Understanding the Role of the Focused Assessment with Sonography for Trauma in Preventing Maternal Morbidity and Mortality due to Postpartum Hemorrhage

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Abstract

Objective: Decreased time to intervention in postpartum hemorrhage (PPH) improves maternal outcomes. Strategies to achieve timely intervention is of great public health importance as maternal mortality rates from PPH in the United States are rising. We sought to identify if using Focused Assessment with Sonography for Trauma (FAST) exams during evaluation of PPH following cesarean delivery affects time to interventions.

Study Design: This is a retrospective cohort study of women who underwent a cesarean delivery that was complicated by PPH. Demographic and outcome data were compared between those who received a FAST exam after delivery and those who did not receive a FAST exam as part of their evaluation. The primary outcome was the time to a composite of interventions (admission to the intensive care unit, reoperation, or interventional radiology procedure within 48 hours of delivery) analyzed using Survival Models adjusted for propensity score weights. Secondary outcomes included hysterectomy, length of hospital stay (LOS) and transfusion morbidity.

Results: A total of 1,128 women with PPH following cesarean delivery were included in this analysis. 113 (10.0%) women had a FAST exam as part of their evaluation. Demographic variables were balanced between groups; with the exception of estimated blood loss ($p < .0001$) and etiology for PPH ($p < .0001$). Mean time to intervention was 8 hours shorter in the FAST exam group compared to usual care (39.2 hours after delivery versus 47.2 hours after delivery, respectively, p < 0.0001)). After propensity score weighting, the FAST exam group still received interventions 3.8 hours faster than the usual care group (FAST exam: 43.4 hours, versus Usual care: 47.2 hours, p = .026). There was no difference in rate of hysterectomy (FAST 2% vs. usual care 1%, p=1.0). LOS was 1.4 days longer in the FAST group (p < .0001). While transfusion rates were also higher in the FAST exam group (FAST exam: 73% vs. usual care 23%, p <.0001), patients in the FAST group received fewer units of packed red blood cells (p <.0001).

Conclusion: FAST exams may lead to more timely interventions in PPH. Prospective studies are warranted to validate these findings.

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1.0 Introduction

1.1 Maternal Mortality and Public Health Significance

The United States (U.S.) faces a pressing challenge to tackle its high and escalating maternal mortality rate. Over the span of two decades, direct obstetric deaths, or deaths due to complications of pregnancy, birth or termination, have nearly doubled, from 8.41 per 100,000 live births in 1999–2002 to 14.1 per 100,000 live births in 2018–2021.[1] A significant contributor to this rise is obstetric hemorrhage, which has increased by 50%.[2]

In the U.S., maternal mortality stemming from postpartum hemorrhage (PPH) emerges as a significant public health concern, revealing systemic challenges including inequities in access to quality healthcare, racial and ethnic disparities in maternal health outcomes, and deficiencies in maternal healthcare delivery. Notably, Black women face a threefold higher risk of mortality from pregnancy-related causes compared to their White counterparts.[3] The cause of these disparities is multifaceted, encompassing variations in healthcare quality, underlying chronic conditions, structural racism, and implicit biases within healthcare systems. Effectively addressing maternal mortality related to PPH is imperative not solely for preserving lives, but also for advancing health equity and securing the welfare of families and communities. Therefore, comprehensive strategies that focus on preventing and managing obstetric emergencies, promoting evidence-based practices in obstetric care, enhancing provider training, and addressing social determinants of health are essential for reducing maternal mortality rates related to PPH in the United States.

1.2 Hemorrhage Related Maternal Morbidity and Mortality in the United States

Obstetric hemorrhage, defined as blood loss greater than or equal to 1000mL or blood loss with signs and symptoms of hypovolemia within 24 hours of delivery, now impacts 5% of pregnancies in the U.S.[4] Despite its relatively low prevalence, obstetric hemorrhage accounts for a substantial portion-- up to 14%--of pregnancy-related deaths and is also associated with increasing rates of severe maternal morbidity (SMM).[5] This increase in SMM, including blood transfusion, hysterectomy, and complications associated with hypovolemic shock and resuscitation, is also closely linked to rising cesarean delivery rates.[6,7] Innovative approaches in evaluation and management of obstetric hemorrhage from cesarean delivery are needed to address the disparity between the prevalence of obstetric hemorrhage and the occurrence of severe complications.

