

Appendix S1 Protocols of Breech Delivery at the Johann Goethe University Hospital in Frankfurt, Germany

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Vaginal Breech Birth Exclusion Criteria Antenatally

A) Maternal exclusions for vaginal birth are:

- a) uterine anomalies with contraindication for vaginal birth;
- b) major surgical damage to the uterus which would not allow vaginal delivery (classical cesareans and opening of the uterine cavity for myomectomy)
- c) placenta praevia, bleeding, and abruption;
- d) poorly controlled diabetes (if test is positive but well controlled, not excluded)
- e) Magnetic Resonance Imaging (MRIs) exclusions: For those who want to have a vaginal birth, if external cephalic version (ECV) was declined or has not worked by 38 weeks, an MRI is provided in supine position for 1) primipara; 2) women who have had a cesarean section and no neonate vaginally; and 3) multipara who have had only smaller neonates that have been approximately 500g less than the current estimated fetal weight).

Spontaneous vaginal breech delivery was offered to every woman with no above contraindication and with a conjugata vera obstetrica $\Rightarrow$ 12 cm.

B) Fetal exclusions for vaginal birth were:

- a) Intrauterine growth restriction.

- b) Fetal anomalies or problems felt to put a viable baby in danger (e.g. hydrocephaly, gastroschisis, and cardiac disease).
- c) Cord presentation or oblique lie that would create malpresentation or a situation not conducive to safe delivery.

What Was Not Excluded Antenatally That May be in Other Units:

There was no restriction based on flexion of the head or from placenta accreta, increta or percreta, bicornuate uterus, or former caesarean(s). There were no upper limits created for exclusions based on the estimated weight of the baby. Small for gestational age babies larger than 2000 g were not excluded. Footling breeches are included if:

- a) the membranes are not ruptured and the cervix is not dilated as they might convert to complete or incomplete breech, or conversely,
- b) if the birth is imminent and the buttocks are near the pelvis, depending on the parity and speed of the labor.

Standard Care During the Antenatal and Intrapartum period

As delivery on hands and knees is unusual in most obstetric units for breech delivery, it is prudent to describe the general management of the delivery at the Goethe Hospital.

The woman who presents breech at 36 weeks has at least 2 visits with one of the obstetricians to have counseling and discuss options. By 38 weeks (or before), she will return for biometry, exclusion of fetal anomalies, an optional external cephalic version, and an MRI to assess her pelvis if indicated. Because of the social structure of the unit, if neither the Division Chief nor Deputy are available, the women are warned that they will not be able to have a vaginal breech birth.

Prostaglandins is used if induction is required. Oxytocin is not administered until the cervix has dilated to 8 cm or in second stage. Intermittent auscultation of the fetal heart is done in first stage and continuous monitoring in second stage unless the mother is walking around (which is encouraged). Hands and knees position is used in rectifying abnormal fetal monitor readings. Epidural anaesthesia is offered that allows the women to remain mobile, but is not mandatory. A neonatology and anaesthesiology team is always available in the unit.

Power in second stage comes from above rather than below. We “never pull, only push the breech.” In the ideal situation, the baby simply takes the cardinal movements on his/her own and flops out without manoeuvres. We rely on the mother’s contractions, but sometimes proceed to the use of oxytocin, and fundal pressure (the Kristeller manoeuvre).

As the baby emerges in the upright position, we watch for the following signs of reassurance or the need for active management:

- 1) The baby starts engagement in the pelvis inlet in the LSA or RSA position.
- 2) In the mid pelvis the anterior buttocks proceeds to descend ahead of the posterior buttocks.
- 3) At the point when it can be perceived digitally to have rotated to LST or RST, that is, the sacrum is at 9:00 or 3:00 in the outlet, and the mother is fully dilated or the anterior buttocks is on view at the perineum, progress should be forthcoming and the mother pushing well. If she is not or the electronic fetal monitor indicates abnormal fetal patterns, we sometimes use the Kristeller manoeuvre. This is done by placing the practitioner's hand at the fundus in a downward direction, making sure the pressure is making the entire baby's body descend.
- 4) The rump of the baby initially arrives at the midpelvis planum in RSA or LSA but turns to RST or LST position (9:00 or 3:00).
- 5) As it emerges from the perineum, it usually turns with no interference from the practitioners to a direct anterior position, that is, with the front of the body facing the practitioner, situated at the mother's backside. The legs sometimes flop out as the baby turns, but certainly come out once the body has made this turn.

