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Impact of Fast Track Clinical Practice Guideline on Surgical Waiting Time and Blood Transfusion in Ectopic Pregnancy: A Quasi-Experimental Study in a Tertiary Hospital

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Abstract This quasi-experimental study aimed to compare surgical waiting time and blood transfusion in ectopic pregnancy patients before and after implementing the Fast Track Clinical Practice Guideline (CPG) at Hatyai tertiary hospital. The study involved 136 women diagnosed with ectopic pregnancy, confirmed through clinical signs, ultrasound findings, and pathology, between January 2023 and July 2024. The CPG, implemented in October 2023, applied lean principles to standardize preoperative protocols and reduce waiting times. Surgical waiting times and blood transfusion rates before and after CPG were analyzed with Wilcoxon Rank Sum test, and Fisher's exact test or Chi square test as appropriated,with significance at $p<0.05$. The implementation of the Ectopic Fast Track CPG significantly reduced median surgical waiting time from 97 minutes to 55 minutes ($p<0.05$). Although the reduction in median blood loss from 500 mL to 425 mL in the post-CPG group was not statistically significant, it influenced significantly lower requirement for postoperative blood transfusion from 55.6% to 37.5%. Overall, the amount of blood loss did not contribute to severe complications such as hemorrhagic shock (11.8% vs 8.1%) or acute renal failure (1.4% vs 3.1%). Overall, the Fast Track CPG effectively shortened waiting times and reduced the need for blood transfusions in ectopic pregnancy surgeries.

***Keywords*:** **surgical waiting time, ectopic pregnancy, clinical practice guideline, lean management**

Introduction

Ectopic pregnancy, commonly located in the fallopian tube, necessitates early detection for minimally invasive surgery or methotrexate treatment, while unstable cases require urgent surgical intervention.[1-3] Advances in socioeconomic conditions and lifestyle changes have improved the management and reduced mortality rates of ectopic pregnancies. This highlights the importance of better treatment guidelines and customized strategies in lower sociodemographic regions to further reduce incidence and improve outcomes.[2,4]

A previous study in Thailand reported an incidence of 9.3 per 1,000 live births, with 25% experiencing hypovolemic shock.[5] At Hat Yai Hospital, a two-year review found 219 ectopic pregnancy cases, 15 (6.8%) of which had hypovolemic shock. Inadequate preparation and management led to diagnostic and treatment delays. Thai Healthcare Accreditation Institute (HAI) classifies ectopic pregnancies as high-risk patients, necessitating timely, safe, and appropriate care and procedures in line with professional standards.[6] Inconsistent care and transfer protocols among network hospitals further delayed surgery within the critical window, causing severe complications, increased blood usage, and higher litigation risks, impacting patient and family satisfaction.

The use of lean methodology in healthcare can reduce waste, increase speed, and improve service efficiency.[7-10] Implementing lean in emergency rooms has significantly reduced waiting times for hospital admissions, shortened patients' length of stay by 30% within three months, decreased the percentage of patients leaving without treatment from 6.5% to 0.3%, and increased patient satisfaction from 24% to 89.9%.[8,11] In orthopedic surgery care, fast-track systems have reduced costs and improved care quality. These findings contribute to the evidence that adopting Lean Six Sigma optimizes care and surgical pathways.[9,12] A study at Buriram Hospital found that using fast-track ectopic pregnancy flowchart care map in hypovolemic patients reduced diagnosis and surgical waiting times from 60 minutes to 34 minutes (43% reduction)within 2 years of implementation, enhancing care efficiency.[13]

Clinical Practice Guidelines (CPGs) aim to guide evidence-based decisions, standardize patient care, improve provider performance, set practice standards, and reduce variability. Numerous studies have demonstrated that proper application of CPGs enhances disease outcomes, increases survival rates, lowers mortality, improves care quality, and boosts cost-effectiveness.[14-15] Key factors that enhance guideline adherence include access to relevant guidelines at the point of care (87%), greater emphasis on guidelines during training (82%), and transparency regarding physicians' commercial affiliations (62%).[16] CPGs should be consistently revised by a diverse panel of specialists and non-specialists. Updates should be based on consensus, patient preferences, evidence certainty, benefit-risk analysis, and cost considerations.[17]

