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Cesarean Delivery: Surgical Techniques – The Fifteen Minute Cesarean Section

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1. Introduction

There is more than one way to skin a cat.

I never liked that old saying because I am very fond of cats. Eventually, however, I learned that it referred not to felines but to catfish, which have no scales and are notoriously difficult to prepare for the frying pan. The point, of course, is that there are many ways to do a cesarean delivery and the vast majority of the time, the outcome is good. However, there can be great differences in the risk of febrile morbidity, in the risk of postoperative adhesions, and in the length of time that the patient is on the table. For example, in the very nice review of techniques published by Hofmeyr et al. (2009) mean operating times varied from 27.5 to 56.5 minutes, with the single exception being the Misgav Ladach technique (Darj & Nordstrom, 1999), where the mean was reported to be 12.5 minutes. However, this technique involves a good deal of finger dissection, which I find awkward, and uses only a single layer closure of the uterine incision, which may increase the risk of uterine rupture in future pregnancies (Bujold et al., 2010)

What I propose to do here is to summarize the technique on which I have settled after more than four thousand procedures done personally. In the absence of complications, operating time "skin to skin" is typically about fifteen minutes, including a two-layer uterine closure and a subcuticular skin closure. The shorter operating time means less tissue desiccation and with that, I believe, less postoperative pain and less risk of both febrile morbidity and postoperative adhesions. The way to shorten operating time is to move efficiently and to eliminate steps that are simply not needed. Emphasis here is on the latter.

2. Positioning the patient: Don't forget the tilt

The traditional position for a cesarean delivery is to have the woman supine but tilted to the left with a rolled towel or other wedge placed beneath the right side of the pelvis. The purpose is to shift the weight of the uterus (which is nearly always dextro-rotated) away from the compressible vena cava and onto the spine and aorta, thus preventing hypotension and the nausea and decreased fetal blood flow that might otherwise result. It is true that most women will do fine without the tilt but it is simple, logical and free and certainly sometimes useful.

Rather than leaving the woman supine, it is often useful to give her a bit of a head-down tilt (Trendelenburg). In heavier patients or with twins, it can be very useful and, if not too much, is very well tolerated. Of course, the spinal or epidural anesthesia needs to be well established first. Once that is done, a little tilt is often not noticed by the woman but may be very useful to the surgeon.

3. Do we need a retention catheter in the bladder?

No, not really, but it helps. A full bladder can make entry into the abdomen dangerous, but if the bladder is already relatively empty, a Foley catheter is not necessary. If an inadvertent cystotomy occurs, a simple purse string suture of a rapidly dissolving material (such as chromic) can be used for closure, followed by two or three days of drainage. That is all that is needed. These injuries on the dome of the bladder heal much quicker than injuries made near or through the trigone, such as might occur during a vaginal hysterectomy. If the bladder is full enough to be in the way, it can be drained with suction tubing and a number 14 needle.

An advantage of having a retention catheter is that if the extent of the bladder is not obvious, the catheter bulb can be pulled up to better define the margins. Did you ever wonder whether a stitch went into the bladder? That is the way to find out.

If general anesthesia is used for a cesarean delivery, the catheter can be removed as soon as the patient is awake. However, if epidural or spinal morphine is used for postoperative analgesia, it is best to leave the catheter for about 18 hours, as inability to void is common, putting the woman at risk of bladder over-distension. If the bladder accumulates more than about six hundred mL, the little actin and myosin fibers that form the smooth muscle of the bladder may be pulled apart and no longer able to find each other. Six to twelve hours of decompression may be needed before the bladder can function normally again.

4. Making the incision

When I first started practice, I habitually made my cesarean incision transversely and in the depths of the natural crease that usually is present a couple of finger breadths above the pubic symphysis. Then I went to a lecture where we were told to move it upward, out of the crease, to reduce the risk of infection. It took me a while to decide that the move created more problems than it solved. It meant going through a thicker layer of tissue; the incision was more visible and less cosmetically pleasing later; and the wound seemed to have a higher incidence of separation because gravity tended to pull it apart. Hence, I advocate following the natural crease. If the area is prepped adequately, allowed to dry a bit before the incision is made and then kept dry in the immediate postpartum days, wound infection and separation seem to be very rare. Women love it, as the incision tends to disappear. The only part of the surgery visible to them is the incision. No matter what happens underneath, if the incision looks good and there are no complications, patients tend to think they have had a great surgeon.

