Artificial intelligence in gynecologic and obstetric emergencies

Dr. Shailja Pandey[1] , Dr. Sonali dongarwar[2]
Email_Id- 0123456789shail@gmail.com, Sonali16dngarwar@gmail.com

Abstract— One use of artificial intelligence (AI) is the ability for computers to mimic human intelligence and make judgments in medical settings without human intervention. In cases of obstetric and gynecologic emergency, this might work well. The goal of this review was to examine artificial intelligence (AI) and its use in obstetric and gynecologic crises. When it comes to women's healthcare, the use of artificial intelligence (AI) in OB/GYN is changing everything. This article delves into the revolutionary effects of AI on gynecological and obstetrical care, including diagnosis, treatment, and management. Highlighting their significance in improving prenatal care, maternal and fetal outcomes, and optimizing gynecological therapies, we discuss important breakthroughs in AI-driven imaging techniques, predictive analytics, and customized medicine. Using the keywords combination of "artificial intelligence, gynecology and obstetrics," a literature search was conducted in July 2023 in PubMed, Cochrane Library, and Google Scholar. We read the relevant articles. Additionally, the reference lists of the chosen articles were perused. Diagnostic imaging, emergency prediction, and emergency service planning and resource allocation are just a few areas where the research has shown AI to play an important role in enhancing healthcare in emergency settings. When compared to human decision-makers, AI is more unbiased and accurate. Artificial intelligence (AI) performance can be improved by building interconnected data registries. Compared to gynecologists' and obstetricians' risk and outcome estimations, AI-prediction tools perform better in emergency scenarios like endometriosis and acute abdominal pain, according to validation study conducted in these contexts. Artificial intelligence and its potential advantages were widely accepted. Data governance, accountability for mistakes, and security concerns are some of the ethical challenges associated with AI. Medical staff members who work in emergency rooms require artificial intelligence training. Final thoughts In order to incorporate AI into their future practice according to established standards, healthcare providers should familiarize themselves with its expected function in gynecologic and obstetric emergencies, as well as its indications, limitations, and ethical considerations.

KEYWORDS- Artificial intelligence Gynecologic Obstetric Emergency Clinical practice

INTRODUCTION:

The field of health informatics is just one of many that has seen tremendous growth in the previous half-century in terms of data gathering, storage, and analysis. Over the years, computers have gone from being bulky, sluggish, and unable to store much data to becoming tiny, fast, and capable of storing a plethora of data. When it comes to developing simulations or prediction models, supercomputers can spend days analyzing data, which is beyond the capacity of regular human brains. The "Knowledge Pyramid" concept lays out the steps involved in gathering data, analyzing it, and drawing conclusions that lead to greater understanding and, ultimately, wisdom [1].

The rise of "artificial intelligence"—a field that aspires to simulate human cognitive processes—is a direct result of these innovations. Artificial intelligence (AI) has recently attracted a lot of attention in the medical field. The interest in artificial intelligence has grown exponentially from 1951 to 2023, according on searches in the PubMed database. From 1971 to 2023, the number of items in the database increased from less than 10 per year to over 37,000.

Artificial intelligence is characterized by its capacity to learn and reason similarly to humans. The goal of machine learning is to create computer programs with the ability to learn new tasks automatically. As a result, computers are able to mimic human intelligence and decision-making abilities with little to no human intervention in the form of programming commands [2].

In times of crisis, it can help by making rapid and accurate automated clinical judgments based on massive medical databases [3-5]. Triage using AI for acute abdominal discomfort (including menorrhagia) achieved an acceptable level of accuracy. For a speedy judgment, this might require numerous input variables [6].

Factors such as workload and human error in emergency situations are driving the use of modern AI-related technologies in healthcare. In intrapartum obstetrics, for instance, AI can aid in reducing fetal monitoring errors [7], and in gynecological oncology, it helps speed up the diagnosis of malignancies [8]. With the increasing global connectivity, artificial intelligence (AI) can play a role in improving health care by creating automated decision-making tools based on high-quality data sourced from international registries. Medical professionals working in emergency rooms must be well-versed in the limitations of artificial intelligence due to the high risk of mistakes [9].