Several state maternal morbidity and mortality committees have focused efforts on developing tool kits to improve healthcare response to obstetric hemorrhage. These toolkits are intended to be used by practitioners who care for individuals experiencing postpartum hemorrhage (PPH) and take into consideration the wide variation in training backgrounds and hospital resources.[8–12] They offer checklists, protocol recommendations, and strategies for implementation geared towards improving in-unit preparedness, early recognition of excessive blood loss, and timely initiation of interventions.[13] Using a bundle of PPH treatments (examination, uterotonics, tranexamic acid (TXA), uterine massage, and fluid resuscitation) in addition to quantifying blood loss, rather than using visual estimates, has been shown to reduce total blood loss, need for operation, and maternal death.[14] This benefit is likely observed because of improved detection of PPH and subsequently faster treatment. TXA, when administered early in the course of a PPH, decreases maternal mortality.[15] Additionally, studies have demonstrated that delays in administration of uterotonics, manual evacuation of the uterine cavity, or calling for assistance by more than 10-20 minutes is associated with increased rates of hypotension, excessive drops in hemoglobin, and need for transfusion.[16] In light of these studies and others that show early detection of PPH decreases severity and associated morbidity, [14,16–18] current toolkit strategies focus on implementing systems to assess risk, accurately quantify of blood loss, expedite administration of uterotonics, and alert providers of warning sign that require close follow up.

PPH following cesarean delivery, however, poses a unique challenge that is not addressed by these interventions. Blood loss after a cesarean delivery may not be immediately visible to providers due to intrabdominal bleeding or incomplete cervical dilation that results in accumulation of blood within the uterus. Both etiologies of hemorrhage can delay diagnosis and treatment of PPH. While changes in vital signs and laboratory blood values such as hemoglobin level or hematocrit can be used to monitor patients after cesarean delivery, vital sign abnormalities may not be observed until cumulative blood loss exceeds 1,000 mL and hemoglobin or hematocrit lab values may take up to 72 hours to accurately reflect the amount of blood lost during an acute PPH episode. Thus, these tools also do not help overcome the barriers to early recognition and treatment and highlight the importance of finding blood loss recognition strategies that specifically lead to earlier management of hemorrhage in patients undergoing cesarean delivery.

1.3 Tools to Address Morbidity and Mortality from Hemorrhage

A computed tomography (CT) scan is the gold standard for diagnosing intra-abdominal bleeding, detecting as little as 100mL of intraperitoneal fluid.[19] However, time delays and transportation off a monitored unit hinder CT evaluation of hemodynamically unstable patients.

Outside of obstetrics, the Focused Assessment with Sonography in Trauma (FAST) is a point of care ultrasound assessment developed to assess for hemorrhage in patients who have had blunt abdominal trauma. With high positive and negative predictive values (83% to 97% and 87% to 96%, respectively) that improve in patients with vital sign instability, FAST exams are a useful tool for making decisions in emergent situations.[20] They decrease the time to surgical intervention, the patient length of stay, and the need for CT scan.[21] Further, it is an inexpensive and non-invasive tool that can be performed quickly at the patient's bedside, detecting intraperitoneal fluid at only slightly higher levels than a CT scan (~ 150-200mL).[19] FAST exams are also not associated with any harm, unlike CT imaging, which requires contrast agents that pose risk of allergy and acute renal injury that may compound hemorrhage-related morbidity.

