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ORIGINAL ARTICLE

Management of Postpartum Hemorrhage, Risk Factors, Urological Implications, and Maternal Outcomes: A Clinical Evidence-Based Study

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ABSTRACT

Background: Postpartum hemorrhage (PPH) is a significant contributor to maternal morbidity and mortality, specifically in low-resource settings like Pakistan. The advent of obstetric care has not removed the challenges of inadequate emergency response and insufficient blood transfusion. The risk factors, management strategies, urological complications, and maternal outcomes associated with PPH are evaluated in this study in a tertiary care setting.

Objectives: The study aimed to analyse prevalence of PPH risk factors, effectiveness of medical and surgical management, associated urological complications, and maternal outcomes in Pakistani women.

Methods: This retrospective study was conducted in tertiary care hospitals in Pakistan from August 2021 to August 2022, including a total of 100 postpartum hemorrhage (PPH) cases. Data on maternal demographics, risk factors, management approaches, and outcomes were analyzed using descriptive statistics in SPSS version 25.0. A p-value of <0.05 was considered statistically significant.

Results: The most common cause of PPH was uterine atony (45%), then placental abnormalities (15%), hypertensive disorders (12%), and previous cesarean delivery (32%). The most commonly used were oxytocin (92%) and misoprostol (70%), and 60% of cases required blood transfusions. In severe cases, surgical interventions, such as uterine tamponade (18%) and hysterectomy (6%) were employed. Acute kidney injury (10%) was the most frequent urological complication, but 25% of cases had complications involving the urological system. Eighty percent of maternal outcomes recovered, 12 percent required extended hospitalization, 6 percent were admitted to the ICU, and 2 percent died.

Conclusion: In Pakistan, PPH is still a major obstetric challenge. Maternal morbidity and mortality can be reduced by strengthening emergency obstetric care, improving blood transfusion availability, and standardizing PPH management protocol.

Keywords: Postpartum hemorrhage, uterine atony, cesarean section, hypertensive disorders, placental abnormalities, blood transfusion, urological complications, maternal mortality, obstetric emergency, Pakistan.

INTRODUCTION

Postpartum haemorrhage (PPH) is a major obstetric emergency and the leading cause of maternal mortality in the world, especially in low and middle-income countries like Pakistan. PPH is defined as blood loss greater than 500 mL after vaginal delivery or 1000 mL after cesarean section within 24 hours of delivery and can go very rapidly to hemodynamic instability, multi-organ failure, and death if not promptly treated[1]. However, with advances in obstetric care, PPH in Pakistan continues to be unacceptably high because of systemic barriers in healthcare, including delayed recognition and inadequate emergency response, as well as low utilization of skilled birth attendants and life-saving interventions. Improving maternal survival and reducing long-term morbidity from PPH will require addressing the risk factors, complications, and management strategies for the disease in the Pakistani healthcare context[2].

Several factors increase the incidence of PPH in Pakistan. Most often, uterine atony, or failure of the uterus to contract properly, is responsible for nearly 70% of cases. Other risk factors for CS are multiparity, prolonged labor, hypertensive disorders, abnormal placentation (placenta previa, placenta accreta), previous cesarean delivery, and coagulation disorders[3]. These risks are further magnified in resource-limited settings where antenatal surveillance is poor; there is little health literacy and practice of home births without trained healthcare providers. Often, socioeconomic and cultural barriers delay patients' timely transfer to tertiary care facilities, predisposing them to severe maternal complications and adverse outcomes[4].

PPH has notable urological implications beyond its immediate impact and is often overlooked in clinical practice. Hypoperfusion-related acute kidney injury (AKI) can occur due to severe hemorrhage and requires prolonged hospitalization and sometimes dialysis. Complications such as bladder dysfunction, ureteric injuries, and fistula formation (vesicovaginal or ureterovaginal) are also recognized, especially in cases of surgical interventions, for example, emergency hysterectomy[5]. These complications are not only physically damaging to women who are affected but also cause long-lasting psychological and social distress, as many of them suffer from chronic pain, incontinence, and social stigmatization. The association between severe PPH and urological injury is clear, but research in this aspect is lacking in Pakistan and needs further research in the prevalence and management of urological injury[6].

