

# Endoscopic Fetoscopy

Endoscopic fetoscopy is a minimally invasive surgical procedure performed during pregnancy that allows physicians to view the fetus in-utero. Physicians use endoscopic fetoscopy to evaluate, diagnose, and treat fetal abnormalities. Physicians use an endoscope, or a thin, flexible surgical device with a light attached to its end, to perform endoscopic fetoscopy procedures. In 1954, Björn Westin performed the first endoscopic fetoscopy in Sweden. Since Westin's initial development of the procedure, interest in endoscopic fetoscopy has grown throughout the early part of the twenty-first century. In addition, the use of endoscopy has expanded beyond fetal medicine and has been introduced to other fields of medicine such as general surgery. Endoscopic fetoscopy allows surgeons to diagnose and correct fetal abnormalities that would otherwise result in fetal death before delivery or in lifelong impairment if treatment were delayed until after delivery.

In 1954 Björn Westin, an obstetrician from Sweden, performed the first endoscopic fetoscopy. Westin first attempted fetoscopy on pregnant women who were going to have medically necessary abortions. He inserted a scope through the woman's cervix and was able to view the fetus in the uterus. In 1967, Bernard Mandelbaum, an obstetrician based in Michigan, was the first to introduce the fetoscope through a small incision in the abdomen of a pregnant woman. Physicians' use of fetoscopy as a diagnostic technique peaked in the 1970s. Following the 1970s, the technique declined in popularity as physicians began using ultrasound, a less invasive method, to diagnose fetal abnormalities. In the 1980s, endoscopy quickly became popular in other fields of medicine, such as general medicine. The increasing use and perfection of endoscopy in general medicine brought the technique back to gynecology, resulting in a renewal of fetoscopic procedures. Interest in treating fetal abnormalities using fetoscopy rather than open fetal surgery, or surgery where the uterus is opened, has grown in the twenty-first century because minimally invasive procedures such as fetoscopy cause less trauma to both the pregnant woman and her fetus.

Fetoscopy uses an instrument called a fetoscope to view the fetus while inside the uterus. There are two types of fetoscopes, one that is used externally on the pregnant woman's abdomen to listen to the fetal heartbeat, and an endoscope that is used internally in the pregnant woman's uterus to view the fetus. Endoscopic fetoscopy uses an endoscope. An endoscope is a long, thin, flexible tube with a fiber-optic camera on its tip. It contains a working channel, meaning the tube is hollow and enables physicians to insert surgical instruments through the endoscope. Surgeons have used surgical instruments such as cutters, forceps, probes, and lasers with fetoscopes to treat fetal conditions. The use of such tools allow surgeons to treat and correct fetal abnormalities after diagnosis.

Endoscopic fetoscopies are typically conducted when an ultrasound shows fetal abnormalities that cannot be diagnosed using a less invasive, external approach. Physicians usually conduct endoscopic fetoscopies after the eighteenth week of pregnancy, when the fetus is developed enough to clearly show existing abnormalities. During an endoscopic fetoscopy, the physician gives the pregnant woman a sedative and local anesthetic to prevent pain and movement of both the pregnant woman and the fetus. Physicians can insert the endoscope transabdominally, or through the abdomen of the pregnant woman, or transcervically, or through the cervix of the pregnant woman. To place the fetoscope transabdominally, a surgeon makes a small incision in the skin of the abdomen. The scope is inserted through that incision into the amniotic sac, which surrounds the developing fetus. Then, the image from the endoscope is projected on a monitor, where the surgeon can view it. Because endoscopes are inserted into the pregnant woman's uterus, risks associated with endoscopic fetoscopy include infection, rupture of amniotic sac, premature labor, and fetal death. Therefore, endoscopic fetoscopies are only conducted in cases where fetal treatment is necessary or when diagnosis through external means is not possible.

The first purpose of endoscopic fetoscopy is to diagnose fetal abnormalities. During a fetoscopy, physicians can take fetal blood and tissue samples. Fetal blood samples can be used to diagnose conditions such as hemophilia, a condition in which blood does not clot normally, sickle-cell anemia, in which red blood cells are abnormally rigid, or Tay Sachs disease, a genetic disorder affecting nerve cells. Fetal tissue samples are used to diagnose Duchenne muscular dystrophy, a disorder of progressively weakening muscles, and Weber-Cockayne syndrome, a condition in which skin is fragile and blisters easily. The images taken during a fetoscopy are used to diagnose neural tube defects such as spina bifida, an opening of the membranes around the spinal cord.