The literature is sparse regarding the utility of FAST examinations in evaluation of obstetric hemorrhage. Feasibility studies have demonstrated that, with training, obstetric providers are able to perform the study appropriately 97% of the time and that results are not impacted by gestational age or BMI.[22] Given the feasibility of FAST examinations in the obstetric population and clearly demonstrated benefit in trauma patients, this study seeks to investigate the effect of FAST examination on timely maternal healthcare delivery and outcomes in obstetric hemorrhage. Because FAST examinations can identify intrabdominal bleeding and accumulation of blood in the uterus, we hypothesize that when a FAST examination is included in the evaluation of PPH following cesarean delivery, time to recognition and treatment will be reduced.

2.0 Methods

2.1 Study Design

This study was a retrospective cohort study performed at a single tertiary care center between January 2016 and December 2020. Approval was obtained from the Institutional Review Board, and a data set was created from the electronic health record of all pregnant women age 14-51 who underwent a cesarean delivery that was complicated by PPH. PPH was defined as the sum of bleeding during delivery and postoperatively greater than or equal to 1000mL. In this hospital, visual estimation is used to determine blood loss using visual aids that characterize volume estimates by the type of sponge or absorbent pad used and percent saturation. Intraoperative blood loss is agreed upon by both the Anesthesia and Obstetric teams.

Patients with placenta accreta spectrum disorder identified at the time of cesarean were excluded because it is standard at our institution for these patients to recover in the intensive care unit (ICU) post-operatively, independent of ongoing bleeding. As such, patients with placenta accreta spectrum disorders would receive one of the interventions of interest prior to the study exposure or evaluation for PPH. Charts were reviewed to assess which patients had a postoperative evaluation for PPH or if their PPH occurred solely intraoperatively/at the time of delivery. Those who did not have a postoperative evaluation were excluded from the cohort as they would not have been able to receive a FAST examination. After chart review, the cohort was divided into two groups—those who received a FAST exam as part of their evaluation for PPH and those who did not receive a FAST exam (usual care).

Starting in 2015, obstetric resident and attending physicians at our institution underwent training in FAST examination by skilled emergency medicine physicians who use FAST examinations in their daily practice. Obstetric providers were taught to assess for blood collection in four views-- (1) the hepatorenal recess, (2) the perisplenic area, (3) the suprapubic window, and (4) the uterus with focus on endometrial stripe. The typical subcostal cardiac view of the FAST examination was not included in the training as it would be an unlikely site for blood accumulation in postpartum hemorrhage following cesarean delivery. Images were reviewed for quality before clinicians could perform the exam without supervision. Examinations were documented in progress notes and included the areas assessed and if free fluid was identified.

2.2 Outcomes of Interest

The primary outcome of interest was the time from the patient leaving the operating room following cesarean delivery to the first occurrence of interventions in a composite including admission to the ICU, reoperation (exploratory laparotomy or dilation and curettage), or interventional radiology procedure. Those without intervention were 'censored.' Their follow-up time was set at 48 hours as it would be unusual for intrabdominal bleeding to go unrecognized past post operative day 2. The secondary outcomes examined length of hospital stay, rate of morbidity related to PPH, including hysterectomy and transfusion, as well as units of packed red blood cells (pRBCs) received among transfused patients. All intervention data was obtained from chart review. All other participant information was extracted from our contemporaneous electronic health record that has previously been validated.[23] The resulting data set included demographic information as well as pregnancy and delivery admission interventions and outcomes.

2.3 Statistical Analysis

Data values were summarized as number (%) for categorical variables and mean (SD) for continuous variables by FAST examination status. The distributions of the variables were compared between the levels of FAST examination. Univariate analyses were carried out using the Wilcoxon rank sum test for continuous variables, and the Pearson chi-square or Fisher exact test for categorical variables where appropriate. Propensity scores were calculated using logistic regression models, where the probability of receiving FAST examination was modeled based on observed baseline characteristics. Covariates included in the propensity score model were selected based on clinical relevance and prior literature. The covariates included maternal age, parity, gestational age, race, ethnicity, laboring status, number of prior cesarean deliveries, etiology and risk factors of PPH, and reason for evaluation. While estimated blood loss (EBL) can affect the decision to perform a FAST exam, it can be affected by time to intervention, making it a collider variable. EBL, thus, was not included in the model to avoid collider bias. Inverse probability of treatment weighting (IPTW) was employed to balance covariate distributions between patients who received FAST examination and those who did not. Each participant was assigned a weight based on their propensity score, with weights calculated as the inverse of the propensity score for patients who underwent FAST examination and the inverse of one minus the propensity score for patients who did not. Cox regression models were utilized to compare the restricted mean time (hours and 95% confidence intervals (CIs)) to the interventions of interest between patients who underwent FAST examination and those who did not, while accounting for propensity score weights.

