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The Gravid Watermelon: An Inexpensive Perimortem Caesarean Section Model

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ABSTRACT:

Audience: Emergency medicine (EM) residents post-graduate year (PGY) 1-4, obstetrics and gynecology (OB/gyn) Residents PGY 1-4.

Introduction: The perimortem caesarean section (PCS) is an extremely rare but potentially life-saving procedure for both mother and child. Americans are estimated to have 450,000 cardiac arrests per year.¹ Of those, a widely quoted 1/30,000 pregnancies are said to be complicated by cardiac arrest,^{1,2} with an out-of-hospital arrest occurring in 1.71/100,000 pregnancies.³ Between the years of 2006 and 2012, a New Zealand Maternal Mortality Review Working Group found that 34% of maternal deaths were potentially avoidable, with lack of knowledge and skills quoted as barriers.³ Although EM residents will deliver neonates under ideal conditions on labor and delivery, few, if any, will perform a caesarean section, let alone a PCS. This model was designed be both a cost-effective trainer and a novel approach to teaching. The proposed model builds upon that established by Sampson et al. to be independent of a simulation mannequin; however, it is easily integrated.⁴

Objectives: At conclusion of the simulation, participants should be able to: 1) discuss indications for PCS; 2) describe each step to the procedure, and 3) demonstrate ability to perform a PCS on the model.

Methods: The gravid watermelon is a cost-effective model that uses common materials from the supermarket and emergency department (ED), using a carved-out watermelon as a base, representing the peritoneal cavity. Inexpensive respiratory tubing is used to represent intestine; watered down gelatin and a small doll in a deflated rubber/plastic ball is used to represent a gravid uterus. The bladder is represented by an unused, water-filled exam glove, and watermelon pulp represents blood clots and mesentery. The gravid watermelon is covered with an elastic bandage to represent tough muscle and fascia, and topped with a shower curtain for skin.

Topics: Perimortem caesarian section, C-section, PCS, simulation, task trainer.



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Learner Audience:

Medical Students, EM or OB/Gyn Interns, Junior Residents, Senior Residents and Attending Physicians

Time Required for Implementation:

Approximately 2 hours spent creating the model, with approximately thirty minutes of that time dedicated to making a single uterus, which is used in simulation for approximately 7 minutes. However, multiple sim uteri could be made ahead of time and replaced, along with new sim skin, for each new resident to use and practice on.

Recommended Number of Learners per Instructor:

Ideally two learners per instructor to ensure a hands-on experience. The ideal ratio is dependent on a program's supplies and time

Topics:

Perimortem caesarian section, C-section, PCS, simulation, task trainer.

Objectives:

At conclusion of the simulation, participants should be able to:

1. Discuss indications for PCS
2. Describe each step to the procedure
3. Demonstrate ability to perform a PCS on the model

- Delorio NM. Trauma in pregnancy. In: Tintinalli JE, Stapczynski J, Ma O, Cline DM, Cydulka RK, Meckler GD, eds. *Tintinalli's Emergency Medicine: A Comprehensive Study Guide*. 7th ed. New York, NY: McGraw Hill; 2012:1687–1712.
- Lew GH, Pulia MS. Emergency childbirth. In: Roberts JR, Custalow CB, Thomsen TW, Hedges JR, eds. *Roberts and Hedges' Clinical Procedures in Emergency Medicine*. 6th ed. Philadelphia, PA: Elsevier; 2014:1175-1177.

Learner responsible content (LRC):

- Wagner J. Perimortem C-Section Simulated Procedure. Vimeo. www.vimeo.com/77314218. Published October 19, 2013. Accessed March 1, 2018.

Implementation Methods:

Two or more participants should be provided an appropriate clinical scenario where early in the case, a gravid mother suffers cardiac arrest, either medical or trauma in etiology. The participants should perform appropriate resuscitation, demonstrate decision-making skills on whether to perform a PCS, and ultimately perform the procedure. For example, a 17-year-old gravida 1, para 0 (G1P0) female of unknown gestational age, presents as the restrained driver of a motor vehicle accident going approximately 80 miles per hour. She presents with an open femur fracture, hypotensive, tachycardic. During the trauma exam she becomes less responsive and loses a pulse. During routine resuscitation, participant(s) should palpate a fundal height above the umbilicus and perform a PCS (Figure 1). After baby is delivered, the uterus should be packed, oxytocin given, and simulation ends.

List of items required to replicate this innovation:

1. One large watermelon, approximately \$7
2. One medium to large sized plastic bouncy ball (example: <https://www.amazon.com/Voit-Playground-Ball-Blue-10-Inch/dp/B0000C863K/>), approximately \$5
3. One baby doll, should approximate between 23 weeks (mango-sized) and 34 weeks (cantaloupe-sized) (example: <https://www.amazon.com/inch-Soft-Body-Doll-Gift/dp/B01MD1SYOC/>), approximately \$13
4. Adhesive glue for plastic ball, (we used Super Glue™, could also use low temperature hot glue), approximately \$5
5. Two disposable examination gloves (one blue, one white)
6. Unused, discarded respiratory tubing of varying sizes (could also use parts of an old garden hose or flexible rubber hose insulation)
7. Unused, discarded intravenous (IV) tubing

Linked objectives and methods:

Rare procedures for life-threatening situations require task trainers for learners to appropriately practice the physical skills required. In this simulation, a low-cost PCS task trainer allows learners to review and practice a PCS. First, learners are put through a case that allows them to recognize the need for and to perform a PCS (objectives 1 and 3). During debriefing, the instructor can review the indications for PCS, review steps of the procedure (objective 2) to allow deliberate practice and fix any errors in performing the procedure (objective 3).

