Breakthrough in PPH Management

With

Lower Uterine Segment Compression

&

New Concept & Etiology of PPH

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Abstract

Postpartum hemorrhage (PPH) is a persistent problem yet to be thoroughly solved. Studies so far revealed that most cases of PPH could be attributed to uterine atony, so effort thus far had been focused on solving uterine atony. However, uterine atony is at the end of the cascade of multiple problems, and its prevention is often proved too slow, too inefficient, and not to yield adequate results. The subsequent complications from failed resolution thus arose. This article emphasizes on other risk factor of PPH which has not been revealed elsewhere. The excessive or profuse continuous bleeding immediately following delivery caused by lower uterine segment bleeding or lower uterine segment atony would lead to uterine hypoxia and, as a result, uterine atony. The vicious cycle of PPH and uterine atony would then continue. Lower Uterine Segment Compression (LUSC) maneuver can prevent bleeding immediately following delivery. This step disrupts the cascade before uterine hypoxia could occur. As a result, application of LUSC could prevent PPH at almost 100% via prevention of uterine atony and interrupting the vicious cycle.

PPH: Current state, Goals, and Expectations

To date, PPH is still an ongoing problem which needs attention. PPH is still a major cause of maternal deaths totaling to 127000 to 289000 deaths annually. Maternal Mortality rate (MMR) can be as high as 1000 per 100000 live births, especially in developing countries. The situation with PPH has somewhat improved as of late but is no where near the goal we had set to achieve. The MDG5 aimed to reduce MMR by 75% before 2015 but we only achieve 43% at average global MMR of 260/100000 live births. The next goal set by WHO is the Sustainable Development Goal (SDG) which aims to decrease MMR to 70/100000 live births by 2030.

The global outlook of PPH has noticeably improved. Nonetheless, even among developed countries such as the USA, Canada, the UK, and Finland, the incidence of PPH has
not decreased in 10-20 years. On the contrary, the incidence seems to be increasing\textsuperscript{6}. The problem persists despite high standard of care, posing serious challenges for obstetricians.

In conclusion, both management and prevention of PPH will require further study, especially into the pathophysiology of the condition itself. It is admitted that various aspects of the disease are yet to be known\textsuperscript{7-8}, hence reinforcing the need to thoroughly understand how PPH came to be.

\textbf{PPH: An unanswered question. A clueless puzzle.}

\textbf{Or something unbeknownst to us?}

1. Global effort to reduce the MMR from PPH has not yield satisfactory results. Various researches into different medical interventions mostly focused on treatment of PPH. The only preventive study was the Active Management of Third Stage of Labour (AMTSL), most aspects of which still encompass treatment rather than prevention. \textbf{This is because PPH has not been adequately prevented.}

2. Developing countries are boasting quick reduction in MMR but developed countries such as the USA, Canada, the UK, and Finland, on the other hand, are facing increasing MMR in the past 10 to 20 years. The incidence of atonic PPH has also drastically increased by 33\textsuperscript{%}.\textsuperscript{6} \textbf{What is the answer behind the atonic PPH?}

3. Various risk factors include multiple pregnancy, previous PPH, chorioamnitis, obesity, etc. However, it was found that most cases of PPH did not possess any of the said risk factors\textsuperscript{9-11}. \textbf{So then what is the real risk factors for PPH?}

4. Some uteri which showed good contraction after delivery still lead to atonic PPH despite being given uterotonic medications. \textbf{Is something disrupting the adequate uterine contraction?}
Theory: Lower Uterine Bleeding leads to Uterine Hypoxia and Uterine Atony

Evidences are as followed:

1. There were cases with profuse bleeding right after deliveries, but the uteri showed good contractions. However, as bleeding continued, uterine atony followed. These cases might have low placental attachment, the nearer to lower uterine segment, the higher risk of postpartum bleeding.

2. Many researches studied lower uterine segment atony as the cause of PPH. This included abnormal placentation as a cause of PPH, especially low-lying placentation in lower uterine segment.

3. In cases with caesarean section, there were more cases which utilized compression suture at bleeding lower uterine segment.

4. In animal studies, it was found that hypoxic status of uterus would lead to rapid and intense smooth muscle relaxation despite receiving uterotonics. As a result, we can infer that continuous bleeding could lead to uterine hypoperfusion leading to uterine hypoxia and as a result, uterine atony follows. Subsequent further bleeding would lead to further uterine hypoxia, creating a vicious cycle which gives rise to many sequelae of PPH.