Since preventing needless surgical operations is an important objective of emergency care, it is imperative that surgical subspecialties, such as gynecology and obstetrics, have thorough understanding of how AI should be applied [10]. Diagnostic imaging, public health emergency prediction, injury pattern identification from large medical datasets, and emergency service planning and resource allocation are just a few of the many applications of artificial intelligence [3, 11, 12].

Patients experiencing pelvic pain who had sonography and MRI come up empty-handed were able to avoid unnecessary procedures thanks to AI's ability to resolve diagnostic problems [12]. Presenting a targeted evidence synthesis regarding the potential of AI to gynecologists and obstetricians providing emergency healthcare is necessary, as its application is currently variable. Hence, our objective was to survey the function and uses of AI in relation to obstetric and gynecologic concerns.

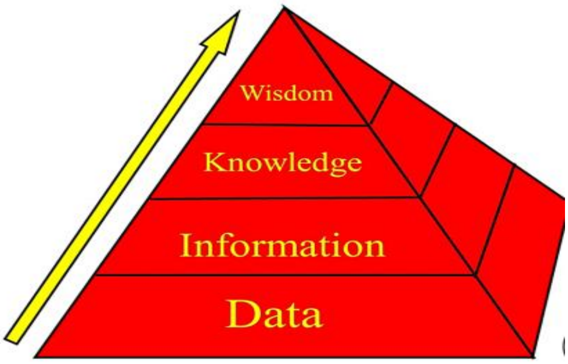

Fig. 1 The DIKW pyramid consists of four components: data, information, knowledge, and wisdom, that develop overtime from base to top

The medical industry is one area where artificial intelligence (AI) has made remarkable strides. AI has quickly integrated into people's everyday lives. Potential AI applications and expectations have grown in tandem with the proliferation of big data. The vast majority of the research articles published over the last 20 years have dealt with AI applications, and this interest has grown substantially in the medical field in particular [1,2]. The field of obstetrics and gynecology (OB/GYN) is seeing the first signs of AI revolutionizing diagnosis, treatment, and management of a wide range of conditions. This paper takes a look at the application of AI in OB/GYN, discussing its potential benefits, downsides, and future possibilities in this rapidly evolving field. But the published research articles and the actual application of AI in healthcare settings are very far apart [3,4].

Originally proposed in the 1960s, artificial intelligence (AI) aims to imitate human intellect in computationally intensive machines. Artificial intelligence has been driven forward by technological developments in deep learning and machine learning (ML) [5]. Machine learning (ML) allows computers to learn on their own without human intervention through the use of data-processing algorithms. Based on the data they process, these models can autonomously change and improve their performance.

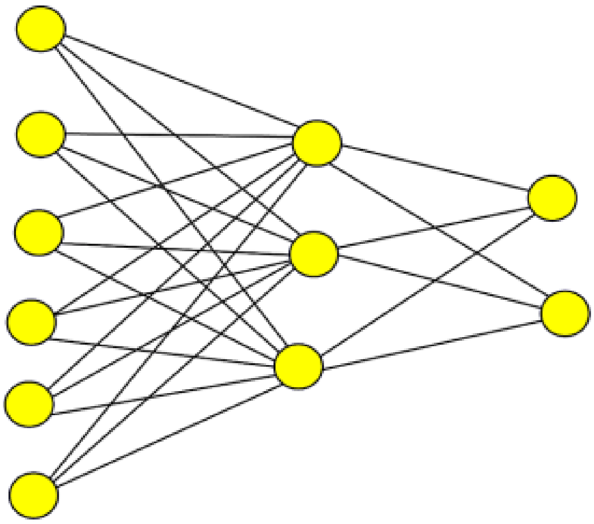

Fig. 2 Artificial neural networks, which mimick human neuron networks, have at least three layers: (1) input layer, (2) hidden layer, and (3) output layer

ISSN PRINT 2319 1775 Online 2320 7876
Research Paper © 2012 IJFANS. All Rights Reserved, Journal UGC CARE Listed (Group-I) Volume 14, Issue 05 2025

There are two main kinds of ML algorithms: supervised and unsupervised. Regression (including elementary regression methods) and classification (including decision trees and support vector machines) are both components of supervised learning. Unsupervised learning algorithms find connections or patterns among random data. Dimensionality reduction and clustering are the two main branches of these methods. K-means and Gaussian mixture models are examples of clustering. Dimensionality reduction is an exploratory method where the final aim is chosen after analysis, in contrast to clustering, which is usually utilized when the learning target is known in advance [6].

