

The History of the Low Transverse Cesarean Section: The Pivotal Role of Munro Kerr

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ABSTRACT: Cesarean section has undergone a transformation that has radically changed the prognosis of both the pregnant woman and her unborn child. The attributed mortality rate of Cesarean section during the 19th century was over 50% worldwide. Today, mortality from Cesarean delivery is rare. However, the technique of transversely incising the uterus in its lower uterine segment, although less than a century old, is passed on from instructor to apprentice, often without either of them being aware of its noble history. In this brief review, we discuss the reported history regarding this incision and the significant role played by John Munro Kerr.

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Cesarean section has undergone a transformation, which has radically changed the prognosis of both the pregnant woman and her unborn child. It has been just a little over 100 years that the majority of women presenting with obstructed labor survived. The mortality rate attributed to Cesarean section during the 19th century was around 56% in the United States, 62% in Europe, and 72% in England [1]. Today, mortality from Cesarean delivery is rare. Fetal indications, such as distress or malpresentation, are now easily diagnosed and Cesarean deliveries are performed in these situations without hesitation [2,3]. However, the technique of transversely incising the uterus in its lower uterine segment, although less than a century old, is passed on from instructor to apprentice, often without either of them being aware of its noble history. In this brief discussion, we briefly review the history. There are many more pioneering physicians who deserve recognition; however, mentioning all of them would be beyond the scope of our review [1,4–8].

Until the mid-1880s, abdominal delivery was considered barbarous and criminal by most. During the surgery, if the woman did not die from exsanguination, she would surely die

within days from puerperal fever. There were no effective remedies for hemorrhage or septic peritonitis. The prognosis was so poor that everything was done to avoid surgery. For the mother with small pelvic dimensions, some experts proposed undernourishment in an attempt to induce a small fetus. Abortion was another option. For the woman with obstructed labor, forceps and its variations had many proponents. Numerous procedures to expand the dimension of the pelvis were tried, and these included symphysiotomy, pelviotomy (sawing through the pelvis on both sides of the symphysis), and pubiotomy (unilateral sawing of the pubic bone). Incision or amputation of the uterine cervix was attempted. Finally, craniotomy of the fetus through the vagina was widely used [6,7].

Surgeons continued to attempt abdominal surgery, albeit under barbaric conditions. Without anesthesia, patients suffered tremendously. The skill of the surgeon was measured by speed, not necessarily by technique. Incisional entrance into the abdomen and uterus were attempted in every conceivable site. Alas, without proper suturing and with non-sterile instruments, almost all women were doomed.

Several crucial milestones were achieved in the mid-1800s, which changed the face of surgery. Much of the significant progress occurred in learning centers in Europe. The Hungarian physician Ignac Semmelweis was able to show that good antiseptic technique, such as hand washing, could save lives by reducing puerperal sepsis. His work was noted and expanded on by the

British Surgeon Joseph Lister in Scotland. The discovery that a microscopic organism could cause a disease was credited to

Cesarean section techniques have undergone modernization with dramatic improvement in maternal morbidity and mortality

the Frenchman Casimir Davaine for his work on anthrax. This was followed by the work of the German physician Robert Koch, who developed wet steam sterilization, and the American surgeon William Halsted, who advanced the use of sterile rubber gloves for surgery.

Another development in the mid- and late-1800s was the introduction of inhalational gases, such as ether and chloroform, for anesthesia. William Clark first used ether for a tooth extraction in January 1842 in New York and Crawford Williamson Long implemented it for a resection of a neck tumor in March

1842 in Georgia, USA [9]. The use of ether spread to the pioneering physicians in Europe. James Simpson, a Scottish obstetrician first used chloroform for anesthesia in childbirth. Both ether and chloroform were used as anesthetic agents for Cesarean sections during the second half of the 19th century, although chloroform was used more frequently. Epidural anesthesia in obstetrics was first introduced by Oscar Kreis, a Swiss obstetrician, in 1900, and by Walter Stoeckel, a German physician in 1909. There were sporadic reports of the sub-arachnoid route anesthesia for Cesarean section in Canada as early as 1901. Still, general anesthesia for Cesarean section was almost universally applied until the 1950s [1]. An important consequence of the ability to anesthetize the patient was that it allowed the surgeon to slow down. Real-time notes could be taken and figures drawn to display techniques, which could be discussed and compared.