Managing patients with ruptured ectopic pregnancies requires prompt and effective intervention according to hospital standards. Implementing Hat Yai Hospital's unified fast-track protocol for ectopic pregnancies aims to enhance diagnosis, laboratory testing, initial treatment, and readiness for transfer from network hospitals or emergency rooms. Improved communication through LINE and phone helps stream-

line processes, reduce redundancy, ease ER congestion, and enable immediate surgery for hypovolemic shock. This approach ensures patient safety, satisfaction, and adherence to Thailand Healthcare Accreditation standards, with our team committed to performing surgery within 30 minutes for hypovolemic shock and 60 minutes for urgent ruptures.

The purpose of this study was to assess the effectiveness of the CPG by comparing surgical waiting time and blood transfusion in patients with ectopic pregnancy before and after implementing the Fast Track CPG.

Methods

This quasi-experimental study, approved by the Hatyai Ethics Committee (HYH EC 103-66-01), gathered data from women diagnosed with ectopic pregnancies who underwent surgery at Hatyai tertiary hospital between January 2023, and July 2024. Diagnoses were determined based on clinical signs and symptoms, ultrasound findings, and histopathological confirmation. The patients were categorized into two groups: those treated before and after the implementation of the CPG. The Fast Track Ectopic Pregnancy CPG, based on the standards of the Royal Thai College of Obstetricians and Gynecologists, was created through a consensus among specialists in obstetrics, gynecology, emergency medicine, and anesthesiology. It includes preoperative patient preparation such as history, physical examination, lab results, and chest X-ray, and has been in effect since October, 2023. The CPG changes the communication methods and preparation for patients by enhancing communication channels to provide more detailed information. It requires preoperative lab tests and chest X-rays to be completed and ready for the operating room, reducing waiting times and the back-and-forth movement of patients. Results can be sent via an official line, allowing the gynecologist and anesthesiologist to evaluate and proceed with surgery immediately upon the patient's arrival, as shown in Figure 1.

A surgical approach was chosen for patients with clinical rupture, peritoneal irritation, hemodynamic instability, or intraabdominal hemorrhage on ultrasound. Surgical methods depended on the extent of tubal damage and fertility preservation goals. Extensive damage necessitated salpingectomy, with additional tubal resection if sterilization was desired. In cases without tubal distortion, the pregnancy material was removed to achieve hemostasis and provide necessary blood replacement.