I mark the skin with a surgical marking pen before the area is draped so that I can confidently put the incision in the right spot when visibility is compromised by the drapes. I like the incision to extend about 7.5cm on either side of the midline, with the midline

marked so that I can find it during closure. If the surgical incision is made boldly and rapidly with a scalpel, and carried down quickly to the fascia, there is no time for blood to obscure the working site and hence no need for cautery. I score the anterior rectus fascia with the scalpel in the midline and then quickly extend the fascial incision laterally on either side with scissors, though some people prefer to open the fascia laterally with finger dissection. If one is in a hurry, the medial fibers of the rectus muscles can be cut so that fingers can be used to expose the peritoneum more quickly. The muscles are then pulled apart laterally with no dissection of the rectus sheath. In most cases, however, I separate the rectus sheath from the muscles cephalad and caudad with scissors, staying near the midline to avoid injury to the nerves associated with the superficial branch of the inferior epigastric artery. (Cutting those nerves produces an annoying hypesthesia in a triangular area above the incision that can last for many months.)

5. The obese patient

Many tricks involving pulleys, Montgomery straps, and Elastoplast tape have been proposed to pull the pannus off the area of incision in the massively obese. I find this embarrassing to the woman and quite unnecessary. I believe in keeping things simple. First, a bit of Trendelenburg helps enormously and is well tolerated even when the woman is awake. Second, I make the incision transversely (and at least 15cm wide) in the depths of the sub-pannus crease, as described above. The subcutaneous tissue is thinnest there, which makes life easier for the surgeon and provides less room for postoperative seromas and hematomas to form and get infected. I believe that if the area is prepped adequately and then someone holds the pannus up while the area dries and gets draped, infection risk is minimal.

The third point is to use a disposable O-ring wound retractor such as the Alexis^{R} O made by Applied Medical Corp. It simply makes the procedure amazingly easier because it provides better visualization and the rigid external ring helps hold the pannus away from the incision.

As will be discussed later, closing the subcutaneous tissue with at least a few interrupted, rapidly dissolving sutures can reduce postoperative problems (Naumann et al., 1995) and closing the skin with a subcuticular stitch rather than staples also reduces infection and disruption according to a meta-analysis published by Tuuli et al. (2011). In these heavier women I also always seal the surface with one of the polyacrylic glues. The theory, unsupported by data as far as I know, is that germs simply cannot live in that stuff.

6. Preventing deep vein thrombosis

Prophylaxis for thromboembolism is important for all cesarean patients, but even more important for older women, for smokers, and for the obese. The least that should be done in every case is intermittent pneumatic compression devices for the first twenty four hours. In obese women, or those with other additional risk factors, consideration should be given to heparin or low molecular weight heparin (for example, 40mg of enoxaparin) subcutaneously. If general anesthesia is to be used, heparin can be given preoperatively but if a spinal or epidural is used, your anesthesia person should be consulted. They will probably want you to wait 12 to 24 hours before giving the heparin because of fear of an epidural hematoma.

7. Prophylactic antibiotics

Prophylactic antibiotics are routinely used for cesarean deliveries these days, typically cefazolin even in the penicillin allergic, given ideally 30 to 60 minutes before the incision (Sullivan et al., 2007). (The textbooks talk about a 15% cross-reaction between cefazolin and penicillin in the penicillin allergic patient but I have never seen it happen.) However, in the obese, usual doses of cefazolin may be inadequate. Pevzner et al.(2011), have demonstrated that the usual two grams of cefazolin, even when given at the ideal 30 to 60 minutes preoperatively, will often produce tissue levels in the wound that are inadequate to be bacteriocidal when the BMI is over 40. Although, as they point out, there are insufficient data to dose cefazolin specifically to BMI, it may be more appropriate to use three grams IV in the massively obese.

8. Transverse or vertical incision?

I cannot remember the last time I did a vertical skin incision except to remove and try to improve an old and ugly scar. Delivery through a low transverse incision, if entry is done as described above, should take two to three minutes or less. In an emergency, the scalpel can be used with just a few strokes to open the skin, the subcutaneous tissue, the fascia, and the rectus muscles in the midline. Lateral pull then exposes the peritoneum with the uterus immediately below. The bladder might be in the way, especially if there are adhesions from a previous surgery or if there has been a long and obstructed labor. If the peritoneum seems thicker than usual, think of bladder and move higher. Otherwise, a quick tenting of the peritoneum with forceps and a cut with the scissors provides rapid and clean entry that can be enlarged bluntly by just pulling laterally.