Around the turn of the 20th century, the stage was set for change and improvement. Anesthesia played an important role in the development of surgical techniques. Laying-in hospitals were springing up for women to go and have their babies. These facilities would be staffed by specialists in obstetrics who would develop academic approaches to problems and find solutions. Research and experimentation became available. Antiseptic techniques became routine. Suturing materials (first of silver) and surgical techniques were advanced, especially by the American gynecologist and surgeon J. Marion Sims. Following the discovery of anticoagulants, blood banks were included as part of hospitals.

In the late 1800s and early 1900s, there were at least four different methodologies for abdominal delivery. The earliest of these was developed by the Italian obstetrician Eduardo Porro in 1876 in Pavia [7,10]. It soon became a widely popular procedure throughout Europe. The Porro operation involved amputating the uterus above the level of the cervix (supracervical hysterectomy) after the baby was removed through a uterine incision. The amputation was achieved by placing a silver wire around the cervix and tightening it. The cervical stump was marsupialized by fixation to the lower margin of the abdominal wound. With removal of the uterus, the risks of post-partum hemorrhage and infection were significantly reduced. For the first time, more women were surviving the operation than not. The Porro operation underwent several modifications, but remained an operation that “sacrificed a part to save the whole.” Its popularity started to wane with the development of other operations, especially since many couples wanted more children.

The movement to preserve the mother, her internal organs, and the fetus developed. The German gynecologist Max Sanger sought a method to enter the uterus using antiseptic techniques and minimize bleeding. He perfected the procedure in 1882, and subsequently became known as the father of the operation

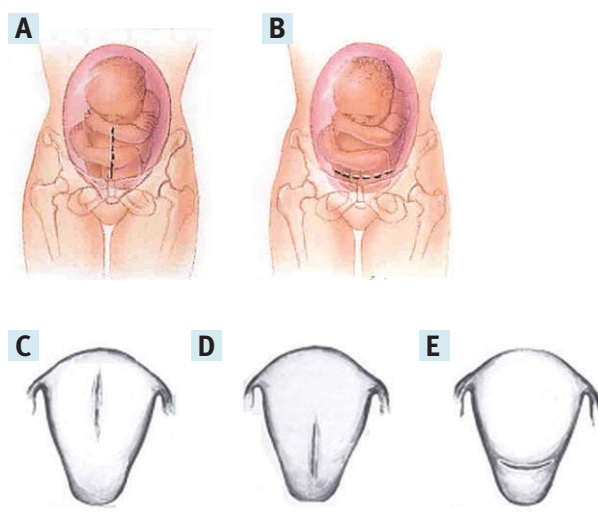
Advances in anesthesia, aseptic technique, and antibiotics were crucial milestones in the improved prognosis of Cesarean section techniques

currently termed the corporeal or classical Cesarean section [4,5,7,11]. In this operation, the abdomen and peritoneal cavity are entered and a high midline longitudinal incision is used to gain access to the uterus for the removal of the baby [Figure 1]. Initially, the abdominal incision was huge to allow for exteriorizing the uterus and fetus prior to the uterine incision. Later, the uterus was incised in situ, and the abdominal incision was made smaller. The uterine incision is meticulously closed with sutures. The salient features included undermining and careful coapting the musculo-peritoneal layer to reduce spillage of infected uterine contents into the peritoneal cavity and perhaps the most revolutionary feature, suturing of the uterus, which was not usually done beforehand. It should be noted that Sanger was not the first to advocate uterine sutures. They were first described by Jen Lebas, a French surgeon in 1769 [12], and later by Spencer Wells from England in 1865 [13]. In the 1890s, maternal mortality after abdominal delivery fell for the first time to below 20%. Poor results were obtained with those women who developed infections. Intra-abdominal adhesions were common following the operation. Furthermore, it became evident that the uterus could rupture in a subsequent pregnancy.

