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Physiological measurements of the effect of cord clamping strategies

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Citation

Brouwer, E. (2021, September 22). *Physiological measurements of the effect of cord clamping strategies*. Retrieved from <https://hdl.handle.net/1887/3213482>

Version: Publisher's Version

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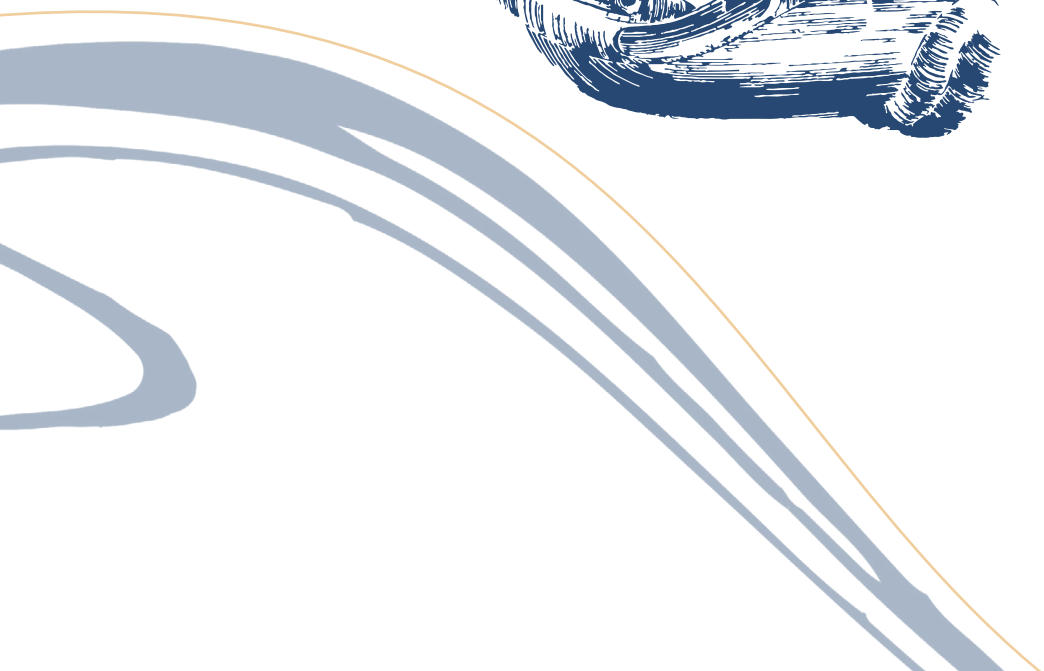
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Note: To cite this publication please use the final published version (if applicable).



PART ONE

Preface and General introduction



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PREFACE

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Wednesday, 5:30pm. You are a neonatal resident and your evening shift has just started. During the handover, your colleague informed you about a woman, 26 weeks pregnant, who had been admitted to the obstetrical ward earlier in the day because of premature contractions with 6 centimetres cervix dilation. She is currently receiving tocolytic medication to suppress premature labour, and corticosteroids have been given to accelerate fetal lung maturation.

It's 10:15pm; the obstetric resident calls. Despite the tocolytic medication the woman has been receiving, the premature contractions have persisted and premature delivery is now imminent. While you are on your way to the obstetrical ward you call the attending neonatologist and nurse to inform them about the delivery. They will join you at the obstetrical ward as soon as they can.

SCENARIO 1

It's 10:18pm. You arrive at the room adjacent to the delivery room and start preparing the resuscitation table by switching on the heater and setting up the ventilation device according to local protocol. Both the neonatologist and nurse arrive, and together you finish preparing the resuscitation table, all equipment, and the medication as well as switching on and setting up a respiratory function monitor (RFM). This monitor allows for continuous measurements of ventilatory settings and neonatal parameters to help guide any decisions about interventions during resuscitation. All data gathered during resuscitation, such as ventilator settings, neonatal heart rate and oxygen saturation measurements, are automatically stored and can be used for auditing or for research purposes. Once everything is prepared, you step into the delivery room to ensure the baby can be transferred to the resuscitation table as soon as possible.