3.0 Results

3.1 Demographic Data

The original data set included 1336 women. After exclusion of women with placenta accreta spectrum disorder and those who did not have a postpartum evaluation for clinical signs or symptoms of hemorrhage, there were 1128 women included in the study. The demographic information for the final population is presented in Table 1. 113 (10%) participants had FAST examinations as part of their evaluation. The mean EBL was 611mL higher in the FAST exam group (P<.001). The number one cause of PPH was multifactorial in the usual care group vs atony in the FAST exam group (p<.001). There were no significant differences between groups with regard to age, gestational age at delivery, parity, BMI, race and ethnicity, risk factors for PPH, or indication for evaluation. (Table 1).

23 FAST exams (20%) were positive for hemoperitoneum. None of the patients who had a positive FAST exam were evaluated for dizziness or syncope. 3 (13%) of the patients with positive FAST exams were evaluated for visible bleeding. Of the remaining positive FAST exams, 3 (13%) were performed for hypotension, 6 (26%) for a post operative hemoglobin drop out of proportion to EBL, 3 (13%) for tachycardia, and 8 (34%) for abdominal pain or abnormal abdominal exam. 15 (17%) of the patients with negative FAST exams on initial evaluation ultimately required intervention.

3.2 Outcome Data

The primary outcome was mean time (hours) from the patient leaving the operating room following cesarean delivery to a composite of interventions, including admission to the intensive care unit, interventional radiology procedure, and reoperation restricted to 48 hours from 54 participants (4.8%) of the cohort received one of the interventions within 48 hours. Those in the FAST exam group had higher rates of receiving each intervention ($p < .0001$) (Table 2). The group that underwent a FAST exam had a faster restricted mean time (RMT) to intervention compared to usual care (FAST exam: 39.2 hours, versus Usual care: 47.2 hours, $p < .0001$). After propensity score weighting, the FAST exam group still received interventions 3.8 hours faster on average than those who received usual care (FAST exam: 43.4 hours, versus Usual care: 47.2 hours, $p = .026$). (Table 3).

Figure 1 shows the difference (usual care – FAST) in RMT to intervention for the composite and individual interventions. The RMT to each intervention was significantly shorter in the FAST group than usual care for each intervention. Time to reoperation was 5.9 hours faster ($p<.0001$), time to an interventional radiology procedure was 1.5 hours faster ($p=.035$), and time to admission to the ICU was 3.9 hours faster ($p=.001$) for people who had FAST exams as part of their evaluation.

Regarding PPH morbidity outcomes, there was no difference in rate of hysterectomy between the two groups (FAST: 2 (2%) vs Usual Care: 10 (1%) $p=1.0$). Individuals in the FAST exam group spent on average 5.8 days (SD = 7.1) in the hospital, and patients in the usual care group, on average, spent 4.4 (SD= 5.0) ($p < .0001$). Transfusion rates were higher in the FAST exam group (FAST exam: 83 (73%) vs . usual care: 232 (23%), $p < .0001$). However, those who were transfused, needed fewer units of packed red blood cells (pRBCs) as part of their resuscitation in the FAST exam group compared to usual care p <.0001). 60 (68%) transfused patients received a single unit pRBCs in the FAST group compared to 129 (48%) of patients in the usual care group. 20 (23%) transfused patients in the FAST group required 2-3 units compared to 108 (40%) in the usual care group. And notably, the rate of massive transfusion, with greater than or equal to 4 units of pRBCs transfused, was half the rate in the FAST group compared to the usual care group (FAST: 5 (7%) vs usual care: 32 (14%)).