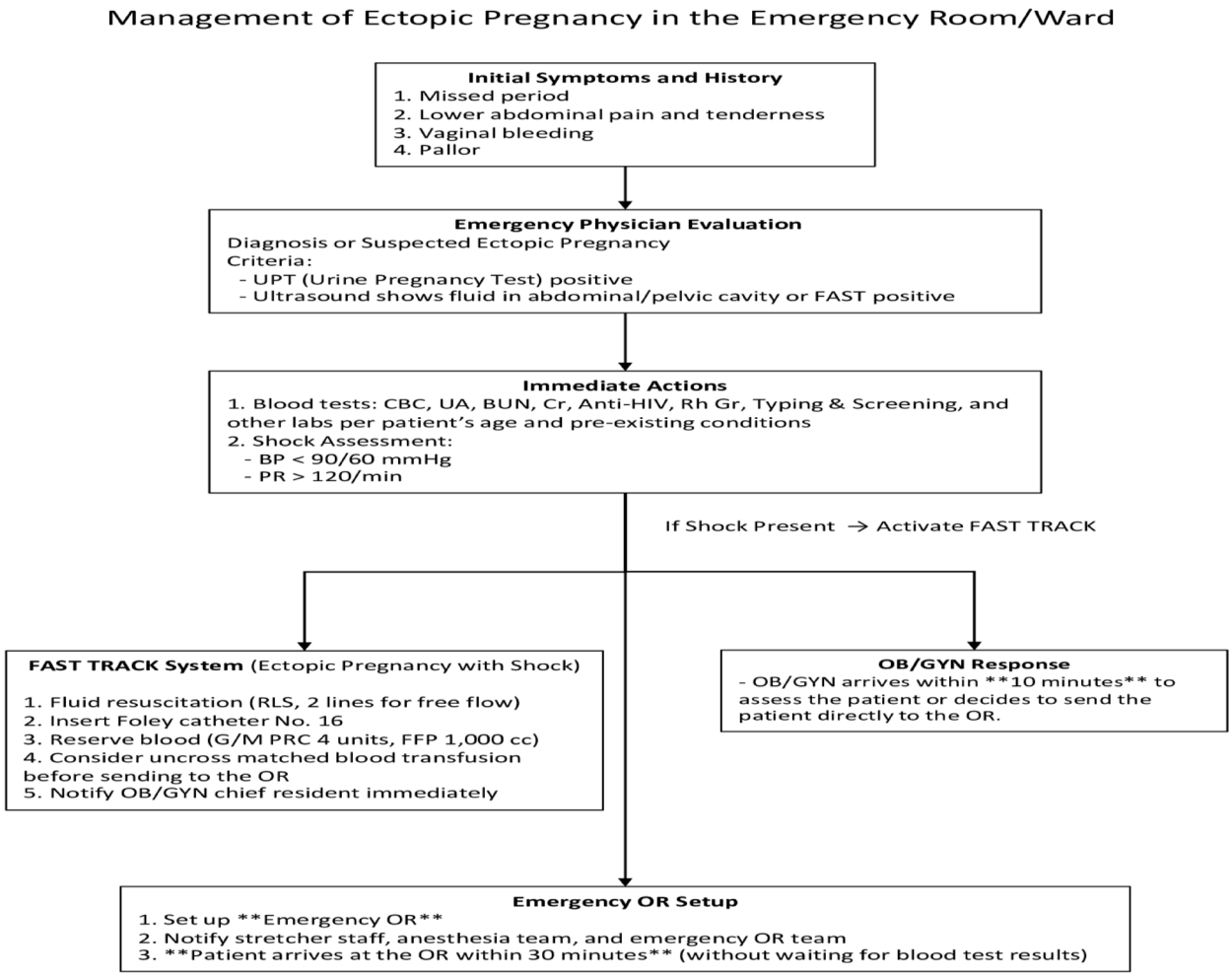
The sample size for the pre-test and post-test of ectopic pregnancy patients, with an incidence of approximately 100 cases per year, was determined using pilot study data from retrospective records. Average surgical waiting times before and after implementing the Fast Track CPG, for 59 cases before September and October 2023, were 189 minutes (S.D. 172) and 107 minutes (S.D. 70), respectively. Using the G*Power program 3.1.9.7 with an alpha of 0.05, power of 0.9, and effect size of 0.62, the required sample size is 60 cases per group.

The inclusion criteria comprised all women diagnosed with ectopic pregnancy who underwent surgical intervention at Hat Yai Hospital. Patients were excluded if the time from the surgical decision to entry into the operating room was not recorded.

Data Analysis and Statistical Methods

The patient's characteristics and clinical information collected including obstetric history, risk factors,

Figure 1 Flow management of ectopic pregnancy



signs and symptoms, investigations for diagnosis, and results of treatment were analyzed using descriptive statistics, reported as frequency and percentage.

For continuous data, the normally distributed data were presented in mean and standard deviation, while non-normally distributed data were presented in median and interquartile range (IQR). For categorical data, the Fisher's exact test or Chi-square test was used.

In the evaluation of the CPG Fast Track Ectopic Pregnancy, we focused on changes in surgical waiting time before and after the implementation of the CPG. Additionally, the evaluation included a comparison of blood usage rates before and after implementing the CPG, aiming to identify significant differences attributable to the new guidelines.

Surgical waiting times and before and after implementing CPG were presented in median and IQR and compared using Wilcoxon Rank Sum test. Blood transfusion rate between this two period was analyzed using Fisher's exact test or Chi-square test.A significance level of < 0.05 was used to determine statistical significance. Data analysis was performed using R version 4.3.1 (2023-06-16).