(Figure 1 Top Diagrams.) Sometimes in a frank breech a perineal stretch will free the legs and subsequently the arms, but this is not normally needed. We try to keep hands off the baby.

6) Then the elbows will appear at the perineum, another reassuring sign that no active management is required for an arm behind the head.

7) If a baby is born past the umbilicus and remains at 3 or 9 o'clock, that is, #5 and #6 are not occurring, and the baby remains or turns back to RST or LST once the umbilicus is born (Figure 1 Top Image on the right), we suspect that we have at least one nuchal arm, that is, one arm is up and behind the head and potentially caught on the symphysis pubis. The right arm is caught on the pubic bone if the baby is RST, and the left arm is caught if the baby is LST. Active management of the mother in upright position is to turn the baby 180 degrees from LST to RST or RST to LST, (Figure 1 Centre Image on the far left) with contact on the shoulders inside the vagina, in the direction towards the practitioner doing the maneuver, so that the baby faces the opposite direction to which he/she faced at the beginning of the maneuver. This is a turn; we refrain from pulling. Then the movement is reversed back 90 degrees. (Figure 1 Center Images) During this process the nuchal arms release and the baby now faces the practitioner, the expected position for an uncomplicated descent. (Figure 1 Centre Images, the one on the far right.)

8) Once the arms are released the baby naturally turns to face us if we wait for the head to flex and come out on its own. If the baby, once facing the practitioner, does not descend, particularly if maneuvers were required to retrieve the arms, it is possible that in the turning, the baby's head is turned to one side or the other. In this case, the mandible (lower jaw) is used to turn it to face the practitioner.

Once it is in this position, we let the baby rest dangling and if the head does not look as though it is coming in the next contraction (in less than 2 minutes and less if the shoulders needed manual maneuvers), we consider using the “Frank nudge,” the name given by B-AD to this FL maneuver: To flex the baby’s head forward, with the practitioner placing him or herself behind the mother who is on her hands and knees, the practitioner places his/her thumbs on the baby’s shoulders to push the shoulders towards the pubic bone, the four fingers grasping and sometimes folding the baby’s back in the vicinity of the scapula. Alternatively, the middle and pointing are used to push the shoulders up toward the pubic bone. (Figure 1 Bottom Image To the left) Care is taken not to push on and potentially snap the clavicles. This mechanically engages the sternocleidomastoid, the muscle that serves to flex the head. It is important that this maneuver is NOT a downward traction but a movement toward the pubic bone to flex the head. This is sometimes combined with the downward pressure on the jaw.

9) It may take some time for the cord to refill. In our unit we allow gentle touching of the cord to feel for the baby’s pulse but consider it unnecessary if we see the cord filling with blood already.

10) The baby is handed to the mother through her legs and the cord is purposely NOT clamped in the vaginal breech, to allow the cord to refill with blood. If the baby is floppy, we like to leave the baby on the bed below the mother to acquire

the extra blood from the cord, except for Rhesus negative mothers. We may check the fetal heart tone through the umbilical cord but still hand the baby to the mother even if the first breath has not been taken. We use research, ACOG and WHO recommendations (2-6) and interpret them, along with our experience with breech babies, to use the following routine:

The fetal heart rate is recorded for the first time after 60 seconds as other additional neonatal parameters (APGAR). Indications for active neonatal resuscitation are mainly less than 60bpm after 60 seconds. If there have been multiple maneuvers used -- Kristeller and the 180 to 90 degree turn, or breech extraction done because of concerns about pathology or fetal heart tones -- we take the heart rate and check for respirations earlier, but still pass the baby through to the mother without clamping, and still slow down cutting of the cord and taking to the warmer, aiming for at least 1 minute for the cord to refill. (More if no resuscitation is required.)

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