A vertical incision, in my hands at least, takes longer to make and much longer to close. The vertical scar often widens out and becomes unsightly, especially if there is an early next pregnancy. Incisional hernia is also a problem with vertical incisions and almost never happens with the low transverse incision. And then there is that same issue mentioned above, that women tend to rate the skill of their surgeon by how the incision looks when it heals. The low transverse incision is not only stronger and more comfortable than the vertical incision, it always looks better afterward.

9. To burn or not to burn: Electrocautery use

Several decades ago, where I was trained, we were not allowed to use electrocautery in a cesarean delivery. I cannot remember why, but I got used to doing without it and have done so ever since. I do not even place a grounding pad. (Which means I do not have to worry about setting an alcohol skin prep afire, nor is there any need to remove metal jewelry.) On rare occasions when I have a bleeding vessel that does not stop after a minute or so of being crushed with a hemostat, it can simply be tied off. When I am assisting a surgeon who is skeptical about the no-burn philosophy, I suggest that they forego cautery use until closure. By that time, all the little vessels that would have been burned on the way into the abdomen will have stopped bleeding and there is typically nothing left to burn.

I am not, of course, talking about someone with a coagulopathy such as happens with severe pre-eclampsia, von Willebrand's disease, etc. But in a normal person, vessels contract and

blood clots within the vessels so rapidly that the electrocautery just destroys tissue without any benefit. Dead tissue increases inflammation and pain and increases the risk of infection. I could not find a controlled trial on the subject, but in my opinion, electrocautery use in the vast majority of cases just increases operating time, prolongs recovery, and increases postoperative pain. In the absence of good smoke evacuation, electrocautery use also puts the woman at risk of having to smell her own flesh cooking.

10. The uterine incision: Don't cut the baby!

Once in the peritoneal cavity, the lower uterine segment can be identified and entered. Development of a bladder flap before the uterine incision is made has been shown to be unnecessary (Hohlagschwandtner et al., 2001). It is simpler and faster to just transversely score the lower uterine segment at the upper edge of the bladder flap (in other words, at the upper edge of the visceral reflection of the bladder peritoneum --- however, see the warning about obstructed labors in the next section). The myometrium is scored transversely part way through the muscle and then, to avoid cutting the baby with the scalpel, I use a curved hemostat like a little shovel to go deeper until the membranes are encountered. The incision is then extended with finger tips (pulling vertically or horizontally) until adequate for delivery. Occasionally, the lower segment simply is not wide enough and a vertical incision in the uterus is chosen. However, in most cases where the incision is too small, one does not discover that until the head refuses to come through it, especially with a breech baby. At that point, the simplest and quickest way to get more room is to "T" the incision upward in the midline. The corners of the T become avascular and are at risk of not healing well, the solution to which is to cut a bit off of each corner before closing the uterus. This converts the upside down T to an upside down "V" and you will find that the incision can be closed transversely just as if no T had been made. There is a little more tension on the incision in the midline but a two-layer closure should take care of that.

It is, of course, useful to know ahead of time where the placenta is to be found. A low anterior placenta need not change the choice of incision. Just work fast to get through the placenta (mostly with blunt dissection) and expose the baby. A rarely needed trick is to deliver the placenta before the baby. A rapid manual extraction of the placenta creates a great deal of new space so the baby can usually be delivered in the next few seconds with less trauma to it and with no hypoxia. I have found this to be especially useful with very small babies.

11. Obstructed labors: That is the vagina, not the uterus

If a labor is allowed to go on long enough, nearly everyone will dilate to ten centimeters. However, it is not dilation that gets us a vaginal birth, it is descent of the baby through the pelvis. That point is often overlooked --- "she is making progress" we are told, meaning that the cervix is dilating, if ever so slowly. It is not progress, however, if the head is not descending, because if the head cannot come down, the uterus will be pulled by its own contractions up into the abdomen. When the cesarean delivery is finally done in such cases, feel around a bit. What you are apt to find is that the lower uterine segment is no longer in the pelvis but is now in the abdomen, leaving the bladder behind and no longer reflected

onto the uterus. Cutting at the upper edge of the bladder flap can actually result in a vaginal incision, made below (caudad to) the cervix.

The problem with this error is that the vagina is very vascular and does not contract as does the uterus. We depend on contraction of the uterus to occlude vessels and to prevent excessive bleeding. It is very difficult to get hemostasis with a vaginal entry, even with electrocautery. And since the bladder is not where we expected to find it, injury is much more likely. So if you are doing a cesarean section for obstructed labor, check all the landmarks, including the round ligaments, to get oriented and then make the uterine incision higher than you might otherwise do.