4.0 Discussion

4.1 Principal Findings

This study demonstrated that individuals who were evaluated with a FAST exam during a postpartum hemorrhage following a cesarean delivery received interventions more rapidly than those who had usual care. Patients who had a FAST exam had a longer length of hospital stay compared to those with usual care. Transfusion rates were also higher in the FAST exam group, but those who were transfused in the FAST exam group required fewer units of pRBCs than those who were transfused in the usual care group. There was no observed difference in hysterectomy morbidity between groups.

4.2 Results in the Context of What is Known in the Literature

These results are largely consistent with data in the trauma literature on FAST examination during blunt abdominal trauma (BAT). A randomized control trial comparing FAST exams to usual care in patients presenting to the ED with direct abdominal trauma found shorter time to operative care in those who had a FAST exam.[21] While this trial did find shorter length of hospital stay in the FAST exam group following BAT, when looking at patients who required operation, there was no difference in length of stay. [21] In our cohort, more patients in the FAST exam group required intervention, which may explain the longer hospital stay.

Decreased time to intervention in PPH has been shown to lower need for transfusion,[16] but our study found higher rates of transfusion in the FAST exam group. This may be the result of the higher EBL noted in the FAST exam group. It is interesting though, that despite higher rates of transfusion and higher EBL, patients in the FAST exam group received fewer units of pRBCs. Early diagnosis and intervention from FAST exam may result in earlier control of bleeding and fewer units being transfused, which could impact morbidity. The literature demonstrates that the risk of sepsis and infection increase with each additional unit transfused.[24] Blood transfusion is also an independent risk factor for multi-organ failure following hemorrhage with a dose dependent relationship observed.[25] It is possible that patients in the usual care group were clinically stable and received transfusion as treatment of their PPH, which may necessitate more products than performing a procedures to definitively control the source of bleeding. However, if providers were choosing to transfuse clinically stable patients with ongoing bleeding, one would expect that time to admission to the ICU would be more balanced between our groups as those patients would still need a higher level of care. Prospective studies are needed to test the hypothesis that FAST examination reduces number of units transfused by reducing time to diagnosis.

Lastly, given known racial disparities in maternal morbidity and mortality related to PPH,[2,26] planned subgroup analysis was intended to investigate the effect of FAST scan on time to intervention by race. Non-Hispanic Black and Hispanic women were 4.7 and 3.7 times more likely to die from a PPH than their white counterparts. [2] Multiple factors contribute to disparate outcome, including inequitable quality of care (e.g. not listening to patient's concerns or not responding in as timely a manner).[2,27] Further, black and Hispanic obstetric patients are more likely to have missed or delayed diagnosis.[28] They suffer higher rates of SMM from PPH and are also less likely to receive higher levels of intervention.[26] Our cohort did not have differences in time to intervention by race, so we were not able to evaluate the role of FAST examination in addressing disparities in PPH care.

4.3 Strengths and Limitations

We believe this study has several strengths; the first comes from its novelty. To the best of our knowledge, no other study exists that has evaluated the effect of FAST exam on time to intervention in women with PPH after cesarean delivery. Studies in the obstetric literature on FAST exam have focused on feasibility and included low risk women who either had a vaginal delivery or were still pregnant.[22,29] Compared to these groups, patients who have undergone cesarean delivery are at increased risk for intrabdominal bleeding. Thus, FAST examination is of particular utility in the post cesarean delivery population. This study was also performed at a single center where most births in the state are performed, giving us access to a large sample size.

Despite its strength, this study is not without limitations. While the overall sample size of the study was large, the frequency of intervention and morbidity outcomes was low. The limited event rate could reduce the statistical power of the analysis and increased uncertainty in parameter estimates, potentially impacting the generalizability and reliability of our findings. Further, it limits statistical power—notably, our study is not powered to detect the difference between groups for secondary outcomes like hysterectomy.