Both a medical and surgical approach are needed to manage PPH. Prevention, however, remains based on the routine administration of uterotonic agents, including oxytocin and misoprostol, as part of active management of the third stage of labor (AMTSL). In the cases of established PPH, prompt interventions such as uterine massage, tamponade techniques (e.g., intrauterine balloon tamponade), and stepwise surgical procedures like B-Lynch sutures and uterine artery ligation are important not only to prevent hysterectomy but also to prevent other complications. However, these interventions are often unavailable in Pakistan in peripheral healthcare centers, which is an urgent need for standardized management of PPH and improvement of emergency obstetric services[7].

This is a clinical evidence-based study to explore new in-depth analysis of PPH management, determination of key risk factors, review of urological complications, and maternal outcomes in tertiary care hospitals of Pakistan. This study examines real-world clinical data to identify gaps in current management practice and provides recommendations for improving maternal healthcare policies[8]. To reduce PPH-related mortality and morbidity in Pakistan, strengthening of obstetric emergency care, healthcare provider training, and availability of essential medical resources are needed. Improving maternal health outcomes and reducing the burden of postpartum complications in the country will be

addressed through data-driven policy reforms and evidence-based interventions[9].

MATERIALS AND METHODS

This study was a clinical evidence-based retrospective study in a span of one year from August 2021 to August 2022 in major tertiary care hospitals of Pakistan. The aim was to evaluate the postpartum hemorrhage (PPH) management strategies, to identify risk factors among them, to assess the urological complications, and to analyze the maternal outcomes. Hospital-based electronic medical records, obstetric registries, and surgical logs were used for data extraction to give a complete picture of PPH cases and management in the Pakistani healthcare system.

In total, n=100 cases were included in the study, which was deemed sufficient for statistical analysis but still narrow in scope for PPH-related outcomes. The study findings were made more reliable by the strict inclusion criteria. They included women who had a documented diagnosis of primary PPH in the 24 hours after delivery, had been treated with medical or surgical management, and had complete medical records of risk factors for PPH, interventions, and maternal outcomes. To maintain data accuracy and reliability, cases of secondary PPH (happening after 24 hours postpartum), incomplete records, or haemorrhage due to non-obstetric causes were excluded.

Data were collected from hospital records, obstetric admission registers, and operative notes for key variables of patient demographics, risk factors for PPH, management strategies, and urological complications and maternal outcomes. Maternal age, parity, gestational age at delivery, and mode of delivery (vaginal or cesarean section) were recorded. Known risk factors for PPH, including uterine atony, abnormal placentation (placenta previa, placenta accreta, retained placenta), birth canal trauma, coagulation disorders, hypertensive disorders of pregnancy, prolonged labor, grand multiparity, history of previous cesarean sections, were specifically addressed.

Medical and surgical strategies for dealing with PPH were analyzed. Medical management was with oxytocin, misoprostol, carboprost, ergometrine, and tranexamic acid (TXA) for haemorrhage control and blood transfusion. In addition, surgical interventions such as uterine balloon tamponade, B-Lynch sutures, uterine artery ligation, and emergency hysterectomy were also assessed. The objective of the study was to evaluate whether these interventions were effective in haemostasis and avoiding complications.

Evaluation of urological complications associated with PPH was a critical component of the study. Acute kidney injury (AKI), bladder dysfunction (urinary retention, atony, prolonged catheterization), ureteric injuries, and vesicovaginal or ureterovaginal fistula formation were identified and analyzed. Maternal morbidity, prolonged hospitalization, and the need for further urological interventions were examined for the impact of these complications.

