

Abdominal Surgical Emergencies in the Puerperium: A Descriptive Study

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ABSTRACT

Background: *Pseudomonas aeruginosa* is a formidable opportunistic pathogen known for its ability to form resilient biofilms, largely regulated by the Multiple Virulence Factor Regulator (MvfR/PqsR) quorum sensing system. Inhibition of MvfR presents a promising strategy to attenuate virulence and overcome antibiotic resistance.

Objective: This study aimed to identify potent anti-biofilm flavonoids that inhibit the MvfR protein through computational screening, molecular docking, and dynamics simulations.

Methods: A library of 1,200 flavonoids was screened against the crystal structure of MvfR (PDB ID: 4JVC). Initial virtual screening was followed by high-precision molecular docking to evaluate binding affinities and interaction patterns. The stability of the top-ranking ligand-protein complexes was further validated through 100ns Molecular Dynamics (MD) simulations and MM-GBSA binding free energy calculations.

Results: Three lead flavonoids Quercetin, Kaempferol, and Luteolin exhibited superior binding affinities compared to the native ligand, with docking scores ranging from -8.5 to -10.2 kcal/mol. Interaction analysis revealed consistent hydrogen bonding with key residues Tyr258 and Ile263. MD simulations confirmed that these compounds remained stably bound within the hydrophobic pocket, maintaining structural integrity throughout the simulation period. MM-GBSA analysis corroborated these findings, indicating favorable energetic profiles for MvfR inhibition.

Conclusion: The identified flavonoids show significant potential as MvfR inhibitors, offering a scaffold for developing new anti-biofilm agents. These computational findings provide a robust basis for subsequent *in vitro* validation to combat *P. aeruginosa* infections.

Keywords: *Pseudomonas aeruginosa*, MvfR Inhibition, Flavonoids, Molecular Dynamics, Biofilm.

INTRODUCTION

Puerperium is the period between giving birth and six weeks after delivery, which signifies the period of dramatic physiological and structural alterations of the female body¹. Most postpartum complications are obstetric in nature; however, abdominal surgical emergencies during this time are uncommon but can be very dangerous to the health of the maternal health². Early diagnosis and treatment are very important because delays have the potential to cause more morbidity as well as mortality.

Appendicitis, bowel obstruction, ovarian torsion, and complications related to postpartum hemorrhage are the common abdominal surgical emergencies during the puerperium³. This diagnosis is usually difficult because of similar symptoms with normal postpartum physiologic changes: abdominal pain, nausea, and bowel habit changes⁴. False diagnosis or late intervention can have severe outcomes, such as sepsis, peritonitis, and multi-organ failure.

One of the most common non-obstetric surgical emergencies is reported to be appendicitis in the post partum period⁵. Normal clinical manifestations are however concealed by physiological leukocytosis and enlargement of the uterus which makes it difficult to detect early enough. On the same note, postpartum intestinal obstruction is rare and may occur because of adhesions as a result of previous cesarean surgeries or pelvic surgery⁶. These emergencies need great clinical suspicion and critical appraisal in order to identify them.

Other factors that should be taken into account in postpartum abdominal pain are ovarian torsion and adnexal masses. Peripartum hormonal variability and heightened vascularity have the potential to predispose to adnexal complications⁷. Some of the imaging modalities that may prove necessary include ultrasound and MRI to distinguish between surgical and obstetric events.

The other vital aspect is the effect of cesarean birth on emergency abdominal surgery. Although Cesarean sections have

life saving effects, they raise the risk of postoperative adhesions, wound dehiscence, and intra-abdominal infections that can either resemble or complicate other acute cases in surgery⁸. Clinicians can be assisted by awareness of these risk factors to recognize them early and manage them.

Regardless of the severity, there is limited literature on abdominal surgical emergencies in the puerperium particularly among the low- and middle-income countries^{2,4}. The majority of the data is based on retrospective studies or cases, and it is hard to create standard diagnostic and treatment regimes. The existence of this gap suggests that further in-depth research on the topic is needed.

Learning all the clinical features, risk factors, and outcomes of abdominal surgical emergency among postpartum women is vital towards augmenting maternal care^{3,5}. These conditions are known to be maternal causes of morbidity and mortality and hence, early recognition and multidisciplinary care in the form of surgery can significantly reduce maternal morbidity and mortality.

The objective of the present paper is to outline the trend, clinical presentation, management, and outlook of abdominal surgical emergencies among puerperal women who have been hospitalized in our institution. The analysis of these cases will hopefully offer insights that will help obstetricians, surgeons, and the emergency care providers to diagnose and properly manage these cases in due time.

MATERIALS AND METHODS

This research was done as a descriptive cross-sectional study in the Department of Surgery and Department of Gynae/Obs Gomal Medical College D I Khan from January 2023 to June 2023 after the approval of the Institutional Ethical Review Board. The researchers were interested in assessing the incidence, clinical presentation, management and outcomes of abdominal surgical emergencies during the puerperium which is the period between the birth, and a maximum of six weeks after delivery. All patients who had acute abdominal complaints that needed surgical intervention and they were all eligible and were admitted puerperal period. The inclusion criteria included women aged between 18

Received on 15-07-2023

Accepted on 15-10-2023

and 45 years, who were within 6 weeks of postpartum, came to hospital with acute abdominal pain, distension, vomiting, or evidence of peritonitis and had undergone surgery during their time in the hospital. Non-surgical abdominal pain patients, chronic history of abdominal conditions or a history of abdominal surgery in the past that did not relate to the current pregnancy were excluded. All the participants were informed and given a chance to participate in the study.

