated by subtracting the baseline pressure of a uterus from the pressure of the uterus at its highest point during each contraction over a ten-minute period, and summing the pressures. If the sum is approximately two hundred Montevideo Units, the labor is progressing adequately. If the contractions are substantially below two hundred Montevideo units, they are not strong enough to dilate the cervix so that the fetus can enter the birth canal. In that case, a physician can induce labor using Pitocin, a drug that mimics the natural hormones that initiate labor.

IUPCs are used when external monitoring is not sufficient to measure intrauterine pressure, or when a high-risk pregnancy necessitates highly accurate readings. External monitoring can be complicated by factors such as patient obesity, in which case contractions are not accurately measured through the layer of fat on the patient's abdomen. If a patient's cervix has stopped dilating during labor an IUPC can be used to measure the contractions. Physicians can quantify them using Montevideo units and assess whether they are strong enough to further dilate the cervix. If the fetus is having decelerations, indicating a lack of oxygen delivery, an IUPC can determine whether the decelerations are temporally related to the uterine contractions.

Physicians also use IUPCs in preparation for amnioinfusion therapy, a technique used during labor as a response to fetal distress. Amniotic fluid provides lubrication between the fetus, amniotic membranes, and the umbilical cord, which supplies oxygen to the fetus. Without enough amniotic fluid, the umbilical cord may be decompressed by the fetus during contractions, preventing the fetus from getting enough oxygen. If decompression of the umbilical cord occurs, saline solution can be passed through an IUPC to relieve the pressure on the cord.

The IUPC is not recommended by the American Congress of Obstetricians and Gynecologists for routine use due to potential complications. IUPC use is associated with an increased risk for bacterial infection, maternal fever, and need for a surgical delivery. As a result, physicians generally use the IUPC only when external monitoring is difficult or when the cervix has stopped dilating.

Since its inception, various versions of the IUPC have been developed. While early versions only measured uterine pressure, later IUPCs included tubes that allowed for delivery of fluids during labor, ensuring rapid relief to a fetus in distress. IUPCs are not routine, however as of 2017, health care providers in the US use them in approximately fifteen percent of deliveries. The ability to monitor fetal health internally was an important advancement in the field of obstetrics because it allowed health care providers to obtain more accurate measurements of uterine pressure and to respond to fetal distress rapidly.

Sources

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