Additionally, the retrospective nature of this study adds inherent bias within the study design. We were not able to control the intervention and suspect that there may be something inherently different about the clinical presentation of the individuals in the FAST group that prompted a provider to perform a FAST exam. While risk factors and reasons for evaluation were similar between groups, the FAST group had a higher EBL and higher frequency of needing intervention. The etiology of PPH was also different between groups. Survival analysis was used to account for the difference in frequency of events, rather than assessing time as a continuous variable; propensity score weighting was used to address differences between groups. But there remains a potential for confounding by variables we have not measured that may prompt clinicians to use FAST exams on patients who are more likely to need intervention or who need more thorough and expeditious evaluation and treatment. For example, while we collected information on the indication for evaluation, vital sign values were not obtained so the degree of vital sign instability cannot be evaluated in this study. The trauma literature questions whether FAST exams are helpful in patients who are vitally stable.[20] Future studies may seek to identify the clinical presentation of PPH in which FAST examination is most used and most useful.

4.4 Clinical and Research Implications

This data adds to the literature on point of care ultrasound in the postpartum patient and suggests the potential of FAST exams for improving the recognition of PPH and reducing morbidity related to PPH. Still, more prospective studies are needed to better understand if and how FAST exams should be incorporated into existing protocols and checklists for management of PPH. Hybrid effectiveness-implementation designs may be a useful approach as they can shed light on outcomes, implementation process, equity, and cost effectiveness, resulting in a more efficient implementation pipeline.

When thinking about implementation of the FAST exam in PPH care delivery bundles, it is important to consider that its effectiveness is contingent upon the proficiency of the operator in acquiring and interpreting the images. Adequate training of obstetric providers is thus critical to successful implementation. Further, FAST scan alone cannot identify all causes of PPH and should serve as an adjunct to existing diagnostic methods, such as transvaginal examinations, to make a precise diagnosis of etiology and facilitate appropriate treatment. The literature has shown FAST to reduce the number of CT scans performed and thus lower healthcare cost, but CT imaging may still be useful as FAST is unable to assess retroperitoneal hemorrhage and requires slightly larger volumes of intraperitoneal blood than CT for reliable detection.[18] To mitigate the risk of false negatives with low volume intraperitoneal bleeding, serial FAST examinations can be considered; more studies are needed in this area to determine if patients who received serial FAST exams also saw the benefit of timely intervention that was observed in this study or the trauma literature.

5.0 Conclusion

In summary, when FAST was used as an adjunct to evaluate patients, it was associated with a reduced time to intervention and fewer total units transfused. Reducing time to interventions in PPH significantly correlates with decreased maternal morbidity and mortality, underscoring the critical public health imperative of timely medical responses in safeguarding maternal health. While FAST exam was associated with higher rates of transfusion and longer lengths of stay, this is likely the result of the higher acuity of patients in the FAST exam group. With ubiquitous point of care ultrasound availability, patients who have PPH can receive necessary interventions more rapidly without need for expensive and time-consuming imaging like CT scans. Therefore, the benefits of FAST exam in obstetric hemorrhage from cesarean delivery may be multifaceted and include decreased morbidity, better resource utilization, and cost-effectiveness.

