Could Revision of the Embryology Influence Our Cesarean Delivery Technique: Towards an Optimized Cesarean Delivery for Universal Use

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Abstract

Until today, there is no standardized Cesarean Section method and many variations exist. The main variations concern the type of abdominal incision, usage of abdominal packs, suturing the uterus in one or two layers, and suturing the peritoneal layers or leaving them open. One of the questions is the optimal location of opening the uterus. Recently, omission of the bladder flap was recommended. The anatomy and histology as results from the embryological knowledge might help to solve this question. The working thesis is that the higher the incision is done, the more damage to muscle tissue can take place contrary to incision in the lower segment, where fibrous tissue prevails. In this perspective, a call for participation in a two-armed prospective study is included, which could result in an optimal, evidence-based Cesarean Section for universal use.

Keywords
- bladder flap
- bladder plica
- cesarean delivery
- hysterotomy

In 1830, Johannes Peter Müller described the paramesonephric ducts, which were named after him.

This time-honored knowledge has never been challenged since.[1]

The Müllerian ducts were described 16 years before William T.G. Morton described the use of general anesthesia on October 16, 1846, in Boston, Massachusetts,[2] and ~50 years before the first reported successful Cesarean Delivery in the modern area, which was performed by Ferdinand Kehrer on September 25, 1881, in Meckelsheim, Germany.[3] Kehrer performed the Cesarean Delivery using a longitudinal abdominal incision as well as a longitudinal incision in the body of the uterus, but in the years since, many variations were developed.

In 1897, Johannes Pfannenstiel modified the abdominal incision by introduction of the transverse abdominal incision[4] and ~100 years after the description of the Müllerian ducts; Munro Kerr described the transverse opening of the uterus in its lower segment.[5] Until today, there is no single evidence-based, standard universal Cesarean Delivery technique, and different variations are sometimes performed even in the same department. Today, the Misgav Ladach Cesarean Delivery[6] is widely used, but even this method, which seems to be optimal, has variations.[7–9]

Even small details, such as which side of the patient the right-handed surgeon stands, the use or nonusage of abdominal packs, closing or leaving open the peritoneal layers, and suturing the uterus with one or two layers, have direct effect on the short- and long-term outcomes.[10]

Although the uterus and the cervix comprise one organ, their histology and function are completely different. There is

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abundant muscle tissue in the body of the uterus, contrary to the predominance of connective tissue in the cervix. The amount of smooth muscle in the lower third of the cervix is estimated at 6.4%, in the middle third 18%, and in the upper third 28.8%, but in the body of the uterus 68.8%. In addition, the amount of actomyosin in the body of the uterus is significantly higher than in the cervix.[11] The endometrium has its unique, known hormonally dependent cyclic pattern. The cervical mucus layer, which develops from the Müllerian mesoderm, shows, however, different cyclic characteristics (Spinnbarkeit and crystallization).[12] The cervix does not function as other sphincters in the body and expands passively and gradually. It is a fibrous organ that contains hyaluronic acid, collagen, and proteoglycan.[13] The uterus differs from other muscles of the body, being retractile.

The different histological structures within each level may have relevance as to the site to open the uterus. The higher the location, the thicker the wall, and the more the damage to the muscle.

At the end of the pregnancy, the bladder plica (the vesicouterine peritoneal fold) corresponds roughly along the border between the body of the uterus and its lower segment. Traditionally, the plica is separated, pushed down, and the uterus is opened in its lower segment. If the lower segment is already developed, after cutting a small incision in its middle, the opening can be stretched bi-digitally as the fibers have already taken a transverse position. This results in minimal bleeding and enables suturing the uterus usually by one layer only. Different suture material influences the outcome concerning pain.[14] The bigger the needle is, the less the suture material is needed, although the influence of the size of the needle on the outcome was never studied. The uterus contracts shortly after the operation and the more suture material left behind, the more foreign body reaction takes place, which might weaken the scar. Although controversial, suturing the uterus with one layer may result in less ruptures during repeated pregnancies.[15]

One of the unsolved questions is where the optimal place is to open the uterus: above or below the bladder plica during Cesarean Delivery in relation to bleeding, duration of the operation, postoperative pain, and the outcome of future pregnancies. We believe understanding the embryology and its resulting histology could guide us in solving this question. As mentioned, traditionally the plica was pushed down before opening the uterus, but, lately, some clinicians challenged the necessity of dissection of the bladder flap.[16,17] Some claim that opening the uterus above the bladder flap has advantages. In a Viennese comparative study, in the group doing so, the incision-delivery time is shorter (5 vs 7 min) and shows significantly reduced need for analgesics.[18] In a study from Nepal, the duration of the whole operation was ~15 minutes shorter, and avoiding dissection of the bladder flap resulted in significantly less blood loss.[19]

However, the higher in the uterus the incision is done, the more the muscle tissue damage is expected. The wall is thicker and therefore, usually, two layers are sometimes necessary to achieve optimal hemostasis, and the scarred wall might be weaker than the wall of the lower segment that contains less muscle tissue.

One of the main problems in evaluation of the short-term outcome is a lack of standardization of the surgical method, as it has been shown that each variation of any surgical technique might have an influence on the short- as well as long-term outcomes.[20]

The conclusion is that a two-armed, randomized prospective study is needed to determine the optimal level of the incision during Cesarean Delivery while all other parameters are standardized. This study might reveal the importance and connection of the current knowledge of the physical properties and histology of each level in the lower part of the uterine body and the lower segment, as determined by the embryology. This study could also result in providing a specific mathematical model like already existing ones concerning other human muscles.[21] Such a model could assist in analyzing the different stages of development of the lower segment before and during birth concerning both magnitude and direction of the functioning vectors. Due to large variations in the population of parturients, large numbers will be needed to determine the outcome between the two groups, the one where the uterus is opened above and the other below the plica. Examining the microcirculation, using a calibrated ultrasound machine, in the different levels toward the end of the pregnancy could show the correlation between the activity and blood flow, as is done in oncology.[22]

A study protocol was already prepared and we are looking for participants willing to use the standardized Cesarean Delivery where the only variation is the level at which the uterus is opened. The evaluation will start with short-term outcomes—such as blood loss, the need for second layer, need for painkillers, and restitution of anatomy—as examined by periodical ultrasound evaluation of the lower segment, the thickness of the wall, and its distance from the external Os. The study will continue with evaluation of the late outcomes, which are subsequent cervical incompetence, preterm birth, scar dehiscence in subsequent pregnancies, and late abortions. This study should become multicentric and people are encouraged to approach the corresponding author. We believe that solving this question will result in, at last, an optimal, standardized Cesarean Delivery method for universal use.

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