5. WHO is recommending bimanual uterine compression and Lower Segment Compression as first-line treatment against PPH. It was effective in 80-90% of the cases. The bleeding is stopped by the compression force and the PPH ↔ atony vicious cycle can be disrupted. Bimanual Uterine Compression used to be the third-line treatment.
Answering with Lower Uterine Segment Compression (LUSC)

Evidences are as followed:

Various researches found benefits of LUSC against PPH

- RCT (Journal of the Medical Association of Thailand; JMAT, 2009)
  - Treatment of PPH with LUSC can significantly reduce blood loss
  - “Lower uterine segment compression for management of early postpartum hemorrhage after vaginal delivery at Charoenkrung Pracharak Hospital.”
- RCT (Journal of the Medical Association of Thailand; JMAT, 2015)
  - Prevention of PPH with LUSC for 10 minutes had 56% effectiveness
  - “The efficacy of lower uterine segment compression for prevention of early postpartum hemorrhage after vaginal delivery.”
- RCT (Journal of the Medical Association of Thailand; JMAT, 2018)
  - Prevention of PPH with LUSC for 20 minutes had 82% effectiveness
  - “Lower uterine segment compression for 20 minutes to prevent early PPH”
- 20-year Retrospective Study (Journal of the Medical Association of Thailand; JMAT, 2018)
  - PPH incidence was reduced by 50% as compared to control group
  - “Postpartum Hemorrhage Outcome in Lower Uterine Segment Compression Maneuver: A 20-Year Experience in Charoenkrung Pracharak Hospital”
- 20-year Retrospective Study (Journal of the Medical Association of Thailand; JMAT, 2018)
  - No emergency hysterectomy needed for LUSC group as compared to 12 atonic PPH cases in control group undergoing vaginal delivery
  - “Postpartum Hemorrhage Outcome in Lower Uterine Segment Compression Maneuver: A 20-Year Experience in Charoenkrung Pracharak Hospital”
- Various studies and guidelines which encourage PPH treatment with placental bed’s raw surface compression. Internal compression includes uterine packing and balloon tamponade. External compression includes bimanual uterine compression as well as surgical techniques such as compression suture.
Paradigm Shift and Unconventional PPH Treatment

“The problem is not uterine atony”

Atony is too late!

Excessive bleeding after delivery can lead to uterine hypoperfusion, uterine hypoxia, and then finally uterine atony. Hence, any methods which cease excessive or profuse continuous bleeding will stop PPH or at least stop the progression into severe PPH in its track. The bleeding needs to be stopped as soon as possible. It is known that PPH can be caused by the 4T’s: Tone, Tissue, Trauma, Thrombin. The “Tone” in the 4T’s carry 2 meanings. First is the flaccid uterus which is the loss of tone right after delivery, and second is the secondary loss of uterine tone called uterine atony regardless of the causes.

The 2 major contributors towards PPH are as followed:

1. The 4T’s. Tone, Tissue, Trauma, Thrombin. “Tone” can refer to the flaccid uterus right after delivery such as uterine overdistension, intrapartum uterine inertia, or due to tocolytic drugs such as MgSO₄. In this group, bleeding as little as 500 ml can potentially lead to PPH. Further bleeding will lead to more uterine hypoxia and then uterine atony. Then the atony-PPH vicious cycle begins.

2. Uterine atony not related to the 4T’s. The other cause of uterine atony is lower uterine bleeding or lower uterine segment atony which refers to excessive continuous bleeding. The accumulated bleeding will eventually cause uterine hypoxia and the atony-PPH vicious cycle continues.

- LUSC has been integrated into PPH prevention guideline in Charoenkrung Pracharak Hospital since 2012
Lower Uterine Segment Compression

**Figure 1**  Lower uterine segment compression method in treatment of acute postpartum hemorrhage by compressing at the lower uterine segment only

**Figure 2**  Lower uterine segment compression method in treatment of acute postpartum hemorrhage by compressing at the lower uterine segment with counteracting pressure from fundus
The benefits of Lower Uterine Segment Compression Maneuver

- Easy to carry out, no special training needed
- Non-invasive, no vaginal manual intrusion, no sedative or analgesic drugs needed
- No instruments needed. Hands only.
- Can be done anywhere and at any time
- No extra cost
- No risk

How to do Lower Uterine Segment Compression

The compression of lower uterine segment may be similar to that of bimanual uterine compression. During the literature review, we found that there were almost no reports of the said procedure being done. This might be due to the invasiveness of the procedure as well as the need for anesthesia. Hence, we devised Lower Uterine Segment Compression which is a non-invasive procedure to combat the problem. This maneuver not only prevents PPH but also can be used to treat PPH.

