MAR Gynecology & Urology (2024) 6:1

Case Report

Integration of AI in Reproductive Medicine through AR & VR

Dr. Nahla Kazim*

***Correspondence to:** Dr Nahla Kazim MD, MSc, PhD (UAE). Consultant/ Reproductive Medicine and Infertility. Director of Fertility Preservation (Bourn Hall Fertility Clinic, UAE). Adjunct Associate Professor (UAE University).

Received: 27 December 2023

Published: 18 January 2024

Abstarct

There is ongoing pursuit for technologies that will enhance the surgeon's operating environment.

Programs that enables devices to function in the ways, that make people seem intelligent are called artificial intelligent systems.

New computational paradigms using real-time visualisation platforms are emerging due to advancement of Smartphones with micro processing powers, compatibility with medical applications and instant access to web-based resources.

This has allowed for the development of powerful wearable technologies that can provide a reliable audio-visual data to the surgeon whilst operating. These disruptive technologies are already being actively examined for use as training tools and for therapeutic interventions

The role and integration of virtual reality (VR) and augmented reality (AR) in clinical practice of ART was explored. A medical application program was developed using head-mountable device that allows incorporating real-time data visualization during the extended time-out and oocyte retrieval procedures to improve work efficiency, safety, and to enhance surgical diagnosis and digitalization.

The use of application, pros and cons of these devices are reviewed

AR and VR can play a vital role in assisting the clinician to deliver health care efficiently in the 21st century. These techniques will serve to enhance and complement the practice of 'artificial intelligence'. The future practice of Reproductive Medicine may be reshaped. However, physicians should be encouraged to explore such emergent techniques in order to find true application in the real clinical set up.

Introduction

AI has been a significant advancement in Reproductive Medicine, with applications in neurology, psychiatry, pain management, and surgeon training. Virtual reality (VR) and augmented reality (AR) are wearable technologies that provide audio-visual data to surgeons during operations. These technologies have been used in various medical applications, including neurology, psychiatry, and pain management. However, their use in reproductive medicine has not been reported in literature or media. The market for AR and VR in healthcare is expected to grow from USD 769.2 Million in 2017 to USD 4,997.9 Million by 2023, at a CAGR of 36.6% between 2017 and 2023. The increasing penetration of connected wearable devices in the healthcare sector, increased investment in AR and VR healthcare, and the need to reduce healthcare costs are major drivers for the growth of these technologies.

Augmented reality superimposes images, videos, or computer-generated models on a user's view of the real world, providing a composite view. Virtual reality simulates a person's physical presence in a specific environment, allowing users to experience and manipulate it as if it were real. AI, the machine's ability to learn and exert intelligent behavior, is also a key factor in this advancement.

AI in reproductive medicine has been used in various studies, including a predictive model of ongoing pregnancy rates following IVF/ICSI treatment using a computational method and neural network. Closed incubation systems with concurrent time-lapse imaging were used to select viable embryos. A collaboration study between São Paulo State University and Boston Place Clinic showed that AI trained to look for viable embryos using characteristics like morphology, texture, and cell quantity and quality, picking viable embryos 76% of the time while highlighting defective ones. Virtual and Augmented Reality is also being used in healthcare.

Patient Care Management

Pear Therapeutics, a digital therapeutics company, has received FDA clearance to market their mobile medical application device, Reset, which includes a VR component for treating substance use disorder (SUD). VR has been shown to reduce anxiety in cancer patients undergoing chemotherapy infusions, and is also being used in rehabilitation for autism, phantom limb pain treatment, burns, and PTDS. Additionally, VR is making painful procedures less distressing for children through distraction, according to SEHA AHS.

Surgical Training

VR has been utilized for endoscopic training and assessment for over two decades, with the Minimally Invasive Surgical Trainer-Virtual Reality (MIST-VR) being one of its earliest platforms. The ASRM and VirtaMed have developed a VR simulator for ultrasound-guided and unguided embryo transfer in In Vitro Fertilization and Intrauterine Insemination on a pelvic model platform.

Figure 1

Planning complex operations

In 2016, The Royal London Hospital broadcasted the first live surgery using Virtual Reality (VR) technology. Professor Shafi Ahmed used Microsoft's Hololens to bring together surgeons from around the world to operate on a patient. Onco-surgeon Shailesh Shrikande and colorectal surgeon Hitesh Patel were able to view patient scans in 3D holograms hovering in the operating theatre, and virtually draw on the images. The experience provided a full 360 view of the operating room from the head of the operating table, allowing viewers to see the surgeons' perspective. Hundreds of thousands of people viewed the live stream. AR was also used during laparoscopic gynaecology surgery to localize myomas. 3D models of the patient's uterus and myomas were constructed from MRI images, and the intraoperative 3D shape was determined using AR.