12. Elevating the head

As we all know, elevating an impacted fetal head can be very hard. Serious injury to the baby's neck is a real risk. If that risk is anticipated, it is prudent to push the head out of the pelvis before the operation starts. However, usually the problem comes as a surprise.

The first thing that most of us try, when the head is truly impacted, is to get another person to push up through the vagina. He or she should use as many fingers as possible, or even an entire fist, to spread the forces. If that fails, the next simplest maneuver is to flex the hips by elevating the knees, one person reaching under the drapes from either side of the patient.

Sometimes, contraction of the uterus is a problem. One can get half a minute or so of uterine relaxation (a half minute that seems like hours) with sublingual nitroglycerin. If that is unavailable, 0.2mg of intravenous terbutaline can be tried. It takes a bit longer to have an effect and another twenty minutes to wear off.

An impacted head is very often the result of obstructed labor with an occiput posterior presentation. When the uterus is opened, the baby's chin or chest is the first thing seen. This makes a reverse breech extraction as described by Fong et al. (1997) straightforward. One simply pulls the feet out of the incision and then delivers the baby as one would do with a typical breech, being careful not to hyperextend the neck.

13. The transverse lie

I was taught that the uterine incision should be perpendicular to the baby. That would mean a vertical uterine incision if a transverse lie is encountered. However, a vertical incision would rule out vaginal birth in the future and put her at extra risk of uterine rupture even before the onset of her next labor. It is better, it seems to me, to convert the baby to breech or vertex after opening the abdomen but before opening the uterus. If there is difficulty in doing that, a little sublingual nitroglycerin or intravenous terbutaline as described above will relax the uterus and facilitate the maneuver. Of course, if the baby is back up and feet down, conversion is not needed.

14. Active or passive placental removal?

Once the baby is delivered, draining the placenta appears to result in less fetomaternal transfusion (Leavitt et al.,2007). In my opinion, it also makes delivery of the placenta quicker

and easier. I prefer a rapid manual removal of the placenta after changing my dominant hand glove if it has been in the vagina. The uterine cavity can be explored at the same time. The literature supports spontaneous extraction of the placenta by cord traction and oxytocin, rather than manual removal, as providing less risk of infection and lower blood loss (Anorlu et al., 2008). And there are studies that suggest changing gloves is not important (Atkinson et al.,1996). My experience has been different. With prophylactic antibiotics, changes of the contaminated glove and rapid manual extraction of the placenta while oxytocin is running, I think the risk of endometritis is minimal. It has been a very long time since I have seen a postoperative fever.

15. Exteriorize the uterus? Why?

Exteriorizing the uterus is probably a useful procedure in a teaching institution, because everyone can see what is being done. Whether it has any other advantage or risk is controversial, and the literature is conflicting. I find it time consuming, awkward, abrasive to peritoneal surfaces (increasing the risk of adhesions --- a factor not addressed by the literature I found). If we leave it where it belongs, we do not need to struggle to get it back inside after closure of the hysterotomy, worry about clots forming in the huge and distended broad ligament veins, nor about air embolus.

16. Uterine closure: Two layers, one suture, one knot

The controversy over closure of the myometrium in one layer or two seems pretty well over. The one-layer closure simply has a higher failure rate in subsequent pregnancies (Bujold et al., 2002; Durnwald et al., 2003; Bujold et al., 2010). I have always preferred two layers, the first a full thickness layer to get hemostasis (with or without "locking" the stitches) and the second an imbricating layer to bring the cephalad and caudad peritoneum together and cover up the exposed myometrial edges that might otherwise adhere to tissue above it during healing. Theoretically, one should use a monofilament suture because a braided suture in an area so often contaminated would give bacteria more places to hide. And although most people use slowly dissolving suture material, in fact, the uterus shrinks so rapidly that by the next day the suture line must surely be very loose. Hence, I don't think the speed of suture dissolution is an important factor.

Whatever type of suture material I have, I prefer to use a single suture pack for both layers of the closure, sewing first away from myself with the full thickness layer (locked or not) and then bringing the same suture back to the starting point without cutting or tying until I get there (Dyson, 2010). To start, I pass the suture deep into the myometrium at the near edge of the hysterotomy, then "follow" myself as I sew the full thickness layer to and a bit beyond the distal edge of the hysterotomy. Without tying or cutting, I convert to a deep parallel Lambert type imbricating stitch to bring the suture back to me. I will have tagged the loose end with a hemostat when I started. Now I just tie the running end of the suture when it gets back to me to that tagged end. If the Lambert stitch is placed at the cut edge of the peritoneum above and below the incision, or even a little further away, the serosal edges will come together to hide raw edges of the myometrium and present a smooth surface for healing. The entire double layer closure takes only about two minutes and there is only one knot to tie (and to come untied).