Results

This study included 136 patients diagnosed with ectopic pregnancy who underwent surgery. They were divided into two groups based on the implementation of the CPG Ectopic Fast Track on October 2023: 72 patients in the pre-implementation group and 64 in the post-implementation group. Patient characteristics in both groups were similar, with an average age of 30.8 years; most being multiparous with no significant ectopic pregnancy risk factors except for a history of abdominal surgery (20.6%). The most common symptoms were abdominal pain (91.9%) and abnormal vaginal bleeding (57.4%). Mostly of the patients (87.5%) exhibited abdominal tenderness, with average hematocrit 32%. Common ultrasonography findings were intraabdominal fluid (84.7%) and abdominal mass (61.8%). There were significant differences between rupture and the non-rupture ectopic group in terms of the presence of free fluid in the abdomen and adnexal mass as shown in Table 1.

The implementation of the CPG ectopic fast track significantly reduced surgical waiting time from 97 minutes to 55 minutes ($p<0.05$), with an overall average surgical waiting time of 75 minutes as shown in Table 1, Table 2 and Figure 2.

Table1 Baseline and characteristics of ectopic patients before and after implementing CPG

Characteristics	Total	Before	After	p-value
Total, n (%)	136 (100%)	72 (53%)	64 (47%)	
Age, year mean (SD)	30.8 (5.7)	31.4 (5.9)	30.1 (5.5)	0.179
BMI, kg/m² median (IQR)	23.7 (21, 26.4)	23.5 (21, 26.2)	23.8 (21, 27.4)	0.604
Gravida	2 (1,3)	2 (1,3)	3 (1.8,3)	0.823
Risk factor, n (%)				
Prior ectopic pregnancy	5 (3.7)	2 (2.8)	3 (4.7)	0.666
Prior abdominal surgery	28 (20.6)	13 (18.1)	15 (23.4)	0.438
Prior pelvic infection	5 (3.7)	3 (4.2)	2 (3.1)	1.000
Contraceptive failure	13 (9.6)	4 (5.6)	9 (14.1)	0.092
Signs and symptoms, n (%)				
Pain	125 (91.9)	67 (93.1)	58 (90.6)	0.604
Abnormal bleeding	78 (57.4)	38 (52.8)	40 (62.5)	0.253
Fainting	26 (19.1)	14 (19.4)	12 (18.8)	0.918
Abdominal sign positive, n (%				
Tender	119 (87.5)	61 (84.7)	58 (90.6)	0.299
Guarding	41 (30.1)	24 (33.3)	17 (26.6)	0.390
Rebound	55 (40.4)	27 (37.5)	28 (43.8)	0.459
Lab investigation, % median (IQR)				
Hematocrit	32 (28.6, 34.8)	31.8 (28.9, 33.1)	33.7 (28.3, 36.2)	0.040

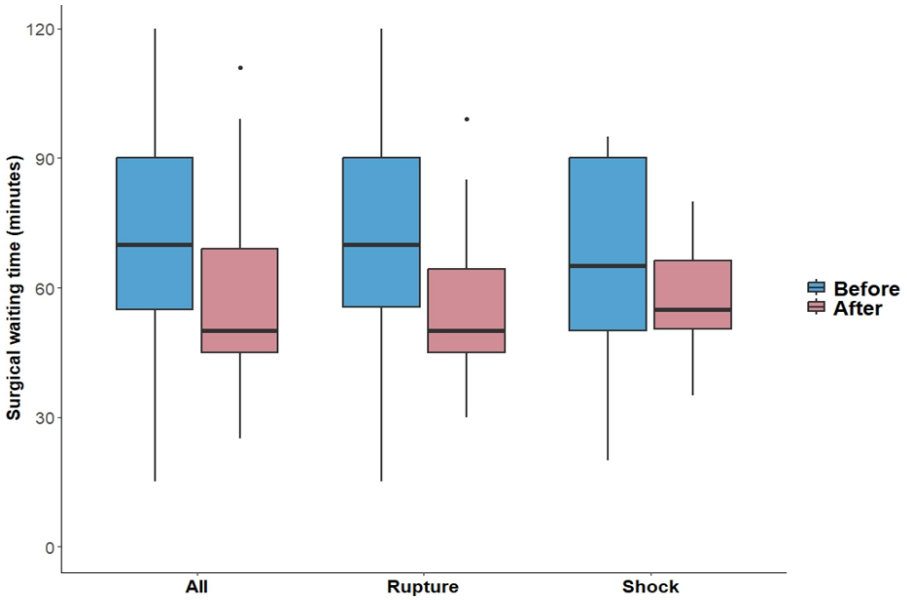
Table1 Baseline and characteristics of ectopic patients before and after implementing CPG (cont.)