In artificial intelligence, data analysis and pattern identification rely heavily on dimensionality reduction and clustering, two subcategories of these methods. Autoencoders, principal component analysis (PCA), and t-SNE are dimensionality reduction methods that attempt to extract meaningful features from data by eliminating unnecessary details and noise. t-SNE reduces high-dimensional data to lower-dimensional visualizations, PCA finds components that explain data variation, and autoencoders compress data representations.

Without the need for predetermined labels, clustering algorithms like K-means and GMM aggregate data points that are similar into clusters. GMM represents data as Gaussian distributions for probabilistic clustering, whereas K-means allocates points to clusters based on centroid proximity.
When it comes to viewing or preparing complicated data, dimensionality reduction is a great exploring tool. If you have data and don't know the structure or quantity of clusters, clustering can help you find patterns. When it comes to mining massive datasets for insights, both are indispensable in industries as diverse as healthcare and banking.

In order to process and understand massive amounts of data, the subfield of machine learning known as "deep learning" employs artificial neural networks (ANNs). A large number of "neurons" grouped in a manner analogous to the human brain make up these networks [7].

ANNs can decipher intricate data sets because they are strong mathematical systems. Neural connections allow neurons to share information and collaborate to get the best possible answers. With this networked architecture, computers may simulate reasoning processes like inference and find the best possible answers to issues. When it comes to monitoring, diagnosing, and preventing diseases, this sophisticated form of AI is invaluable for analyzing massive datasets. Deep learning makes use of convolutional neural networks (CNNs) for image and video processing applications.

These networks are better able to integrate and process visual data because of their deeper topologies and more convolutional layers [8].

As of 2020, the US FDA had greenlit just twenty medicinal breakthroughs utilizing AI [9]. However, artificial intelligence applications in this domain have not yet received FDA clearance. Additionally, there is a large gap between the amount of papers on AI utilized in OB/GYN (18%) and core academic journals for AI/computer science (82%), according to Web of Science. Until the therapeutic value of AI is fully established, OB/GYN publications typically hold off on publishing studies on the topic [10]. Topics covered in these articles include the use of AI in fetal magnetic resonance imaging (MRI) scans, the use of electrohysterography to predict preterm labor, and the evaluation of the risk of fetal distress during labor [11–13].

Additionally, more generalized studies have investigated healthcare-related aspects impacting AI adoption in the actual world [14–19]. Nevertheless, research on obstetrical physicians' views on AI's possible benefits to their profession is lacking. The key to effectively incorporating e-health technology into clinical practice is comprehending the expectations and demands of individual healthcare workers, which is why this disparity is worrisome [20]. On top of that, if most OB/GYN research stays within the AI community, there can be a misalignment between AI research's aims and clinical demands. Medical practitioners should keep up with the newest research in artificial intelligence (AI) and its potential uses in obstetrics, and they should help shape the future of this growing area of study.

Understanding the expectations of obstetrical practitioners and identifying promising areas for AI application development within their sector are vital for bridging the gap between research and clinical practice. By gaining this comprehension, we can make sure that the goals of artificial intelligence research are actually achieved, benefiting both doctors and patients. So, these are the questions that our research aims to answer: Where do obstetricians see the potential for AI to improve patient care, and how do they currently see AI?

Review papers and research studies concentrating on the use of AI in OB/GYN are the main types of studies featured in this article. Research in this area focuses on the effects of artificial intelligence (AI) tools including convolutional neural networks (CNNs) and machine learning (ML) algorithms on OB/GYN diagnostic imaging, predictive analytics, personalized medicine, and clinical decision-making.
Synonyms and definitions of artificial intelligence AI refers to the subfield of computer science that uses algorithms to simulate human intelligence in ways that computers were not designed to do.