Recommended pre-reading for instructor:

- Datner EM, Promes SB. Resuscitation issues in pregnancy. In: Tintinalli JE, Stapczynski J, Ma O, Cline DM, Cydulka RK, Meckler GD, eds. *Tintinalli's Emergency Medicine: A Comprehensive Study Guide*. 7th ed. New York, NY: McGraw Hill; 2012:1687–1712.



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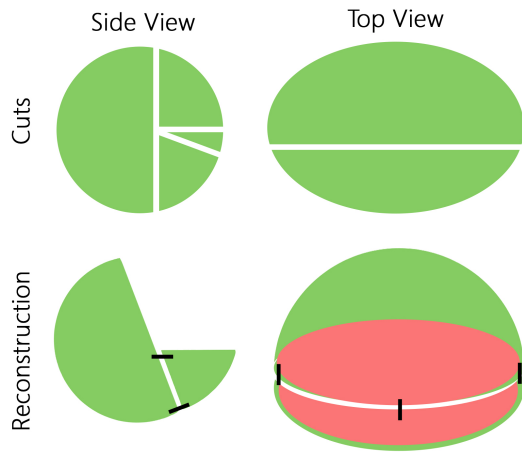
8. Unused, discarded 3" elastic wrap (we used an ACE wrap™)
9. One shower curtain, approximately \$2
10. One package clear, unflavored gelatin, approximately \$1
11. Tap water
12. Thick/sturdy tape, such as Duct™ or Scotch™, approximately \$4
13. Scissors
14. Twine or wire
15. Funnel

Approximate cost of items to create this innovation:

Approximately \$30-\$40 dollars depending on season/availability of watermelon, with each uterus costing approximately \$20.

Detailed methods to construct this innovation:

1. Create the peritoneal cavity:



Cut the watermelon in half lengthwise, approximately two inches off of center. Proceed to cut only one side of the melon in half. Remove and discard approximately 1.5 inches of the rind of one of the quarters; discard the remaining quarter. Carve/scoop out pulp and set aside for later. Along one edge of the remaining quarter rind, punch three small holes along the edge - one at each apex of the cut and one in the middle. Puncture corresponding holes along the edge of the half rind. Connect the rinds with wire at the puncture sites.

2. Create the uterus:
 - a. Prepare enough gelatin to fill the ball (approximately one box) per the package directions; however, add 1/3 extra water to create a consistency closer to amniotic fluid.
 - b. While the gelatin is being prepared, puncture the rubber/plastic ball and make a hole just

large enough to fit the doll. Cut two or three pieces of unused IV tubing, each 15 cm in length. Glue the tubing in a spiral fashion to form an “umbilical cord.” Glue one end of the “umbilical cord” to the doll’s mid-section. Fill one unused blue exam glove 1/4 of the way with tap water and tie tight. This will represent the placenta. Glue the other end of the “umbilical cord” to the knot of the “placenta.”



- c. Place the doll, “cord,” and “placenta” within the ball. You can glue the “placenta” in place to simulate placenta accreta or leave unglued for easy removal. Glue the opening of the “placenta” so that the funnel can just fit in. Using the funnel, fill the “uterus” with gelatin mixture (amniotic fluid) so that the ball is full/distended, but not overflowing. Carefully remove the funnel and glue the remainder of the “uterine” opening shut. Place in the refrigerator overnight to set.





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3. Create the bowel:
Using tubing, fill the watermelon/peritoneal cavity with just enough to approximate the large, and possibly some small intestine. Hold in place by attaching with wire ties through the outer wall of the watermelon rind.
4. Create the bladder:
Fill an unused white exam glove with as much water as possible and tie.
5. Final assembly:
 - a. Prior to the simulation, place the “uterus” in the peritoneal cavity, seam-side down. Place the “bladder” anterior to the uterus, fingers down, glove knot facing you. Fill with extra watermelon pulp; you can consider adding ultrasound gel to make things extra slippery.



- b. (Optional) If you are fortunate to have a Noelle simulation mannequin, the watermelon should fit nicely into the evacuated cavity. First place towels or other padding in the mannequin cavity, followed by the gravid uterus. The mannequin should NOT be connected to power or other electronics.



- c. Cut strips of unused 3” elastic bandage wraps just long enough to cover the opening of the “peritoneal cavity” and tape in place to represent abdominal wall muscle and fascia.



- d. Lastly, cut a piece from the shower curtain just big enough to cover the watermelon/mannequin abdomen and tape into place. In this image, you see we were fortunate to find an unused synthetic chest skin left and retrofitted to cover the abdomen.



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Results and tips for successful implementation:

Based on the post-simulation survey, those watching gave an average approval rating of 93.3%, with one attendee commenting that it was “innovative... engaging while being informative.” The participants in the simulation felt that the model provided realistic hands-on experience and commented that the simulation added realism to performing an anxiety-provoking procedure.

In the future, if our gravid watermelon model were to be used repeatedly as an isolated task trainer or repeatedly in simulation sessions, multiple uteri and replacement skin could be prepared ahead of time and easily switched out between cases.

References/suggestions for further reading:

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5. Lipowicz AA, Cheskes S, Gray SH, et al. Incidence, outcomes, and guideline compliance of out-of-hospital maternal cardiac arrest resuscitations: a population-based cohort study. *Resuscitation.* 2018; 132:127-132. doi: 10.1016/j.resuscitation.2018.09.003
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