Using the working channel of a fetoscope, physicians can also use endoscopic fetoscopy to treat the fetal abnormalities that they diagnose. Fetoscopy is routinely used to treat three conditions: twin-to-twin transfusion syndrome, amniotic band syndrome, and congenital diaphragmatic hernia. During pregnancy, a fetus receives nutrients and oxygen from the placenta, which is an organ in the uterus of a pregnant woman. The placenta is attached to the fetus through the umbilical cord. The umbilical cord consists of three blood vessels, two that carry blood to the placenta and one that carries blood to the fetus. In twin-to-twin transfusion syndrome, two identical fetuses share a placenta with abnormal blood vessels. Because of the abnormal vessels, blood is shared between the fetuses. One fetus pumps blood to the other, which then can receive too much blood. The excess blood stresses the heart of the recipient fetus and can cause heart failure. In addition, the donor fetus receives too little blood, which slows its growth.

Twin-to-twin transfusion syndrome can be treated using a fetoscope in a procedure called fetoscopic laser photocoagulation. During this procedure, the surgeon makes a small incision in the abdomen of the pregnant woman and inserts the fetoscope into the amniotic sac. The surgeon then uses the fetoscope to find the abnormal blood vessels and seal them with a laser, inserted through the working tube, to immediately stop the transfer of blood between the fetuses. After physicians seal the abnormal blood vessels, the donor fetus no longer pumps its blood to the recipient fetus, which allows both fetuses to grow and develop normally. After physicians have sealed the abnormal blood vessels, the donor fetus no longer loses blood to the recipient fetus, and the recipient fetus receives a normal amount of blood from the remaining normal blood vessels, allowing it to grow without the risk of heart failure.

The second condition that physicians routinely correct with fetoscopic surgery is amniotic band syndrome. During pregnancy, the fetus grows inside the amniotic sac, which is made up of an inner and an outer membrane. While the exact cause of amniotic band syndrome is unknown as of 2017, researchers hypothesize that if the inner membrane breaks during pregnancy, the tissue of the broken membrane entangles the digits and limbs of the fetus, cutting off blood flow to the affected areas. In some cases, the tissue naturally amputates the limb or digit during pregnancy, and in other cases, the affected area may become necrotic, or dead, requiring surgical amputation after delivery. Physicians can use fetoscopy to treat amniotic band syndrome by inserting a fetoscope with a cutting instrument in the working tube to cut the bands from the fetus's limbs and digits.

The final condition that physicians frequently correct with fetoscopy is a congenital diaphragmatic hernia, which is an underdeveloped diaphragm. The diaphragm is a muscle that separates the chest from the abdomen. In a fetus with a congenital diaphragmatic hernia, the diaphragm has a hole in it. The organs of the abdomen, including the spleen, stomach, intestines, liver, and kidneys then travel into the fetus's chest. The presence of those organs in the chest prevents the lungs from forming. A fetus can survive in the uterus without lungs, but cannot breathe after delivery without functioning lungs. A congenital diaphragmatic hernia can be repaired after delivery, but recovery is long and the infant requires intensive support for months.

The most severe cases of congenital diaphragmatic hernia occur when the liver has travelled into the chest. Fetuses with that condition are candidates for a fetoscopic procedure called a tracheal occlusion. The trachea is a tube connecting the mouth to the lungs. After birth and throughout life, air passes through the trachea. During pregnancy, however, the fetal lung makes a fluid that passes through the trachea, out of the mouth, and into the amniotic fluid. During a fetoscopic tracheal occlusion, a physician places a balloon in the trachea of the fetus and expands the balloon to block the trachea. That blockage causes fluid to build up in the lungs, expanding them and pushing the abdominal organs back into the abdomen. Before birth, the balloon is deflated and removed so that

the fetus can be delivered normally.

While physicians only use the fetoscope routinely for a few fetal abnormalities, its use continues to grow in the twenty-first century. In 2012 Ruben Quintero, a physician based in Florida, removed a large fatal tumor from a fetus using a laser inserted through the working tube of a fetoscope. In 2014 Michael Belfort, physician at Texas Children's Fetal Center and Baylor College of Medicine in Houston, Texas, treated a fetus with spina bifida in utero using endoscopic fetoscopy. That was the first time that a physician performed the procedure in the United States. Spina bifida sometimes prevents infants from moving their legs, but the first infant to undergo fetoscopic repair of spina bifida had full use of his legs at age one. According to Quintero, the efficacy and safety of fetoscopic surgeries cannot be assessed until they reach more widespread use. However, such surgeries have the potential to decrease fetal morbidity and mortality.

## Sources

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