6.0 Figures and Tables

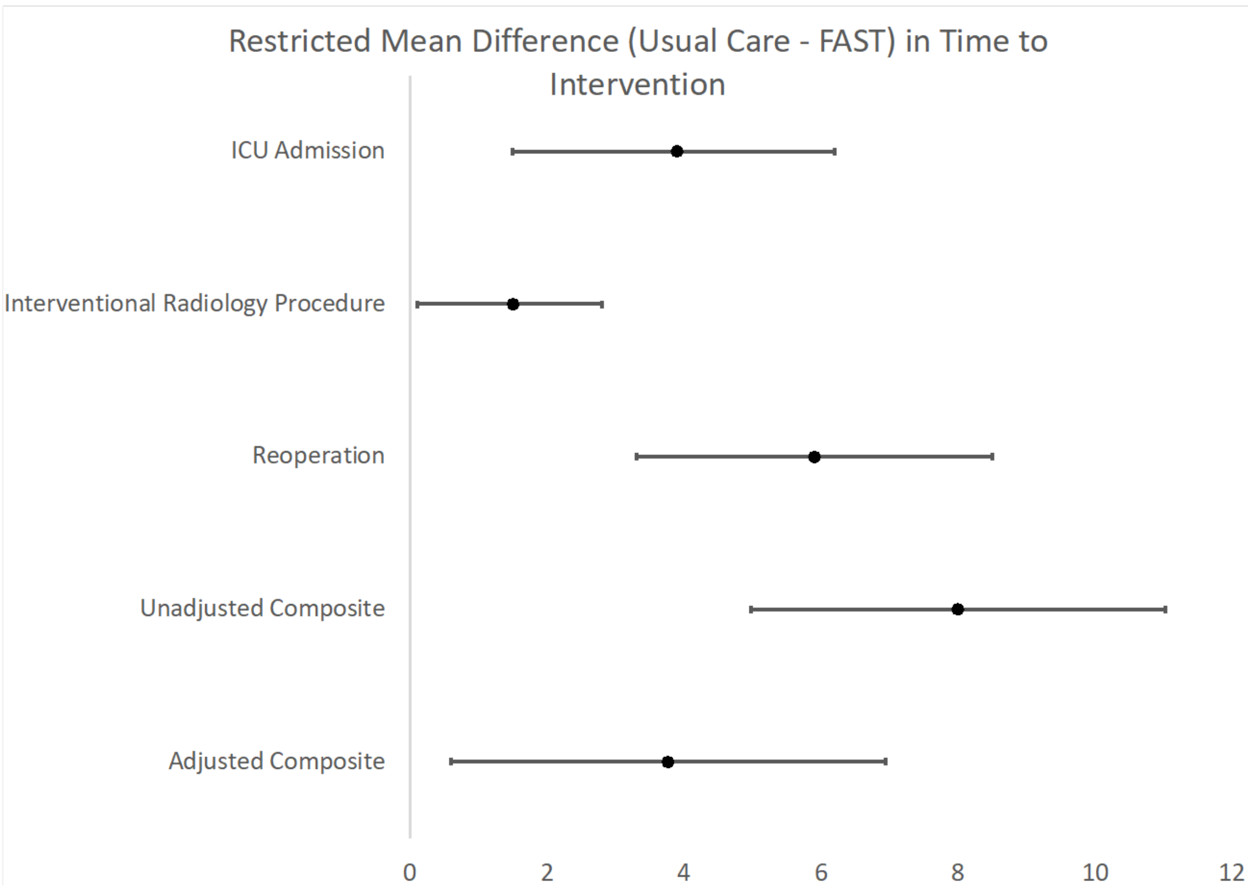

Figure 1: **Restricted Mean Difference in Time (Hours) to Intervention**
Time to interventions all favor FAST examination as all values and the CI's are > 0.