The hospital length of stay, need for intensive care unit (ICU) admission, need for multiple blood transfusions, as well as maternal mortality rates were assessed based on maternal outcomes. The study also looked at long-term complications like chronic anemia, kidney dysfunction, and persistent urological issues to evaluate the broader implications of PPHs on maternal health. The direct causes of death in cases of maternal mortality were further investigated, including hemorrhagic shock, sepsis, and multi-organ failure.

SPSS version 25.0 was used for statistical analysis. Demographic characteristics and prevalence rates of risk factors were summarized by descriptive statistics (mean, standard deviation, percentages). Associations of PPH risk factors, management approaches, and maternal outcomes were determined by Chi-square tests and logistic regression analysis. Independent predictors of adverse outcomes were identified by multivariate analysis, and a value of $p < 0.05$ was considered statistically significant.

The study had been approved by the Ethics Review Boards of the participating hospitals, and all its procedures were strictly adhered to ethical guidelines. Anonymized records were used for research purposes only, and patients' confidentiality was maintained. The study was retrospective, and waiver of informed consent was per institutional ethical guidelines. The study was conducted according to the principles of the Declaration of Helsinki on ethical research with human subjects.

RESULTS

Demographic Characteristics: The study involved 100 women with postpartum hemorrhage (PPH). It was demonstrated that the mean maternal age was 30.1 years, 40% were primiparous, and 60% were multiparous, implying high multiparity as a dominant characteristic in PPH cases. Most cases were delivered at or near term, the mean gestational age of which was 37.9 weeks. In most of the cases, the patients had Cesarean deliveries, which increased the risk of hemorrhage if surgical delivery was performed. This study further implies that advanced maternal age, multiparity, and cesarean delivery were major risk factors for PPH in this cohort as shown in table 1.

Table 1: Demographic Characteristics (Sample Size 100)

Characteristic	Value
Mean Age (years)	30.1
Primiparous (%)	40
Multiparous (%)	60
Gestational Age at Delivery (weeks)	37.9
Cesarean Delivery (%)	50

Risk Factors for PPH: Uterine atony (45%) was the most frequently observed risk factor for PPH and remains the leading cause of postpartum hemorrhage because of inadequate uterine contractions. We found that 15% of cases had placental abnormalities, including placenta previa and placenta accreta, that required surgical intervention in most of them. Ten percent of cases were due to birth canal trauma (perineal tears, uterine rupture), which were usually due to complications of or prolonged delivery. Preeclampsia and eclampsia made up 12% of cases and added to the increased risk of coagulation dysfunction and excessive bleeding due to hypertensive disorders of pregnancy. Eighteen percent were documented to have prolonged labor, a known risk for uterine exhaustion, and ineffective postpartum contractions. Twenty-five percent of the cases had grand multiparity (≥ five previous deliveries), which further substantiated the link between high parity and weakened uterine tone. In 32 percent of cases, a history of previous cesarean delivery was seen, which reflected a strong correlation between surgical delivery, abnormal placentation, and hemorrhagic complications as shown in table 2.

Table 2: Risk Factors for PPH (Sample Size 100)

Risk Factor	Cases (%)
Uterine Atony	45
Placental Abnormalities	15
Birth Canal Trauma	10
Coagulopathies	8
Hypertensive Disorders	12
Prolonged Labor	18
Grand Multiparity	25
Previous Cesarean Delivery	32

Management Strategies Used: The 92% of cases received an oxytocin, which is the most used uterotonic agent among medical interventions. In 70% of cases, misoprostol was given, which further supports its use for the prevention and management of PPH. In 50% of cases, tranexamic acid (TXA) was used, which proved to be an effective clot stabilizer that decreases the amount of blood loss. In 60 percent of the cases, blood transfusions were required, indicating that severe anemia and hypovolemia were common post-haemorrhage complications of the surgical

interventions, uterine tamponade was performed in 18%, and B-Lynch sutures were used in 12% in an attempt to mechanically compress the uterus and control bleeding. In 10% of cases, uterine artery ligation was needed, while emergency hysterectomy was performed in 6% of cases, mostly in severe cases where conservative management failed a shown in table 3.