Around the same time, a third operative technique was developed by another German gynecologist, Ferdinand Adolph Kehrer at the University of Heidelberg [4,14]. In the era before

Figure 1. Cesarean section techniques for entering the abdominal cavity to access the uterus

- [A] Kronig incision
- [B] Kerr incision
- [C] Sanger: classical (high vertical) uterine incision
- [D] Kronig: vertical uterine incision in the lower uterine segment
- [E] Kerr: transverse lower uterine segment incision



antibiotics were developed, one of the greatest fears was entering the peritoneal cavity with the resultant risk of peritonitis. Years earlier, in 1824, Phillip Physick, considered the “father of American surgery,” was a leading figure to propose that a portal of entry to the lower uterine segment could be made by separating the unopened lower sac of peritoneum [8], yet he never performed the operation himself. Kehrer, however, adapted this approach by performing the technically difficult dissection outside the peritoneal cavity to obtain an accessible window on the uterine cervix (the lower uterine segment). He then entered the uterus by performing a transverse incision into the cervix at the level of the internal os (uterus). There was remarkably little bleeding, and the incision was easily closed. In practice, however, it was extremely difficult to avoid buttonholing of the peritoneum and bladder, and the technique was modified in 1909 by Wilhelm Latzko of Vienna. It is possible that Kehrer also experimented with a transperitoneal approach to the lower uterine segment. Very little else is known about Kehrer, and he never reached prominence, perhaps because he later became involved in performing non-indicated operative sterilizations on women [15].

In 1912, another German gynecologist, Bernard Kronig, developed a technique for entering the abdominal cavity to access the uterus through a low vertical incision in the lower uterine segment [Figure 1]. Occasionally, the incision would extend into the vagina or into the body of the uterus. In the early 1900s, this operation was gaining favor throughout Europe and North America.

Each of these operations had advantages and disadvantages. Each had its own school of proponents and adversaries. It took the ingenuity and capability of John Munro Kerr to extract the

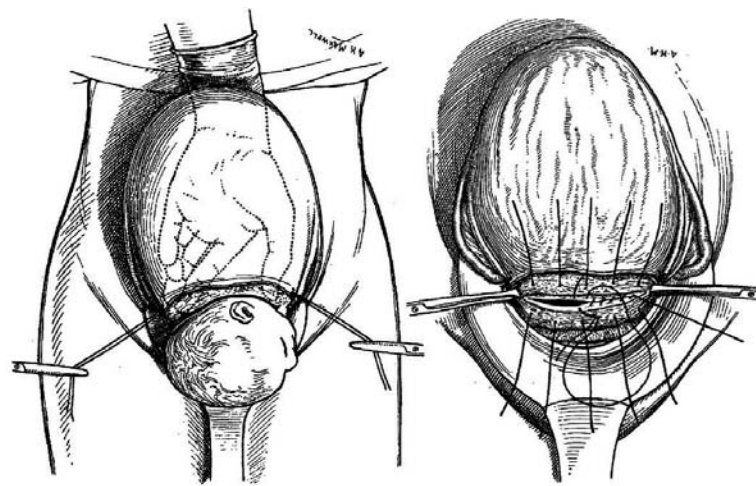
Several leading European surgeons made key contributions in Cesarean surgical techniques, which were combined by John Munro Kerr to result in the procedure used most often today

most important elements of the work of his predecessors. He was the first physician in the United Kingdom to extensively publicize the superiority of the lower segment approach [Figure 1]. He is credited with changing practice away from the classical uterine incision. In Kerr's own words, “I make no claims to originality as regards the incision, and I recommend it only because I believe that the cicatrix that results will be less liable to rupture” [16]. Of note was his ability to describe and publish his work so that his achievements quickly spread to all centers of education. However, credit for the transverse segment incision should be given to Robert Wallace Johnson who first suggested it as early as 1786 [17].