Characteristics	Total	Before	After	p-value
Ultrasonography finding n (%)				
Abnormal fluid in abdominal cavity	105 (84.7)	54 (87.1)	51 (82.3)	0.455
Pelvic mass	68 (61.8)	35 (63.6)	33 (60.0)	0.695
Extrauterine gestational sac	29 (30.5)	16 (35.6)	13 (26.0)	0.313
Result of surgery				
Surgical waiting time, minutes median (IQR)	75 (50,127.8)	97 (65, 171)	55 (45, 85)	<0.001
Estimated blood loss, cc median (IQR)	500 (250, 1,300)	500 (300, 1,500)	425 (200, 850)	0.121
Packed red cell transfusion, n (%)	64 (47.1)	40 (55.6)	24 (37.5)	0.035
Fresh frozen plasma transfusion, n (%)	16 (11.8)	8 (11.1)	8 (12.5)	0.802
Renal failure, n (%)	3 (2.2)	1 (1.4)	2 (3.1)	0.601

Table 2 Subgroup analysis of ectopic pregnancy before and after implementing fast track clinical practice guidelines

Variables	Before	After	Total	p-value
Surgical waiting time, minutes (median, IQR)	97 (65, 171)	55 (45, 85)	75 (50, 127.8)	<0.001
Estimated blood loss, cc (median, IQR)	500 (300, 1500)	425 (200, 850)	500 (250, 1300)	0.121
Rupture ectopic pregnancy, n (%)	55 (40.5)	46 (33.8)	101 (74.3)	
Surgical waiting time, minutes (median, IQR)	90 (65, 125)	53.5 (45, 75.2)	70 (50, 105)	<0.001
Estimated blood loss, cc (median, IQR)	900 (400, 1,600)	575 (300, 1,500)	700 (330, 1,500)	0.198
Hypovolemic shock, n (%)	16 (11.8)	11 (8.1)	27 (19.9)	
Surgical waiting time, minutes (median, IQR)	70 (53.8, 91.2)	55 (51, 75)	65 (51, 90)	0.265
Estimated blood loss, cc (median, IQR)	2181.5 (1,074.9, 2,400)	2031.2 (838, 1,364.6)	2400 (1,364.6, 1,074.9)	0.392

Figure 2 Surgical waiting time before and after ectopic CPG implementation



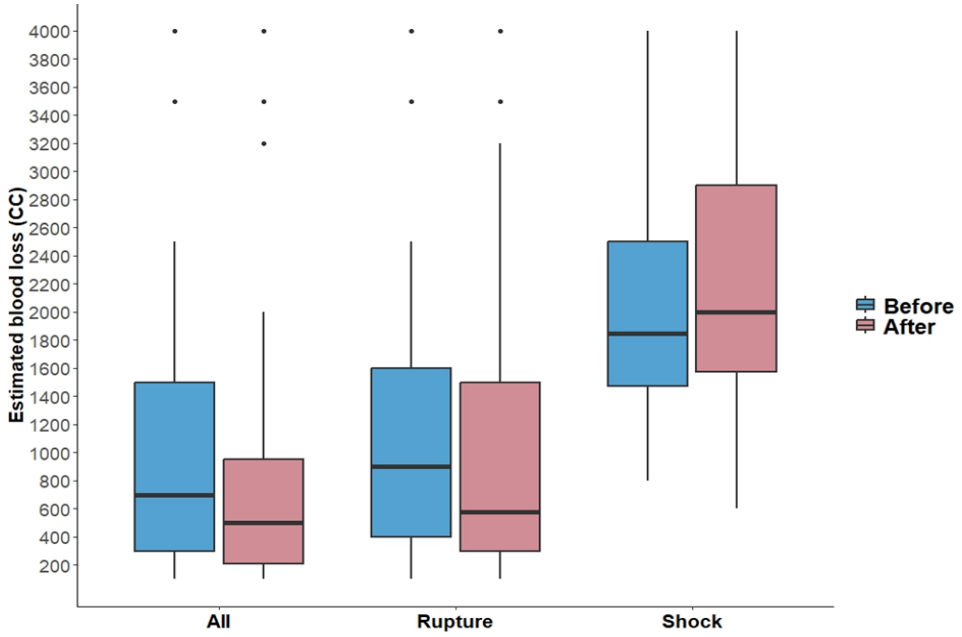
While the decline in mean blood loss from 500 mL to 425 mL in the post-CPG cohort was not statistically significant, it did affect the need for blood transfusions. Rate of packed red cell transfusion was significantly lower after CPG implementation from 55.6% to 37.5% (p=0.035) as shown in Table 1 and Figure 3.