A baby boy is born at 10:38pm. The baby is reactive but has a blueish colour; he briefly makes some crying sounds but stops after a few seconds. The obstetrician clamps and cuts the umbilical cord immediately, as instructed, and hands the baby over to you. To keep the baby warm, he is placed in a plastic wrap after which he is transferred to the resuscitation table in the adjacent room. The father of the baby follows into the adjacent room, leaving the obstetrician and his wife in the delivery room.

The baby is placed on the resuscitation table at 10:39pm. The nurse has already started both the Apgar clock and the RFM recording and a pulse-oximeter sensor is placed around the right hand to measure heart rate and oxygen saturation. Respiratory support is started by placing a mask over the baby's mouth and nose.

There are no visible chest wall rises, which would indicate spontaneous breathing, and ventilation with positive airway pressure is therefore initiated. After 1 minute the RFM displays that both heart rate and oxygen saturation are too low and it shows no spontaneous breathing during the evaluation. Ventilation is continued while both heart rate and oxygen saturation increase. After administering ventilation for several minutes, during which time the administered oxygen is set to 100% (air contains 21% oxygen), the baby starts breathing spontaneously. The baby continues breathing and is further stabilised using continuous positive airway pressure (CPAP) to make spontaneous breathing easier, while the administered oxygen can gradually be decreased to 30%. **It's now 10:48pm.**

The nurse prepares the incubator for transport, while you explain to the father what has happened over the past couple of minutes. Afterwards you ensure that the obstetrician informs the mother about the status of the baby, as she has not seen or held him yet. Fifteen minutes after the birth, the baby is transferred to the incubator. Before transporting him to the neonatal intensive care unit (NICU) the incubator is briefly placed in the delivery room next to the mother, so she can see her baby boy. The nurse opens one of the apertures so the mother can touch her baby for a short moment.

SCENARIO 2

10:18pm: you've arrived at the obstetrics ward and transfer a mobile resuscitation table with an adjustable platform to the delivery room, next to the mother in labour, and start preparations. While setting up the equipment, both the neonatologist and nurse arrive, and together you finish preparing the mobile resuscitation table, the respiratory function monitor (RFM), and all the equipment and medication. The briefing of the obstetric and neonatal team takes place, tasks are allocated, and use of the table is clarified. After the procedure has been discussed, you walk into the adjacent room and wait for the delivery to progress further.

At 10:30pm the obstetrician asks you to step back into the delivery room as the baby is about to be born. A baby boy is born at 10:38pm. The baby is reactive and has a blueish colour; he briefly makes some crying sounds and continues breathing. The obstetrician closes a plastic wrap around the baby while the adjustable platform of the mobile resuscitation table and the over-head heater are placed above the pelvis of the mother. The baby is placed on the adjustable platform while he remains attached to the umbilical cord.

The nurse has already started both the Apgar clock and the RFM recording, and a pulse-oximeter sensor is placed around the right hand. A mask is placed over the baby's nose and mouth and breathing efforts are visible on the RFM. The baby is

only supported with some positive airway pressure to support the breathing, and no ventilation is necessary. The first pulse-oximeter measurements are displayed after 1 minute, heart rate is good and stable, and oxygen saturation is acceptable.

Breathing support is continued while the heart rate remains stable and oxygen saturation increases. The mother is invited to touch her baby and gently rub the sole of his foot, which will stimulate him to breathe with even more effort. The baby's breathing is regular and stable, and the oxygen saturation gradually increases while the administered oxygen can be decreased back to 30%. This means that the baby is stable and breathing, and the neonatologist gives the obstetrician a sign that the umbilical cord can be clamped. **It is now 10:44pm.**

The nurse has been continuously updating the parents on everything that has happened during the resuscitation. After the obstetrician has clamped the umbilical cord, the father is allowed to cut the cord. The baby remains on the mobile resuscitation table, close to the mother, while the nurse prepares the transport incubator. Fifteen minutes after he was born, the baby is transferred to the incubator and transported to the NICU.

These two scenarios, whilst they could realistically occur at our clinical wards, are fictive. Two different cord clamping strategies are presented, including the logistics and clinical implications. In this thesis, we have focusses on both these cord clamping strategies, to obtain more knowledge on the underlying physiology, and to compare both strategies.