A study by Wanchai et al. utilized LUSC for 10 minutes to prevent PPH and was successful in 56.5% of the cases. However, in reality, it is feasible to compress the lower uterine segment for up to 30 minutes, depending on individual cases. If 10 minutes are sufficient in bleeding cessation, the procedure can stop. If the bleeding persists, which at this point should be significantly less than how it started, the compression can continue for 5-10 more minutes, which is in accordance to the normal clotting time of 15-20 minutes.
Compression techniques are also essential, but they are relatively easy to learn (PACS).

1. **Position.** The compression should be directed to lower uterine segment which lies just above the pubic symphysis and below uterine body. Some uteri can be very flexible and float far above the pubic symphysis. In which case, the other hand can be used to control fundus by applying caudal force while the other hand palpates the uterine body. Some patients have very wide abdominal diameter, allowing the uterus to be tilted rightward or leftward. This problem can also be solved by using the other hand to control the uterine fundus and position it in midline.

2. **Adequate force.** The pressure should be as intense as physically possible. The personnel applying the pressure will be able to feel the effacement between 2 layers of uterus. The pressure applied is similar to that of bleeding elsewhere in the body. The pressure force should be decreased when patients show sign of pain or significant discomfort.

3. **Continuous pressure.** The duration has to be long enough to allow the severed end of blood vessels to clot so both duration and strength of compression are important. If the personnel doing the compression experience fatigue or pain in their upper extremities, hands can be switched but no loss of pressure has to be ensured while switching hands.

4. **Start fast.** The maneuver can be initiated immediately right after delivery. Quick compression will reduce the amount of blood loss and give better results.

**Other Suggestions for LUSC**

1. When excessive bleeding starts, begin compression first and only then you can call for assistance. Compression will abruptly stop the bleeding, allowing for more time for other management such as forming a resuscitation team. Vaginal trauma can be inspected while the compression is ongoing. This is because the compression towards cephalad direction will cause tenting of upper portion of the vaginal canal, which allow for easy inspection for
lacerations. With wider view and no interference from blood ooze, the laceration can be sutured with ease.

2. If the uterus feels soft during the compression, one hand can simultaneously give a fundal massage. This will allow easy identification of uterine body and lower uterine segment when the contraction begins.

3. In cases of abdominal wall laxity such as multiparity or very slim body type, one hand can press the fundus downward and the other hand can do the lower uterine segment compression. For cases with distended abdominal wall such as primigravida or obese body type, fundal palpation may be difficult so lower uterine segment compression should suffice. However, with thick abdominal wall, both hands may be required to do the compression.

**Key Messages**

1. Stop the fire before it starts. Don’t wait for atony, by then it will be too late.

2. Lower uterine segment is an important factor leading to PPH

3. Uterine hypoxia leading to uterine relaxation is the major principle of PPH

4. If bleeding continues to the point of uterine atony, the Atony-PPH vicious cycle will begin

5. Lower Uterine Segment Compression is a method to help reduce the profuse bleeding in the first period after delivery which prevents the subsequent uterine hypoxia and atony

6. Cases where placental attachments are at the body or the fundus often have sufficient contractions and respond well to uterotonics so the risk of PPH in these groups are rather low. LUSC might not be required for these cases.
Changes in uterine force and myosin phosphorylation with cyanide

Ref

Lower Uterine Segment Compression Maneuver (LUSC)

How does it work

<table>
<thead>
<tr>
<th>Cause &amp; Effect</th>
<th>Profuse/Excessive bleeding</th>
<th>Uterine hypoperfusion</th>
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<td>Uterine hypoperfusion</td>
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<td>Uterine hypoxia</td>
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<td>Uterine atony</td>
<td>PPH</td>
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Vaginal delivery → Profuse/Excessive bleeding → Uterine hypoxia → Uterine atony

Block with "Lower Uterine Segment Compression Maneuver" → Normal bleeding
Algorithm of PPH

PPH without Associated Risk Factors 90%

Lower Uterine Segment Bleeding
LUS Placenta Implantation / LUS Atony

Continuous Excessive Bleeding

Extraordinary Bleeding

Uterine Hypoxia

Uterine Atony

PPH

Uterine Hypoxia

Uterine Atony

PPH with Associated Risk Factors 10%

Tone
(Flaccid Uterus)

Tissue

Trauma

Thrombin

(New Concept of PPH with Lower Uterine Segment Bleeding/

Lower Uterine Segment Atony)
References


19. Li GT, Li GR, Li Xf, Wu BP. Funnel compression suture: a conservative procedure to control postpartum bleeding from the lower uterine segment. BJOG 2016;123(8):1380-5