Based on subgroup of rupture ectopic pregnancy or those with shock, median surgical waiting times were lower regardless of the conditions of rupture or shock as seen in Figure 2. For estimated blood loss, patients with shock showed highest estimated blood loss Figure 3. Table 2 presents the results of surgical waiting time and estimated blood loss in all cases with subgroups of those with rupture and those with shock. In ruptured ectopic pregnancies, the use of CPG significantly reduced surgical waiting times in these cases, from 90 minutes to 53.5 minutes (p<0.05). For patients with hypovolemic shock, median surgical time also insignificantly reduced from 70 minutes to 55 minutes.The total blood loss did not have a substantial impact on severe complications like hemorrhagic shock or acute renal failure. There was one case of small intestine injury during pelvic adhesiolysis, which was been treated with end to end anastomosis. However, no patient deaths were reported.

Discussion

Our study confirmed the benefit of implementation and demonstrated the effectiveness of the fast track for ectopic pregnancy. Its implementation significantly reduced surgical waiting times and the need for blood transfusions. In our hospital, a significant proportion of ruptured ectopic pregnancy cases (74.3%) are late diagnosis, presenting with signs of intra-abdominal rupture or hemodynamic instability, necessitating surgical intervention. This contrasts with earlier diagnostic studies such as Dur R's, where treatment options predominantly included methotrexate treatment in 55.9%, surgical procedures in 36.6%, and expectant

Figure 3 Estimated blood loss before and after ectopic CPG implementation



management in 7.4% of cases [20] and Buhur A's study, where methotrexate treatment in 70.1%, surgical procedures in 21.2%, and expectant management was used in 8.7% of cases.[18] Most ectopic pregnancies occurred in the absence of risk factors, as observed in Sanguanpao P's study at Wichian Buri Hospital in Thailand.[19] The most common signs and symptoms of ectopic pregnancy in our study were similar to other studies.[1,4,18-19] Our study further highlights the prevalence of free fluid in the abdominal cavity (84.7%) as a prominent ultrasonography finding for surgical intervention need. This contrasts with Buhur A's study, where the surgical intervention group reported a 53% presence of an extrauterine gestational sac, 40% incidence of free fluid in the abdominal cavity, and 23% detection of extrauterine fetal cardiac activity in earlier gestational age diagnoses ranging from 37 to 62 days.[18] Additionally, our findings differed from Sanguanpao P's study, where most cases (63.6%) were diagnosed as unruptured ectopic pregnancies.[19]

Clinical practice guidelines offer significant benefits across various healthcare settings by providing evidence-based recommendations that enhance the quality and consistency of patient care. Steinberg et al. highlight the trustworthiness and reliability of well-developed guidelines, ensuring standardized care practices.[14] Carrasco-Peña et al. demonstrated that adherence to these guidelines can significantly improve survival rates in colorectal cancer patients, highlighting their impact on patient outcomes.[15] Qumseya et al. identified and addressed barriers to guideline implementation among physicians, emphasizing the importance of overcoming these challenges to improve care delivery.[16] Sada et al. provided updated guidelines for managing complex conditions like vasculitis, ensuring that the latest research informs treatment strategies, ultimately improving patient care and outcomes across diverse medical fields.[17] A fast Track CPG for ectopic patients was developed by considering the signs of peritoneal irritation, hemodynamic instability, or intraabdominal hemorrhage detected by ultrasound which are routine procedures done in most hospital settings in Thailand. Three-fourths of the cases involved ruptured ectopic pregnancies, and the use of CPG significantly reduced waiting times in these cases which was consistent with the reduction of estimated blood loss, even the significance was not shown. For patients in shock—an emergency category that receives priority management in the operating room—CPGs did not have a significant impact on either surgical waiting times or blood transfusion rates as shock has been realized as emergent surgical conditions.