Table 3: Management Strategies for PPH (Sample Size 100)

Intervention	Cases (%)
Oxytocin	92
Misoprostol	70
Tranexamic Acid	50
Blood Transfusion	60
Uterine Tamponade	18
B-Lynch Sutures	12
Uterine Artery Ligation	10
Emergency Hysterectomy	6

Urological Complications: Severe urological complications were attributed to PPH, especially hypovolemia, prolonged catheterization, and adjacent organ trauma related to surgical interventions. However, 10% of cases suffered from acute kidney injury (AKI), most commonly caused by hypoperfusion due to excessive blood loss. Seven percent of cases were noted to have bladder dysfunction, manifested as urinary retention and atony requiring extended catheterization. It documented that in 5% of cases, ureteric injuries were documented, and the majority of these cases occurred in patients who underwent extensive surgical intervention. Three percent of cases showed formation of vesicovaginal fistula, mostly in women who underwent hysterectomy because of uncontrolled hemorrhage as shown in table 4.

Table 4: Urological Complications Associated with PPH (Sample Size 100)

Complication	Cases (%)
Acute Kidney Injury (AKI)	10
Bladder Dysfunction	7
Ureteric Injury	5
Vesicovaginal Fistula	3

Maternal Outcomes: PPH management resulted in the full recovery of 80% of women during maternal recovery. However, 12% required extended hospitalization (>7 days) due to complications such as severe anemia, infections, or prolonged surgical recovery. Six percent of cases required ICU admission, typically to monitor hemodynamic instability requiring intensive monitoring. 2% of maternal deaths were recorded, the leading causes being hemorrhagic shock and multi-organ failure. These findings emphasize the need for early intervention, adequate blood transfusion facilities, and multidisciplinary care to avoid severe maternal morbidity and mortality as shown in table 5.

Table 5: Maternal Outcomes (Sample Size 100)

Outcome	Cases (%)
Full Recovery	80
Extended Hospital Stay (>7 days)	12
ICU Admission	6
Maternal Mortality	2

Key risk factors for PPH in Pakistan were uterine atony, previous cesarean delivery, and hypertensive disorders. Most cases of refractory PE were managed medically with oxytocin and misoprostol, with surgical interventions such as hysterectomies required for a subset of refractory cases. Notable urological concerns included acute kidney injury and bladder dysfunction, and therefore, complete postpartum monitoring was warranted. Most women did well, but a large number remained hospitalized or were in the ICU for weeks, and 2 percent of cases ended in maternal mortality.

These findings underline the importance of better antenatal risk screening, rapid emergency obstetric care, improved access to blood transfusions, and surgical expertise. Improving maternal healthcare and utilizing standardized PPH management protocols is dependent on policy-directed interventions in Pakistan.

DISCUSSION

Despite the availability of a multimodal approach to the management of postpartum hemorrhage (PPH), PPH continues to be a major challenge in the setting of obstetric care in low and middle-income countries like Pakistan. This study's finding is that uterine atony is the main cause of PPH and occurs in 45% of cases[10]. This is consistent with global research, which finds that inadequate uterine contractions are the main cause of severe postpartum bleeding. The high incidence of placental abnormalities (15%) and previous cesarean deliveries (32%) is real and suggests an increasing trend of abnormal placentation, probably because of the increasing number of cesarean sections in Pakistan. Many cases of placenta previa and placenta accreta were complicated by severe hemorrhage, which required surgical intervention. These findings highlight the need for meticulous antenatal screening in women with a history of prior uterine surgery to identify and treat placental abnormalities before delivery[11].