In Kerr's own words: The patient is “placed in the Trendelenburg position. A longitudinal incision is made, reaching from below the umbilicus as far as the symphysis. After the abdomen is opened the bladder is dissected off the anterior uterine wall. A transverse incision is made in the lower uterine segment. A suture is inserted at each end of the wound; this is employed to control any laceration at the ends of the wound and after delivery to pull up the wound so that it can be easily stitched. The child is then expressed by passing a hand behind the uterus. Where this is not possible and the uterus has not been turned out of the abdomen, one blade of the forceps used as a vectis may be employed. Only once have I employed the two blades of the forceps. The child having been extracted and the cord tied, the placenta may be removed through the wound if the cervix is not sufficiently dilated, but if the cervix is sufficiently dilated I drop the cord into the uterine cavity and deliver the placenta by the vagina. I then pull up the wound so that it is within easy access for stitching by means of the two lateral stitches already referred to. I insert three layers of sutures, catgut for the mucous membrane, linen thread for muscle, and a third layer of catgut for tucking back the bladder into its old position” [16] [Figure 2].

John Martin Munro Kerr was born in 1868 at Glasgow and received his medical education in Glasgow, Dublin, Vienna, and Berlin. In 1900, he was appointed to the University of Glasgow, where he remained on the teaching staff for 40 years. He was particularly interested in the contracted female pelvis and its treatment options [18]. He may not have been satisfied with the Sanger operation, and therefore became convinced that the lower uterine segment would be the safest place of entry into the uterus. He was successful in combining the readily accessible entry into the peritoneal cavity followed by a transverse incision into the lower uterine segment. He noted there was much less hemorrhage, quicker convalescence, and lower incidence of abdominal adhesions [16,19]. He also noted that the risk for uterine rupture was low in subsequent pregnancies, negating the saying by Craigin of the early 1900s, “once a Cesarean, always a Cesarean” [20]. Physicians acquainted with both the

Figure 2. Reproductions of original figures from Kerr's article [16].



Kerr procedure (transverse incision) and the Kronig operation (longitudinal incision) gradually became convinced that the former technique was preferable.

Canadian-born Louis Phaneuf, of Boston Massachusetts, wrote in 1931 that the transverse incision had three distinct advantages, namely that it avoided encroaching on the uterine musculature and allowed the placing of the incision entirely in the lower segment. Furthermore, the bladder separation did not have to be carried as far downward, and repeated operations were simpler to perform [21]. In 1926, Kerr added another improvement to his technique: a curved transverse incision in the uterus with the convexity directed downwards. The object of this line of incision was to lessen the risk of injuring the uterine vessels [19]. Phaneuf slightly modified Kerr's transverse incision by recommending that the edges be curved upward (often referred to as the "smiley" incision) [19].

The brilliance of Munro Kerr was remarkable. He was a prolific writer; his renowned book, *Operative Midwifery*, later titled *Operative Obstetrics*, was first published in 1908, which was followed by many updated editions. He was frequently quoted in medical journals. His eminence as an obstetrician and gynecologist was recognized throughout the world. He was known as having great wit, charm, and humor, and was always approachable. Above all was his fame as a teacher [22,23].

Early on, Munro Kerr recognized that convincing other established schools to adopt the low transverse incision into the uterus was a tedious process. He stated that educating the obstetric communities had been a "slow business" [18]. In the absence of a decidedly contracted pelvis, he was also opposed to the doctrine "once a Cesarean always a Cesarean" [18], coined by Edwin Craigin in 1916 [20].

Due to Munro Kerr's persistence that the low transverse Cesarean operation was superior to any of the other alternatives, it became, and continues to be, the accepted standard. Although the percentage of women undergoing Cesarean delivery varies dramatically worldwide, it is significantly above 30% in the United States and Brazil [24], making it one of the most common major operations. Women no longer need to feel in morbid danger on being admitted to the hospital for the procedure. Other advancements include the liberal use of regional anesthesia, the routine use of prophylactic antibiotics, the availability of uterotonic agents, and improvements in suture material. The advent of spinal and epidural anesthesia permits the mother to avoid the inconvenience and complications (albeit, rare), associated with general anesthesia. The father is now encouraged to be beside his spouse and to be present during the birth process. Because of its simplicity, safety, and adaptability, the low transverse Cesarean section, as expounded on by Munro Kerr, is here to stay.

So that one does not conclude that Cesarean delivery should be preferred over vaginal delivery, it should be noted that vaginal delivery is superior to any type of Cesarean delivery in terms of

maternal and fetal short- and long-term complications. In addition, Cesarean delivery remains a subject of extensive research and continues to undergo improvements such as the type of closure and sutures used as well as other prophylactic measures to decrease morbidity.

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