The key aspect of our management strategy is the urgent and efficient handling of cases while minimizing waste through lean processes. Ensuring a well-prepared and timely readiness in the operating room, in accordance with CPGs, is crucial for enhancing patient safety and outcomes. Applying Lean Six Sigma principles fosters continuous improvement in healthcare, enhancing value delivery, innovation, and health outcomes.[21-22] This study highlights the benefits of process analysis—such as mapping, root cause analysis, and impact assessment—in identifying inefficiencies. It emphasizes the need for waste reduction, process standardization, and patient-centered care to achieve significant improvements in efficiency, quality, and patient satisfaction.

For "lean thinking" to be effective, it requires the full commitment of every team member, embedding itself into the organizational culture and promoting innovation at all levels. The adoption of lean principles in healthcare improves patient satisfaction by prioritizing patient-centered decision-making and processes, while also fostering continuous improvement across the organization.[22] Our CPGs have revised the communication method and streamlined the preparation process for lab investigations and chest X-rays, designating them as initial check-in points for the operating room. This allows emergency operations to proceed immediately upon the patient's arrival with sign and symptoms of rupture, thereby reducing surgical wasting time and improving the efficiency of the management logistics flow. We eradicate defects to improve the quality of care and decrease unnecessary patient movement between multiple investigation sites, enhancing patient flow. Early operation management prevents complications and saves time. We maximize resources by minimizing healthcare overproduction at our central facility and remove waste from duplicated and over-processed tasks.

Dong-Shang Chang et al. identified inefficiencies in the surgical process and implemented targeted improvements, subsequently measuring their impact on waiting times and workflow efficiency. By applying workflow analysis and Six Sigma methodologies, the study demonstrated that it is possible to reduce waiting times for surgical rooms.[23] Finally, we recognize how healthcare waste leads to untapped human potential, and we are committed to fully utilizing our workforce's capabilities.[24] Tracking and evaluating the effectiveness of system efficiency measures, along with implementing lean practices and process improvements, can lead to significant short- and long-term benefits in reducing surgical wait times, enhancing clinical throughput, and improving patient care and satisfaction.

Chanpen S.'s research examined the waiting periods for emergency surgeries utilizing two distinct queue management systems at Ratchaburi Hospital. The study revealed that the implementation of an online queue system markedly decreased the waiting time for emergency procedures from 5.4 hours to 4 hours, representing a 25.47% reduction.[25] Our study results aligned with those of Prabnongbua et al.'s prospective descriptive study, which examined 133 patients treated in the emergency OR after office hours. In their study, none of the true emergency cases received procedures within 15 minutes, 76% of emergency cases were treated within 1 hour, and 86% of urgent cases were treated within 6 hours. The primary limitations identified were insufficient operating rooms and personnel.[26] Furthermore, the online system enhanced convenience for surgeons by enabling them to manage priorities using personal devices. This system may offer a novel IT solution for improving hospital workflow management and healthcare quality, as outlined in the six aims of the Institute of Medicine's (IOM) framework for quality assessment: patient safety, effective evidence-based care, patient-centeredness, timely care, efficiency, and equity.[27]

Strengths and Limitations

This study used clinical characteristics in real practice and ultrasound finding in different ectopic diagnostic criteria for urgency clinical utility in a low-resource setting. This finding can be further modified in other settings for preventing morbidity and

mortality in women with ectopic pregnancy. There were some limitations in this study. First, this was a retrospective study which the data obtained relied on the medical records. Second, the diagnosis and care for this ectopic pregnancy in this tertiary hospital were managed by obstetricians which may not be as same as other hospital levels which were responsible by general practitioners. Third, this study was conducted in tertiary hospital having patient load for operating theater; therefore, surgical waiting times were still high even the significant reduction was shown. This situation necessitates additional teams and resources for effective management, requiring intervention and support from policy makers.