An elaborate history was made on admission, mode of delivery, timing and symptoms after delivery. Clinical observation was directed at vital signs, abdominal tenderness, guarding, rebound tenderness, and sepsis or hemodynamic instability. The applied laboratory tests were complete blood count, liver and renal functions, coagulation profile, serum electrolytes, and inflammatory markers, including CRP when necessary. There was also an imaging investigation performed of cases with clinical indication such as the abdominal ultrasonography and contrasted-enhanced CT scans to help in the diagnosis.

Surgical management of patients followed conventional surgery procedures. Primary stabilization included intravenous education, adjustment of electrolytes and empirical broad-spectrum antibiotics. The decision-making process was influenced by the clinical diagnosis, imaging, and patient stability. Surgery performed appendectomy, laparotomy when the bowel is obstructed, perforated viscus, or hysterectomy when there is postpartum complications like the rupture of the uterus. The pain management, complications monitoring, and early mobilization were the parts of the postoperative care.

Recording of data was in a well-organized proforma collecting demographics, clinical presentation, laboratory and radiographic findings, surgical procedure description, length of stay, complications and outcomes. The mean and the standard deviation of continuous variables, including the age and the hospital stay, were given, whereas frequencies and percentages were given in categorical variables, including the type of surgical emergency and mode of delivery. The SPSS version 23 was used to perform statistical analysis and the primary method of summarizing results was the use of descriptive statistics.

All cases were handled according to the standard protocols, and the prospective method was used in data collection to reduce bias. Patients were also followed up until they discharged to evaluate immediate postoperative outcomes. The cases that had complications or mortality were further analyzed in order to determine possible risk factors that led to unfavorable results.

RESULTS

The patients' demographic details are reported in Table 1. The majority of patients lived in rural areas and were multiparous.

Table 1. Demographic characteristics (n = 75)

Variable	Frequency (%)
Age (years)	
<25	15 (20%)
25–35	45 (60%)
>35	15 (20%)
Parity	
Primipara	22 (29.3%)
Multipara	53 (70.7%)
Mode of delivery	
Vaginal	51 (68%)
Cesarean	24 (32%)
Residence	
Urban	28 (37.3%)
Rural	47 (62.7%)

There were many differences in the clinical presentation. The most common symptom was stomach pain (100%), which was followed by vomiting (58.7%), fever (46.7%), abdominal distension (36%), and peritonitis symptoms (24%).

Laboratory results showed that 38% of patients had anemia, 52% had increased CRP, and 64% had leukocytosis. Twenty-two percent of patients had electrolyte imbalances.

Appendicitis accounted for the majority of surgical emergencies (36%), followed by obstructed bowel (21.3%), uterine rupture (13.3%), postpartum hemorrhage needing surgery (14.7%), and other reasons such as ovarian torsion and perforated viscus (14.7%).

According to postoperative results, 62.7% of patients recovered without any problems, whereas 37.3% had issues, such as prolonged ileus (9.3%), sepsis (12%), and wound infection (16%). Three maternal fatalities (4%) were linked to uterine rupture and delayed presentation. ICU stays were necessary in 18.7% of cases, with an average hospital stay of 6.3 ± 2.7 days.

Table 2. Clinical presentation of patients (n = 75)

Symptom/Sign	Frequency (%)
Abdominal pain	75 (100%)
Vomiting	44 (58.7%)
Fever	35 (46.7%)
Abdominal distension	27 (36%)
Peritonitis	18 (24%)

Table 3. Laboratory findings (n = 75)

Parameter	Abnormality Frequency (%)
Leukocytosis	48 (64%)
Anemia	29 (38.7%)
Elevated CRP	39 (52%)
Electrolyte imbalance	16 (21.3%)

Table 4. Types of abdominal surgical emergencies (n = 75)

Diagnosis	Frequency (%)
Appendicitis	27 (36%)
Obstructed bowel	16 (21.3%)
Uterine rupture	10 (13.3%)
Postpartum hemorrhage (surgical)	11 (14.7%)
Others (perforated viscus, ovarian torsion)	11 (14.7%)

Table 5. Postoperative outcomes (n = 75)

Outcome	Frequency (%)
Uncomplicated recovery	47 (62.7%)
Complications	28 (37.3%)
Wound infection	12 (16%)
Sepsis	9 (12%)
Prolonged ileus	7 (9.3%)
Maternal deaths	3 (4%)
Mean hospital stay (days)	6.3 ± 2.7
ICU admission	14 (18.7%)

DISCUSSION

The puerperium is the period of acute physiological changes, and even though the majority of complications are obstetric in nature, non-obstetric surgical emergencies are a peculiar situation to diagnose. The age range of most of the patients formed part of the present study is 25 to 35 years of age and most patients were multiparous, which is in line with other researches expressing the view that multiparity can be linked to increased prevalence of post

partum complications expressed through cumulative physiological stress on the abdominal wall and other structures of the pelvis⁹. The fact that the majority of patients are rural inhabitants (62.7%) emphasizes why healthcare accessibility remains a challenge because patients living in rural areas are generally associated with late presentation and higher morbidity in surgical emergencies¹⁰.