17. Check the ovaries

Those of us who do not exteriorize the uterus should remember to take a look at the ovaries before closing the abdomen. I have found many ovarian tumors that way, mostly just cystic teratomas, of course, but it is a shame to leave them as they will one day likely need removal. It only takes a few minutes to shell one of these benign tumors out of the ovary and if done carefully, without rupture, there is often no bleeding and no need for suture. One purse string suture inside the ovary will approximate the surfaces enough to allow healing. I think we tend to forget that ovaries are very good at healing (they rupture and heal with every ovulation) so that sewing the ovarian surface is really counterproductive.

In addition to removing ovarian tumors, we have the opportunity to remove fibroids if they are subserosal, especially if on a stalk. Most of us have done that once, but if you are so tempted, be prepared to be late for dinner as getting hemostasis may be a major problem. Those vessels feeding the placenta on the endometrial side are as big as a small finger but stop bleeding as soon as the uterus contracts. The myometrium on the serosal surface is also very vascular but does not behave the same way. It is better to leave the fibroids for another day unless they are on a very narrow stalk that can simply be tied off.

18. Irrigate, but with what?

I am a big fan of irrigating. "The solution to pollution is dilution" I was told as a resident and it makes a lot of sense, though the literature is not as convincing (Harrigill et al., 2003). I prefer to irrigate a little at a time (the principle of serial dilution) using physiologic, isotonic solutions such as lactated Ringer's or "normal" saline. Some very good surgeons prefer water. One can see small bleeding vessels better with water, as the red blood cells burst from its hypotonicity, leaving a pink but clear liquid. My worry is that surface epithelial cells might similarly be destroyed. We know that injuring a serosal surface is the first step to getting adhesions, hence it makes sense to avoid epithelial damage from rubbing, blotting, burning, drying or (maybe) using hypotonic solutions to irrigate.

19. Peritoneal closure?

Since I do not create a bladder flap, I have no need to close the visceral peritoneum, except as it is re-approximated with the hysterotomy incision. However, closing the rectus muscles along with the underlying peritoneum is attractive to me. I once had a patient whose small bowel was coughed up through the gap in the rectus muscles and found the fascial suture line, where it stuck, requiring a return to the operating room. Therefore, I agree with Cheong et al. (2009) that some sort of closure of the parietal peritoneum can reduce adhesions. However, peritoneal surfaces seem to "flow" together rapidly if given the chance. Hence, I favor a simple mattress suture that incorporates a full-thickness bite through the rectus muscles and peritoneum near the midline, crosses the midline, comes to the surface on the other side and is then returned beneath the surface to near its starting point. The advantage of a mattress suture is that it tents up the midline away from the underlying uterus and may thus reduce the common problem of adhesion between the uterus and overlying tissue. This one suture also loosely re-approximates the rectus muscles. Actually closing the muscles has been shown to increase postoperative pain (Berghella et al., 2005) but this one stitch seems like a good compromise. Plastic surgeons charge a lot of money to repair a diastasis of these muscles, so there must be a problem here that we can help to prevent.

20. Fascial closure

A simple running closure using delayed absorbable suture is commonly used to re-approximate the cut edges of the anterior rectus sheath. A short stitch interval of a centimeter or so is advocated (unlike the closure of the uterine incision, which can be spaced more generously) with wide bites of a centimeter or more on either side of the cut. It is faster to use a single suture for the entire incision, though that means a "loop to strand" knot at the final end. Alternately, one can run the suture line from either end to the middle, tagging the first suture to reach the middle and tying it (strand to strand) to the mirror image suture when it in turn gets to the middle.

21. Subcutaneous closure

Some sort of closure of the subcutaneous tissue is advocated if the thickness is greater than two centimeters (Chelmow et al., 2004). A rapidly dissolving monofilament suture would be the theoretical ideal as the purpose is to prevent hematomas and seromas that may get infected. If infection of the area were to happen, a suture that disappears quickly would have an obvious advantage.

