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The Accuracy and Application of Foetal Sex Determination by Ultrasonography in Cattle  
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Foetal sex determination by ultrasonography is based on the relative position of the genital tubercle. This method was first reported in 1989 by Curran et al (1)

### **History**

Since then it became a wide spread management and marketing tool in USA and Canada. Especially in embryo transfer programs. In these countries there were large recipient herds available. The farmer had his cow on a donor station and all the embryos were transferred into recipients. At 2 months pregnancy ultrasonic foetal sex determination was performed. And the recipient including the female pregnancies were sold to the farmer. If there was no interest for the male pregnancy by a breeding centre the recipient was aborted

In 1991 the technique was introduced in the Netherlands by the Dutch breeding centre from Canada. Within the embryo transfer program of the breeding centre the application of foetal sex determination was focussed on the recipient herd. At that moment the Dutch breeding centre had own donors in USA. These donors were flushed there and embryos were frozen and transported to the Netherlands. After transfer into recipients and confirmation of their pregnancy, ultrasonic foetal sex determination was performed for planning or reuses the donor and selecting the sire. The Dutch breeding centre didn't sell the pregnant recipient and never abort a recipient. The latter is a part of discussion of the application of foetal sex determination.

### **When and how to apply?**

Although the sex of the embryo is fixed at the moment of fertilisation, the expression of the reproductive organs is relative late in the development of the foetus. The genital tubercle (GT) is the first sign, which can be determined easily at the foetus. The GT is the embryonic process that differentiates into the praeputium/scrotum in the male and the vulva/clitoris in the female. . The principle of foetal sex determination is the detection and the location of the Genital Tubercle of the foetus.

During the process of embryonic differentiation the GT migrates from the initial position between the legs toward the umbilical cord in the male foetus. In the female foetus, the GT migrates in the other direction, which means toward the tail. This process of migration of the GT to the umbilical cord in the male and to the tail in the female starts at Day 47 and is completed at Day 55. From day 55 you will find the GT in the male just caudal of the umbilical cord and the GT in the female just under the tail.

The Genital Tubercle and his or her location can be detected accurately by ultrasound, within a certain period of gestation, with proper equipment and an experienced operator. The optimal time of determination is between 55 - 70 days pregnancy, because the migration of the genital tubercle is completed and the echogenic appearance of the GT is most evident until Day 70. The GT can be described in this period as a bilobed, hyperechogenic structure comparing to the surrounding tissues and therefore appear lighter in colour on the ultrasound image. After Day 70 further development of the GT can be detected such as mammary glands and scrotal swelling, but these structures are less evident compared to the genital tubercle. Moreover the foetus will be too large for a clear overview. A linear array scanner with a 5 MHz transducer is convenient for foetal sex determination. The results of the foetal sex determination in this report were based on ultrasonography with a Pie Medical scanner 480V, with a 5 MHz linear transducer. Recently foetal sex determination is also performed with the Tringa with Multi Angle down fire transducer

The examinations are performed transrectally. It is important to clean the rectum as much as possible because of dispersion of the ultrasound signals. Epidural anaesthesia is recommended and also slight fixation of the animal.

Experience is the base for success. The principle of foetal sex determination is easy to learn, but to show the principle and to make the decision male/female needs experience of the operator. One

of the difficulties is to make a clear view in order to make up your mind. Frontal, sidelong and cross sectional view are the possibilities to determine the sex of the foetus. The cross sectional view appears to be most clear in order to make the decision, especially when it is a male foetus. Subsequently the head is located, the heartbeat is checked and the umbilical cord is passed: If a hyperechogenic bilobed structure behind the umbilical cord is located it is a male foetus. If there is a no hyperechogenic bilobed structure behind the umbilical cord the cross sectional view is continued to the hind legs and a hyperechogenic bilobed structure under the tail will be located: it is a female foetus. If the preparations are well done, the actual determination can be carried out in a couple of minutes.

## **Results**

Many authors mentioned high accuracy in foetal sex determination by ultrasonography. Muller and Witkowski (2) performed determinations between 73 and 120 days pregnancy on ultrasonic visualization of the scrotum and mammary glands. They mentioned overall 94 % accuracy. But most authors prefer foetal sex determination by means of detection and location of the genital tubercle (4). In 1989 Curran et al (1) mentioned the highest accuracy between 55 – 70 days of pregnancy. They mentioned 96% accuracy within this period

In 1991 foetal sex determination was introduced in the Netherlands by Dr. Mc Allister Alta Genetics, Canada. After a training period of 2 months the results of 343 ultrasound determinations were not too bad. The results (3) are shown in the next table.

Correct Determination		
Male foetus	99.4%	176/177
Female foetus	96.8%	161/166
Total	98.2%	337/343

Almost 90% of the heifers were examined between Day 59 and Day 66 of pregnancy (with a minimum of Day 56 and a maximum of Day 75). There were no cases of abortion as a result of the ultrasound examinations. The determination of a male foetus was relative easier compared to the female foetus. Some authors report the determination of a female on the basis of failure to find the tubercle in either location, whereas all the male foetuses are diagnosed on the basis of finding the genital tubercle near the umbilical cord. In this way mistakes are easily made. The wrong determinations for female foetuses are often based on this fact. Determinations carries out after 67 days of pregnancy are also a source of mistakes, especially when it is a female foetus. Because the bones of the tail have a more echogenic structure, these bones can be easily mistaken with the echogenic structure of the genital tubercle.

## **Conclusions**

Besides these detailed possibilities of mistakes it can be concluded that foetal sex determination provides the earliest and most convenient indicator of foetal gender (sex). It is a safe and rather "simple" technique what can be carried out under field conditions.

Location of the tubercle is not only restricted to cattle. It can be used in all species in which the tubercle migrates to a location near the umbilical cord and vice versa. So also in dogs, lama's and horses ....



### **The limits and benefits of the method**

The main disadvantage of foetal sex determination by ultrasonography is the fact that pregnancy has been already established for two months. And this is the main limitation of large-scale application in the field. At least this is the conclusion in the Netherlands 10 years after introduction of foetal sex determination in our country. Farmers (dairy cattle) know the possibility of this technique but are not interested in their regular farm management for extra costs predicting the sex of the future calf. On smaller scale in breeding programs of the AI centres and in some cases of import/export people were interested in foetal sex determination. Knowing the foetal sex the embryo transfer manager can make more timely decisions about when to change sire selection or when to discontinue collecting embryos from a particular donor. In this way foetal sex determination was used as retrospective management and only interesting for very valuable donors and sires within the AI centre. But there was also a prospective management aspect of this technique because the breeding manager just wanted to know how many bulls and heifers he could expect from a certain donor – sire combination for the future breeding programs. That is why foetal sex determination was carried out at all recipients. But also pregnant donor heifers of the MOET program were ‘sexed’.

Another possibility of this technique was the selective import or export of pregnant animals instead of live calves. For example it is very difficult to flow imported calves in own herd because of all veterinary restrictions. But imported pregnant heifers can be put on quarantine farms the calves can be raised up under the same veterinary conditions as the “own” calves

In the Netherlands we have had and still have no intention to introduce this technique for large scale application in the field; because of the question: “What to do with the unwanted sex??” This is an ethical discussion. Selective termination of early pregnancy is still questionable in the Netherlands.

But the conclusion is still that foetal sex determination by ultrasonography is a very reliable, safe and rather “simple” technique, what can be carried out under field conditions in order to predict the sex of the future calf.

### References

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