In this cohort, the presenting symptom was universal abdominal pain but the diagnosis was complicated because the pain overlapped with the expected postpartum pain. Other studies point to physiological uterine enlargement and abdominal wall laxity post delivery as some of the most common concealment of traditional peritonitis symptoms of guarding and rigidity¹¹. This is in line with our results where although there is high prevalence of underlying serious pathology, only 24 percent of cases had classic peritonitis. A different study also noted that nausea and vomiting which were evident among 58.7 percent of our patients are commonly mistaken as postpartum changes or dieting problems resulting in a considerable delay in diagnosis¹².

Appendicitis was the most common surgical emergency in our study and this represents 36 percent of all cases. This observation is corroborated by other sources that point out appendicitis as the most predominant non-obstetric cause of an acute abdomen, in the both the pregnant and postpartum conditions¹³. Nonetheless, as observed in the literature, clinical diagnosis of appendicitis during the puerperium is famously challenging due to the fact that the appendix might not be back to its normal anatomic location and physiological leukocytosis can also make white blood cell count an inappropriate screening method¹⁴. Leukocytosis, in our series, was also observed in 64% of patients, which is a high value; however, it should be applied with caution in the directly postpartum period.

The second most prevalent diagnosis was intestinal obstruction with a rate of 21.3%. It has also been reported in other studies that the risk of bowel obstruction is heightened in the period of puerperium especially after cesarean sections, because of the development of adhesions or changing of intra-abdominal space suddenly when the uterine decompression takes place¹⁵. In line with these, our findings revealed that close to one-third of the patients had received cesarean deliveries, which is a factor that an earlier study found to be a major risk factor in adhesive obstruction and complications with the wound¹⁶. Early detection of obstruction is of vital importance to avoid bowel ischemia, but the symptoms become non-specific in the early phases.

Cases of uterine rupture and postpartum hemorrhage that necessitated general surgical intervention were also of prominent burden of disease in this study. Other studies have found that such emergencies are often linked to high-parity and unsupervised home deliveries and this could be the reason why they are common in our study population as the number of rural dwellers is very high¹⁷. A comparative analysis observed that even though the management of uterine rupture mainly involves obstetric emergency, it might need the competence of general surgeons in case the uterus is highly involved with the bladder, broad ligament, or major pelvic vessels¹⁸.

These conditions are characterized by a high morbidity as noted by the complication rate of 37.3% and the rate of ICU admission of 18.7%. The most impressive postoperative problems were wound infections (16 percent) and sepsis (12 percent). The puerperal state is a pro-inflammatory and, possibly, even immunosuppressed period as it is noted in other studies that predisposes women to the rapid transition between localized infection and systemic sepsis¹⁹. This is another study that showed anemia to be a great independent risk factor of poor wound healing and prone to postoperative infection since 38.7% of our subjects were anaemic²⁰.

Our study has shown that our maternal mortality rate of 4% was directly associated with presentation delay and severe sepsis, especially at the uterine rupture cases. This goes along with the other reports which have indicated that the time lag between the occurrence of symptoms and the operation is the most crucial

prognosis of survival in postpartum surgical emergencies². The 6.3 mean hospital stay is an indication of the intensive care that the recovery process in this population of patients needs, which is comparable with the results found in other studies of the same type on the morbidity of maternal surgery⁴.

This study is limited in some way despite the insights it provides. The cross-sectional and single-centered study design might be limiting in how the results can be generalized to larger populations that have varying socio-economic statuses. Also, the requirement to use retrospective proforma data collection may lead to bias in the information and the sample size is rather small and may not represent less common causes of the puerperal acute abdomen. More intensive diagnostic protocols and standardized management algorithms of this vulnerable group of patients require future multi-center prospective studies to develop.

CONCLUSION

The problem of abdominal surgical emergencies in the puerperium, which is rather rare, is characterized by a high level of maternal morbidity and possible death. The paper shows that the most common causes of acute abdomen intervention in the postpartum are appendicitis and bowel obstruction that can be complicated by the physiological alterations of the puerperal period and delayed presentation, especially occurrence in rural population. Such conditions are severe given that the postoperative complications rate is high, and almost one-fifth of them require ICU care. Finally, high clinical suspicion index, access to prompt diagnostic imaging, and multidisciplinary collaboration of obstetricians and general surgeons are the key to improving maternal outcomes and guarantee the timely surgical intervention.

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This article may be cited as: Saba N, Khan MH, Mehsood N, Rashid S, Ayub H, Khan MA; Abdominal Surgical Emergencies in the Puerperium: A Descriptive Study. *Pak J Med Health Sci*, 2023; 17(10): 390-393.