Medical Training and Education

Anatomical evaluation

supplement anatomy learning by superimposing radiological (CT or MRI) images on to a body and creating a direct view of spatial anatomy for the learner.

Additionally, the use of haptic technology alongside this AR application provides the user with tactile feedback for appreciating the tactile consistency to different tissue components (Hsieh et.al. 2018).

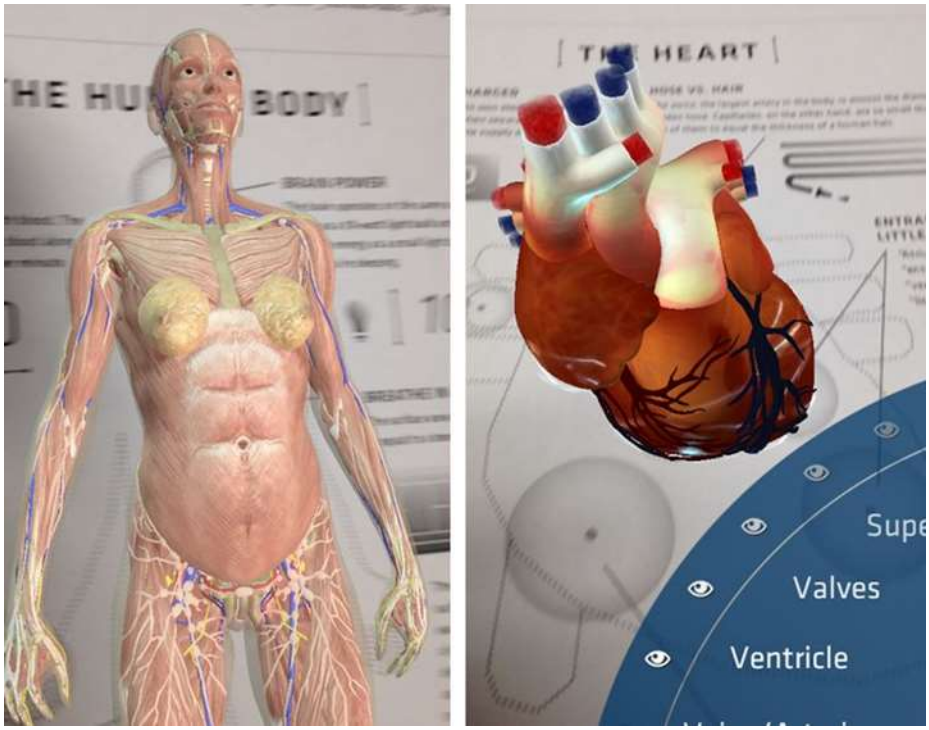

Figure 2

POP UP ATLAS

Figure 3: HOVERING IMAGES & haptic technology

Implementation of AR at Tawam THE CONCEPT Of AR

An Augmented Reality (AR)-based surgical navigation system was developed using an optical see-through HMD (head-mounted display)HoloLens to enhance the oocyte retrieval procedure

We demonstrated the use of pre-operative US imaging with intra-operative real-time US imaging overlay to guide oocyte retrieval procedure for Extended time out, pre- anaesthesia, and “follicular navigation”

AR at Tawam

Microsoft HoloLens has developed an Augmented Reality (AR) surgical navigation system for oocyte retrieval, enhancing the process by combining virtual digital couple data and diagnostic images in real-time environments.

Figure 4

Microsoft Hololens Live demonstration

Implementation of AR at Tawam THE CONCEPT Of AR

The HMD combines real- and virtual-world views during surgery, providing a combination of pre-anesthesia, pre-trigger, and real-time views. It allows for accurate and safer intraoperative ultrasound scans, a 360-degree view of the operating room, and voice activation for operator communication beyond the theatre environment.

The Time Out (Universal Protocol JCI, 2004) and Guidelines for Safe Surgery (WHO, 2007) outline the components of a safe surgical procedure, including patient identity, procedure, side and site, agreement on procedure, availability of implants, special equipment, and position. However, procedural time out catches (glitches) exist, and there is no standardization across institutions or personalized time-out for ART-related

procedures. Pre-operatively, an extended time-out briefing checklist is provided for both spouses, including patient's diagnostic images, trigger type, and time. Post-operatively, gametes are injected or frozen, and luteul support is provided. Voice commands can be used to update patient observations and locations.