Additionally, 12 percent of PPH cases occurred due to hypertensive disorders of pregnancy, such as preeclampsia and eclampsia. Hypertensive disorders are known risk factors for hemorrhage due to the damaging effects on vascular integrity and coagulation[12]. The conditions were usually poorly controlled in pregnancy, and there was a resultant increased maternal morbidity. Significant contributors to PPH were also Prolonged labor (18%) and grand multiparity (25%). These findings capture gaps in intrapartum care because prolonged labor can leave the uterine exhausted, making postpartum contractions less effective. The other highly documented risk factor is grand multiparity; repeated stretching of the uterus can result in poor myometrial contractility, thereby increasing the risk of excessive bleeding after delivery[13].

Management strategies in this study include oxytocin (92%) and misoprostol (70%), indicating that uterotonics were used as per global standards of active management of the third stage of labor. Nevertheless, the need for blood transfusion in 60% of cases underscores the severity of hemorrhage and underscores the need to enhance blood bank availability in obstetric settings. 50% of cases used tranexamic acid (TXA) to stabilize clot formation and grow its role in hemorrhagic control. Surgical interventions included uterine tamponade (18%), B-Lynch sutures (12%), uterine artery ligation (10%), and emergency hysterectomy (6%). The findings suggest that in most cases, medical management was effective, but in a subset of patients, aggressive surgical interventions were needed to control bleeding[14, 15].

The study also considered the effect of PPH on maternal health, especially its urological implications. In 10% of cases, acute kidney injury (AKI) was diagnosed due to hypovolemia and hypotension and resulting renal hypoperfusion. Patients who required prolonged catheterization or surgical intervention for control of hemorrhage had bladder dysfunction (7%) and ureteric injury (5%). In addition, the formation of vesicovaginal fistula (3%) in patients who had hysterectomy confirms the complications associated with severe hemorrhage and surgical trauma. These findings underscore close postpartum monitoring and a multidisciplinary management approach with urologists for PPH that is severe[16, 17].

From this study, maternal outcomes were shown with 80% of patients having full recovery, but 12% of patients required extended hospitalization for complications like anemia, infections, or slow postoperative recovery. Only 6% of cases required ICU admission, the majority of them due to hemodynamic instability and intensive monitoring required. Maternal mortality was recorded as 2%, indicating the urgent need for prompt and successful intervention of severe cases. These data support the importance of early recognition and rapid protocols for the treatment of PPH to reduce morbidity and mortality[18].

This study will contribute to the public health and management of PPH in Pakistan. It also points out some difficulties that should be solved. The major barriers to effective PPH management include limited access to skilled obstetric care, delayed emergency response, and inadequate availability of blood products. Finally, the high rate of cesarean deliveries and its associated risks warrant reconsideration of obstetric policies that favor safe vaginal delivery when it is clinically appropriate. Maternal outcomes can be significantly improved through the training of healthcare providers in evidence-based PPH management, availability of essential medications, and surgical expertise[19].

The impact of PPH-related complications on maternal renal and urological health in the long term should be investigated as part of future research. Further, it will also document the effectiveness of standardized PPH management protocols and their implementation in different health settings in Pakistan to improve maternal care. Reduction of PPH-related morbidity and mortality will rely on strengthening antenatal screening, improving emergency obstetric preparedness as well as increasing community awareness regarding maternal health risks[20].

CONCLUSION

Despite considerable success in reducing the incidence of PPH in Pakistan, uterine atony, previous cesarean delivery, and hypertensive disorders are key risk factors for PPH. In most cases, medical management with uterotonics was effective, but in cases of severe cases, surgical interventions were required. The long term of PPH causes urological complications such as acute kidney injury and bladder dysfunction.

Although 80% of patients had an 80% full recovery, extended hospital stays, ICU admissions, and a 2% maternal mortality rate reflect the need for early intervention and improved emergency obstetric care. To reduce maternal mortality, PPH management protocols need to be strengthened, blood transfusion sources need to be increased, and antenatal risk screening needs to be improved. Future efforts need to be on multidisciplinary combinations and better healthcare infrastructure to optimize maternal outcomes.

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