These algorithms can grasp language, retrieve information, reason, and learn, among other things. In computer science, an algorithm is a set of predefined, sequential procedures for solving a problem. The term "machine learning" (ML) refers to a combination of supervised and unsupervised AI techniques that enable algorithms to learn from complex inputs and previous experiences in order to carry out tasks typically performed by humans. These algorithms can then improve over time without requiring additional programming instructions. Statistical models are constructed by algorithms using the supplied data. The term for this procedure is training. A dimension is an input data variable. [15]

Algorithms that employ deep learning utilise multiple processing layers to derive complex insights from relatively simple inputs [16]. Deep learning includes artificial neural networks (ANNs). These sophisticated models imitate the way a human neuron network works. In these more involved models, we look for non-linear correlations between our input data and our desired output. Input, hidden, and output layers are the minimum number of layers in such a system. Maybe there's more than one secret level. Nodes in one layer communicate with nodes in the layer below them, but they do not communicate with nodes in the same layer [15].

An equation may be thought of as a gate that allows a neuron's output to progress through a network. You may hear this referred to as the transfer function or activation function. Neuron activation is determined by the activation function [17, 18]. In order for the learning process to take place between the input and output layers of a model, various model variables are used to weight the input to a neuron [15]. Depending on the feedback of the output error, the neurons' weights and biases should be changed to achieve an accurate output. Referred to as back propagation, this is [18]. Algorithms in computer vision attempt to deconstruct images by analyzing their constituent elements. Classification of these discoveries by the machine allows it to generate an output choice, such as a diagnosis, based on repeated observations learned from several images [19].

Discovering hidden patterns, correlations, and outliers in massive datasets for the purpose of making predictions is known as data mining (DM). Text is used as data in text mining. Another form of artificial intelligence is natural language processing (NLP), which makes use of computational linguistics to allow computers to comprehend and react to human speech. Data storage and retrieval are the three main functions of information retrieval (IR). An information retrieval (IR) system, a search engine allows users to input a query and retrieves documents that are ranked based on their relevancy. In order to enhance query formulation and document selection, IR can utilize techniques from ML and NLP.

Diagnostic imaging and interpretation

Diagnostic imaging, especially ultrasound and magnetic resonance imaging (MRI), has been greatly enhanced by AI.

Ultrasound is a safe and noninvasive way to find out if a woman is pregnant. A number of factors, such as motion distortions, foggy borders, acoustic shadows, a low signal-to-noise ratio, maternal obesity, and speckle noise, might make it difficult to acquire accurate readings, despite its widespread use [22].

For some time now, algorithms trained on ultrasound images of fetuses taken in the United States have been able to automatically identify and differentiate between various foetal body components thanks to ML. Several studies have created algorithms to extract biometric data and fetal characteristics from ultrasound images [23].

Presently, there is an AI-powered app that can partially interpret foetal ultrasound; after a doctor or sonographer selects the appropriate images of each part of the body, the app will automatically provide measures. A plethora of companies are preparing to provide services connected to this technology, which is currently in operation. For instance, automated standard scan planes have been developed to measure the size and width of the fetal brain in three dimensions (the transthalamic plane) and two dimensions (the transventricular plane).

Results

1. Early and Accurate Diagnosis

AI tools, especially those using machine learning (ML) and deep learning (DL), have shown high accuracy in identifying obstetric and gynecologic emergencies:

Ectopic Pregnancy Detection: AI models using ultrasound imaging and clinical data can identify ectopic pregnancies earlier and more accurately than traditional methods.

Preterm Labor Prediction: AI algorithms analyzing uterine contractions, cervical length, and other clinical data can predict preterm labor with over 80% accuracy in some studies.

2. Enhanced Imaging Interpretation

AI-enhanced imaging supports faster and more accurate interpretation:

Ultrasound & MRI: AI assists in detecting fetal abnormalities, placental issues, or gynecological masses (e.g., ovarian torsion or ruptured cysts), improving emergency response.

Automated fetal monitoring: AI can interpret cardiotocography (CTG) in real time, alerting clinicians to fetal distress sooner than traditional monitoring

3. Risk Stratification and Decision Support

AI helps prioritize emergency cases and guide interventions:

Triage Tools: AI-based triage tool

4. Robotic Surgery and Emergency Management

AI-guided robotic systems are used in minimally invasive emergency gynecologic procedures (e.g., for ruptured ectopic pregnancy or hemorrhagic cysts), improving precision and reducing complications.