22. Skin closure

I prefer a subcuticular skin closure. It takes a minute or two longer than staples but the careful approximation of edges inherent in a subcuticular technique leads to rapid healing with a usually good cosmetic result. There are data (Tuuli et al., 2011) to suggest that a subcuticular closure results in fewer wound infections, which makes sense to me, since everything is beneath the surface. More importantly, women like it. Seeing staples in the skin is unpleasant for them, and they worry that removal will be painful (which, of course, it usually isn't).

I prefer to use a Keith needle with a fine, delayed absorbable suture. The Keith (straight) needle has a reputation for causing more needle-stick injuries, but I think that is because people tend to sew toward themselves with it, the way we do with almost all suture lines. If one pushes the needle away from oneself and picks up the needle with forceps instead of fingers, I do not see why needle injuries should occur. The Keith needle seems to me to be faster than a curved needle, and there is a tendency with it to keep the suture closer to the cut edge, avoiding some of the tension and puckering that can inhibit skin healing.

If I am especially worried about infection, I seal the surface of the skin with polyacrylic glue. I could find no data to prove that glue reduces wound infection but it seems logical. I also like to apply a moderate pressure dressing to inhibit seroma and hematoma formation. We also know from many studies that wounds heal more rapidly if the surface is made anaerobic, as it would be with either a pressure dressing or with glue.

23. Conclusion: Time is more than just money

The approach outlined here results in a cesarean section that, in the absence of complications, takes about fifteen minutes to perform, including a subcuticular skin closure

and a double layer uterine closure. We are usually ready to close the skin at ten to twelve minutes from the start time. An additional advantage, though I have no formal statistics, seems to be a greatly reduced rate of febrile morbidity and postoperative adhesions.

Post cesarean febrile morbidity is reported in a Cochrane review to be typically about 20% (Smaill & Gyte, 2010). And adhesions are found at the first repeat surgery in roughly a third of women after one previous cesarean section and approximately half of those undergoing their third cesarean section (Tulandi et al., 2009). In contrast, of the more than four thousand cesarean deliveries I have personally performed, there have been many repeat surgeries, including high order repeats. Yet I cannot remember the last time we had febrile morbidity postoperatively and we virtually never find any kind of adhesions at subsequent surgeries.

The principles espoused here are simple and logical. We know that it takes blood and epithelial damage to create adhesions. Eliminating blood from a cesarean delivery is impossible, so protecting epithelial surfaces is the way to prevent adhesions. That means using suction instead of sponges to improve visualization, it means avoiding epithelial damage by drying (keep the uterus in the abdomen, irrigate as needed, eliminate unnecessary steps so that operating time is minimized), and it means avoiding where possible the tissue damage that is inherent in electrocautery use. Placing the incision in the thinnest part of the lower abdomen, closing the subcutaneous layer if it is over two centimeters, sealing the surface with a subcuticular stitch, and making the incision anaerobic for the first day at least with a pressure dressing and/or with glue, seem also to be logical steps that help with a rapid recovery and fever-free postoperative course.

The number of cesarean sections that we do has been increasing year by year in nearly every country of the world. This, in my opinion, has been driven largely by a decreasing tolerance for taking risks with the baby, but has been made possible by increases in safety of the mother when cesarean delivery is used. The principles outlined here seem like` a step further along that same road.

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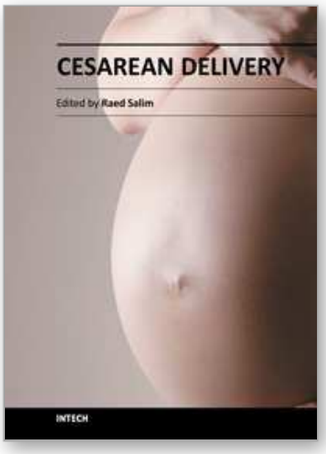

Cesarean Delivery

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This book provides broad, science-based information regarding the most common major surgical procedure performed, i.e. Cesarean Delivery. The book provides relevant scientific literature regarding epidemiology and rates of cesarean delivery in low and high income countries and the impact of the disparities in the rate of cesarean delivery between countries. In addition, the book systematically reviews the relevant scientific literature regarding all perioperative considerations with a broad cover of anesthetic techniques, drugs and difficulties that anesthesiologists may encounter during cesarean delivery. Care of the neonate after cesarean and crucial guidelines for obese women undergoing cesarean are also provided. The book was written by distinguished experts from different disciplines to ensure complete and accurate coverage of the recent scientific and clinical advances and to bring care providers and purchasers up to date including essential information to help improve health care quality.

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