Table 1: Demographic Comparisons

	Overall	Usual Care	FAST Exam	
	1,128	1,015 (90)	113 (10)	
Baseline Demographics				
Age (years) , mean *(SD)*	31.3 (5.8)	31.3 (5.7)	30.6 (6.7)	0.39
Gestational age (weeks), mean *(SD)*	37.6 (3.3)	37.6 (3.3)	37.3 (3.0)	0.0417
Gravida, mean (SD)	2.8 (1.9)	2.8 (1.9)	2.9 (1.8)	0.23
Parity, mean (SD)	1.1 (1.3)	1.1 (1.3)	1.2 (1.3)	0.27
EBL, mean (SD)	1401 (819.1)	1340 (662.4)	1951 (1562)	<0.0001
BMI, mean (SD)	36.0 (7.7)	36.1 (7.6)	35.0 (8.9)	0.09
Race, N (%)				0.22
Black	392 (35)	345 (34)	47 (42)	
White	531 (47)	487 (48)	44 (39)	
Asian	75 (7)	66 (7)	9 (8)	
Others	130 (12)	117 (12)	13 (12)	
Ethnicity, N (%)				0.86
non-Hispanic	950 (84)	857 (84)	93 (82)	
Hispanic	175 (16)	155 (15)	20 (18)	
Unknown	3 (0)	3 (0)	0 (0)	
Risk Factors for PPH				
Repeat Cesarean Delivery, N (%)	403 (36)	360 (35)	43 (38)	0.51
Labored Cesarean Delivery, N (%)	195 (17)	173 (17)	22 (19)	0.91
Chorioamnionitis, N (%)	104 (9)	90 (9)	14 (12)	0.24
History of PPH, N (%)	75 (7)	66 (7)	9 (8)	0.73
Multiple Gestations, N (%)	80 (7)	68 (7)	12 (11)	0.24
Fetal Macrosomia, N (%)	101 (9)	94 (9)	7 (6)	0.83
Polyhydramnios, N (%)	38 (3)	36 (4)	2 (2)	0.61
Fibroids, N (%)	49 (4)	42 (4)	7 (6)	0.51
Previa, N (%)	25 (2)	24 (2)	1 (1)	0.8
Abruption, N (%)	51 (5)	45 (4)	6 (5)	0.84

PPH Characteristics				
EBL, mean (SD)	1401 (819.1)	1340 (662.4)	1951 (1562)	<0.0001
Reason for PPH, N (%)				
Atony	291 (26)	249 (25)	42 (37)	<0.0001
Hysterotomy/Extensions	160 (14)	145 (14)	15 (13)	
Tubal site	39 (3)	35 (3)	4 (4)	
Retained Products	63 (6)	50 (5)	13 (12)	
Coagulopathy	35 (3)	24 (2)	11 (10)	
Multifactorial	540 (48)	512 (50)	28 (25)	
Indication For Evaluation, N (%)				0.23
Hypotension	188 (17)	173 (17)	15 (13)	
Tachycardia	281 (25)	251 (25)	30 (27)	
Dizziness/syncope	246 (22)	222 (22)	24 (21)	
Abdominal pain	203 (18)	184 (18)	19 (17)	
Abnormal hemoglobin drop	118 (10)	108 (11)	10 (9)	
Unknown	41 (4)	32 (3)	9 (8)	

Table 2: Rate of Intervention in the Population

	Overall 1,128	Usual Care 1,015 (90)	Fast Exam 113 (10)	P-value
Primary Outcome N (%)				
Composite	54 (5)	17 (2)	37 (33)	<0.0001
Reoperation (D&C or Exploratory Laparotomy)	33 (3)	12 (1)	21 (19)	<0.0001
Interventional Radiology Procedure	16 (1)	4 (0)	12 (11)	<0.0001
ICU Admission	5 (0)	1 (0)	4 (4)	<0.0001

Table 3: Restricted Mean Survival Time to Intervention

	Overall	Usual Care	Fast Exam	P-value
Adjusted Restricted Mean Time to Interventions, Hours (95% CI)				
Composite	45.3 (44.4-46.2)	47.2 (47.0-47.3)	43.4 (41.8-45.0)	0.026
Unadjusted Restricted Mean Time to Interventions, Hours (95% CI)				
Composite	43.2 (41.5-44.9)	47.2 (46.8-47.6)	39.2(36.2-42.3)	<0.0001
Reoperation (D&C or Exploratory Laparotomy)	44.7 (43.3-46.0)	47.6 (47.4-47.8)	41.7 (39.2-44.2)	<0.0001
Interventional Radiology Procedure	47.2 (46.5-47.8)	47.9 (47.8-48.0)	46.5 (45.1-47.6)	0.035
ICU Admission	45.6 (44.3-46.9)	47.5 (47.3-47.7)	43.7 (41.3-46.1)	0.001

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