Predicting Mode of Delivery Using Real-Time Data

A systematic research of ML models built from data of 94,480 delivery attempts found that prediction accuracy (AUC) increased with real-time data. Basic admission models reached AUC ~0.817. With added cervical exams and fetal heart monitoring, AUC rose remarkably to ~0.932—demonstrating strong predictive potential.

Predicting Obstetric Outcomes (Preterm Birth, Gestational Diabetes, etc.)

A scoping research of five studies showed machine learning models (XGBoost, Random Forest) can identify risks for preterm birth, gestational hypertension, low birth weight, and gestational diabetes. Techniques to improve interpretability—like SHAP—were used, though most studies were retrospective and limited in scope, requiring broader validation.

Artificial intelligence applications in obstetric and gynecological crises Gynecologic emergencies can manifest in a variety of ways, including but not limited to: pelvic masses, ovarian cysts, ectopic pregnancies, endometriosis, abortions, breast lumps and discharge, emergencies related to pelvic prolapse, heavy menstrual bleeding, and infertility treatment emergencies. With the support of human supervisors, AI is currently assisting gynecologists in emergency situations with diagnosis and therapy.

Artificial intelligence is already helping in radiological diagnosis of breast tumors, to name just one example [8]. It is also being worked on for use in the triage of acute abdominal pain [6] and in the detection of endometriosis in women [11]. Using three methods—conventional MRI, two artificial intelligence algorithms—namely, the standard hard C-means (HCM) algorithm and the fuzzy C-means (FCM) clustering algorithm—Jiang et al. assessed the diagnosis accuracy of MRI in 116 patients with ovarian endometriosis.

The AI Shortcomings

It would be a mistake to discount the challenges of incorporating AI into well-established gynecologic and obstetrics emergency protocols just because there have been promising advances in this area. To be clear, AI cannot supplant human doctors and nurses entirely. The lack of flawless accuracy and prediction performance is the primary shortcoming of AI clinical decision making. But it could help doctors make faster diagnoses, so they can spend more time talking to patients and their families about medical care.

Therefore, it could help alleviate work and burnout, but it won't be able to take the place of a doctor entirely. In addition, the patient's disease, their health and preferences, and their setting should all be considered appropriately when making key therapeutic decisions, which is a difficult process in and of itself. An educated decision that is shared should be made on an individual basis. While the patient, their legal guardian, and the treating physician deliberate and weigh the dangers, AI can assist with the evaluation. Also, it's important to remember that AI has a lot of restrictions. To start, correct data entry is the first determinant of the reliability of statistical algorithm modeling. The reliability of the prediction model could be compromised by inaccurate or absent data. Secondly, an AI model's predictive capabilities might only be applicable to the specific population from which it was trained. Thirdly, developing nations do not benefit as much from clinical trials, improvements in information literacy, and data collecting because they are mostly conducted in developed nations. As a fourth point, researchers' inherent biases could lead them to discount crucial variables. Lastly, AI models can be influenced by gender, race, socioeconomic status, and language biases, all of which can impact their accuracy.

Conclusion

There is hope for the application of AI in obstetric and gynecologic situations. With the right data inputs and human expert supervision, AI can aid in life-or-death decision-making and emergency crisis prediction. As a result, management can stay on schedule and save time. The lack of training in artificial intelligence (AI) may make gynecologists and obstetricians wary of its potential benefits.

References

1. Frické M. The knowledge pyramid: the DIKW Hierarchy. Knowl Organ. 2019;46:33–46.
2. Madani A, Namazi B, Altieri MS, et al. Artificial Intelligence for Intraoperative Guidance: using Semantic Segmentation to identify Surgical anatomy during laparoscopic cholecystectomy. Ann Surg. 2022;276(2):363. https://doi.org/10.1097/SLA.0000000000004594.
3. Litvin A, Korenev S, Rumovskaya S, et al. WSES project on decision support systems based on artificial neural networks in emergency surgery. World J Emerg Surg WJES. 2021;16(1):50.
4. Loftus TJ, Vlaar APJ, Hung AJ, et al. Executive summary of the artificial intelligence in surgery series. Surgery. 2022;171(5):1435–9.
5. Bertsimas D, Dunn J, Velmahos GC, Kaafarani HMA. Surgical Risk is not Linear: derivation and validation of a Novel, User-friendly, and machine-learningbased predictive