Virtual reality (VR) is being integrated into infertility treatment education, engaging patients with high-quality education and a break-through experience. VR glasses and smartphones are used to show patients the virtual fertilization and implantation process, allowing realistic tactile interaction and getting them involved in their treatment. This non-conventional method improves patients' understanding of their illness background and addresses the issue of lack of counselors and psychological support in many facilities.

Video Presentation

Documentation reflecting time out

- 3-4D images compiled by programme / software for reconstruction https://youtu.be/SWREwpDPTuU

VR at Tawam

Figure 5

Implementation of AR & VR at Tawam

Key Indicators

Selecting appropriate use of audio-visual content, relevant to fertility

No. of views

Ratings

Content Quality

Content time

Implementation of AR & VR at Tawam Method

The text highlights the importance of digitalized medical education and training in waiting areas, particularly for visually challenged patients. It highlights the challenges of traditional methods, such as reading information booklets and printed materials, and the need for hands-free review of patient details. It also highlights the potential to improve operational procedures, save time and cost, enhance customer experience, and improve satisfaction. The text also emphasizes the UAE Government's vision of integrating technical revolutions into medical practice.

Implementation of AR & VR at Tawam **Negative Impact If Implementing**

The integration of 3D surgical aids (HMDs) into medical practice has several challenges, including delays, potential blindness, distractions, property damage, and patient data security. The use of HMDs can also cause simulator sickness, nausea, headaches, vertigo, and vomiting due to a discrepancy between visual, proprioceptive, and vestibular inputs. Patients may feel intimidated and vulnerable.

Disadvantages of HMDs include cumbersome, heavy, long-term wear comfort, and high costs. The devices must be lightweight, mobile, comfortable, and functional for potentially long periods of time. Battery life is limited, and the cables can be cumbersome. Confidentiality and data management of electronic patient records are protected under the Data Protection Act 1998 and the Freedom of Information Act 2000.

Data that is regarded as confidential, such as witnessed during a doctor-patient relationship, should only be disclosed with consent from the patient. The release of data from patient care records through HIMs is a major hurdle in the integration of recordable HMDs into medical practice.

In conclusion, the integration of recordable HMDs into medical practice requires a balance of cost-effectiveness, user-friendliness, and patient acceptability. The future of HMDs in healthcare must be cost-effective, versatile, and comfortable to ensure their widespread adoption.

Augmented reality (AR) and virtual reality (VR) are revolutionizing surgical science by providing a virtual digital couple's data and diagnostic images during live surgery and real-time environments. These technologies can improve safety, reduce costs, and enhance quality by reducing procedure-related complications. AR and VR are expected to serve as an advanced human-computer interface, working in symbiosis with surgeons. However, collaboration between computer scientists and physicians is needed to make AR and VR a reality in medicine. Further research is needed to evaluate the applicability of these technologies in Reproductive Medicine and to ensure their effectiveness in reshaping and adjusting practices.

Acknowledgement

Ahmed Ali Al Hammadi

Member of Futurist Hub, Founder of AR master software and designs.

Reference

1. Gardner, D. K., Rizk, B. R. M. B., & Falcone, T. (2011). Human assisted reproductive technology: Future trends in laboratory and clinical practice. Cambridge University Press. DOI: 10.1017/CBO9780511734755

2.Hsieh MC, Lee JJ (2018) Preliminary Study of VR and AR Applications in Medical and Healthcare Education. J Nurs Health Stud Vol. 3:No.1:1.

3.Carbonnel, Marie et al. (2014) Robot-assisted laparoscopy for infertility treatment: current views. Fertility

and Sterility , Volume 101 , Issue 3 , 621 – 626

4.Khor WS, Baker B, Amin K, Chan A, Patel K, Wong J. Augmented and virtual reality in surgery—the digital surgical environment: applications, limitations and legal pitfalls. Ann Transl Med. 2016;4:454

5.McHugh M. 2016 Pause for thought - Surgical Time Out: Before or after Painting & Draping. A Quality Improvement Project. [MSc Thesis]. Dublin: Royal College of Surgeons in Ireland

6.DeLacy, F.B., Nehme J. et al. Educational technology: revolutionizing surgical education. British Journal of Hospital Medicine 2017 78:8, 426-427.