Conclusion

The implementation of the ectopic fast track clinical practice guideline significantly diminished surgical waiting times, decreased blood transfusion rates, improved the management of intraabdominal hemorrhage, and maintained patient safety without a substantial increase in complication rates.

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Conflicts of interest

No potential conflict of interest was reported.

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Ethics approval

This study was approved by the Research Ethics Committee at Hat Yai Hospital (Protocol Number HYH EC 103-66-01)

Authors' contribution

Conceptualization, design, planning, conduct, supervision: SS and WW. Acquisition and curation of data: SS, WW and AS. Formal analysis, Writing – original draft, administrative technical or material support, Writing – review & editing: SS. Final manuscript approving: All authors had full access to the data in the study and accepted responsibility for the decision to submit for publication.

Availability of data and materials

All data generated and analyzed during this study are available on request included in this published article. Data sharing is dependent upon permission from the health service and ethics approval.

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ผลของการใช้แนวปฏิบัติทางคลินิกแบบเร่งด่วนต่อระยะเวลารอคอยการผ่าตัดและการให้เลือดในผู้ป่วยตั้งครรภ์นอกมดลูก: การศึกษาเชิงกึ่งทดลองในโรงพยาบาลระดับตติยภูมิ

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บทคัดย่อ: การศึกษากึ่งทดลองนี้มีวัตถุประสงค์เพื่อเปรียบเทียบระยะเวลารอคอยการผ่าตัดและการให้เลือดในผู้ป่วยตั้งครรภ์นอกมดลูก ก่อนและหลังการใช้แนวทางปฏิบัติทางคลินิกแบบ Fast Track (CPG) ที่โรงพยาบาลระดับตติยภูมิ โดยเกี่ยวข้องกับผู้หญิงจำนวน 136 คนที่ได้รับการวินิจฉัยว่าตั้งครรภ์นอกมดลูก จากการยืนยันของอาการทางคลินิก ผลการตรวจอัลตราซาวด์ และพยาธิวิทยา ระหว่างวันที่ 1 มกราคม 2566 ถึง 31 กรกฎาคม 2567 CPG ได้ถูกนำมาใช้ในเดือนตุลาคม 2566 ซึ่งใช้หลักการของลีน เพื่อปรับลดขั้นตอนการเตรียมตัวก่อนผ่าตัดและลดระยะเวลารอคอยการผ่าตัดและอัตราการให้เลือดก่อนและหลังการใช้ CPG ด้วยการวิเคราะห์โดยใช้การทดสอบ Wilcoxon rank sum test และ Fisher's Exact test หรือ Chi square test ตามความเหมาะสม โดยมีระดับนัยสำคัญที่ $p<0.05$ การใช้แนวทาง CPG Fast Track สามารถลดเวลารอคอยเฉลี่ยในการผ่าตัดจาก 97 นาทีเป็น 55 นาที อย่างมีนัยสำคัญทางสถิติ ($p<0.05$) และลดปริมาณเลือดที่สูญเสียเฉลี่ยจาก 500 มิลลิลิตรเป็น 425 มิลลิลิตรในกลุ่มหลังการใช้ CPG แม้จะไม่แตกต่างอย่างมีนัยสำคัญทางสถิติ แต่ส่งผลให้อัตราการถ่ายเลือดหลังผ่าตัดลดลงจากร้อยละ 55.6 เป็นร้อยละ 37.5 และไม่ส่งผลให้เกิดภาวะแทรกซ้อนที่รุนแรงจากการเสียเลือด เช่น ภาวะช็อก (ร้อยละ 11.8 เทียบกับร้อยละ 8.1) หรือภาวะไตวายเฉียบพลัน (ร้อยละ 1.4 เทียบกับร้อยละ 3.1) โดยสรุป แนวทาง CPG แบบ fast track นี้ช่วยลดระยะเวลารอคอยการผ่าตัดและลดการให้เลือดในผู้ป่วยตั้งครรภ์นอกมดลูก

คำสำคัญ: **เวลารอคอยการผ่าตัด; การตั้งครรภ์นอกมดลูก; แนวทางปฏิบัติทางคลินิก; การจัดการแบบลีน**