OpTimal trees in emergency surgery risk (POTTER) calculator. Ann Surg. 2018;268(4):574–83. https://doi.org/10.1097/SLA.00000000000 02956.
6. Farahmand S, Shabestari O, Pakrah M, Hossein-Nejad H, Arbab M, BagheriHariri S. Artificial Intelligence-based triage for patients with Acute Abdominal Pain in Emergency Department; a diagnostic accuracy study. Adv J Emerg Med. 2017;1(1):e5.
7. Warrick PA, Hamilton EF, Precup D, Kearney RE. Classification of normal and hypoxic fetuses from systems modeling of Intrapartum Cardiotocography. IEEE Trans Biomed Eng. 2010;57(4):771–9.
8. Williams P, Murchie P, Bond C. Patient and primary care delays in the diagnostic pathway of gynaecological cancers: a systematic review of influencing factors. Br J Gen Pract. 2019;69(679):e106–11. https://doi.org/10.3399/bjgp19 X700781.
9. Cobianchi L, Verde JM, Loftus TJ, et al. Artificial Intelligence and surgery: ethical dilemmas and open issues. J Am Coll Surg. 2022;235(2):268–75. https://doi.org/10.1097/XCS.0000000000000242.
10. Emin EI, Emin E, Papalois A, Willmott F, Clarke S, Sideris M. Artificial Intelligence in Obstetrics and Gynaecology: is this the Way Forward? Vivo. 2019;33(5):1547–51.
11. Jiang N, Xie H, Lin J, Wang Y, Yin Y. Diagnosis and Nursing Intervention of Gynecological Ovarian Endometriosis with Magnetic Resonance Imaging under Artificial Intelligence Algorithm. Comput Intell Neurosci. 2022;2022:3123310. https://doi.org/10.1155/2022/3123310. PMID: 35726287; PMCID: PMC9206576.
12. De Simone B, Abu-Zidan FM, Gumbs AA, et al. Knowledge, attitude, and practice of artificial intelligence in emergency and trauma surgery, the ARIES project: an international web-based survey. World J Emerg Surg. 2022;17(1):10. ht tps://doi.org/10.1186/s13017-022-00413-3.
13. Gasparyan AY, Ayvazyan L, Blackmore H, Kitas GD. Writing a narrative biomedical review: considerations for authors, peer reviewers, and editors. Rheumatol Int. 2011;31(11):1409–17. https://doi.org/10.1007/s00296-011-199 9-3. Epub 2011 Jul 29. PMID: 21800117.
14. National Medical Library. Accessed February 21. 2024. https://www.uaeu.ac.a e/en/nml/
15. Ceresoli M, Abu-Zidan FM, Staudenmayer KL, Catena F, Coccolini F, editors. Statistics and Research Methods for Acute Care and General surgeons. Springer Nature; 2022. Dec 13.
16. Kuo RYL, Harrison C, Curran TA, et al. Artificial Intelligence in fracture detection: a systematic review and Meta-analysis. Radiology. 2022;304(1):50–62. https://doi.org/10.1148/radiol.211785.
17. Madhuri J, Indiramma M. Artificial neural networks based Integrated Crop Recommendation System using soil and climatic parameters. Indian J Sci Technol. 2021;14(19):1587–97.
18. Feng J, Lu S. Performance analysis of various activation functions in Artificial neural networks. J Phys Conf Ser. 2019;1237:022030.
19. Team GL. What is Artificial Intelligence in 2024? Types, Trends, and Future of it? Great Learning Blog: Free Resources what Matters to shape your Career! Published November 8, 2023. Accessed February 21, 2024.
20. Nadel E, Talbot-Stern J. OBSTETRIC AND GYNECOLOGIC EMERGENCIES. Emerg Med Clin North Am. 1997;15(2):389–97.
21. de'Angelis N, Khan J, Marchegiani F, et al. Robotic surgery in emergency setting: 2021 WSES position paper. World J Emerg Surg. 2022;17(1):4.