THE WOCSI JOURNAL OF MEDICAL SCIENCE

THE WOCSI JOURNAL OF MEDICAL SCIENCE

TWJMS

WOUND & OSTOMY CARE SOCIETY OF INDIA

Chief Editor
Dr. CHANDRAPRAKAS CHOUHAN

Executive Editor
NIPIN KALAL

Managing Editor
VIJAY KUMAR

Effectiveness of Artificial intelligence based technology to improve wound assessment and better management: A Review Article

Miglani Gitika[1], Sharma Karitika[2], Jeengar Naresh[3], Kumar Dr. Nitesh[4], Kumawat Nitesh[5]

[1]Department of Nursing, Dr.BRA. IRCH, AIIMS New Delhi, India

[2]Department of Nursing, Main Hospital, AIIMS New Delhi, India

[3]Govt. College of Nursing, Merrut, Uttar Pradesh, India

[4]Department of Medicine, NIMS University, Jaipur, Rajasthan, India

[5]Department of Nursing, AIIMS Jodhpur, Rajasthan, India

Abstract:

Wound care clinicians face challenges in accurately predicting wound healing trajectories due to the intricate and dynamic nature of the healing process. During clinical visits, wound care teams capture images of wounds, resulting in the accumulation of extensive datasets over time. The development of innovative artificial intelligence (AI) systems can assist clinicians in diagnosing, evaluating therapy effectiveness, and forecasting healing outcomes. Precise assessment of wound area and the percentage of granulation tissue (PGT) play a crucial role in optimizing wound care and achieving favorable healing results. By utilizing AI-based wound assessment tools, the accuracy and consistency of wound area and PGT measurements can be enhanced, leading to improved efficiency in wound care workflows. Accurate measurements of wound area are particularly vital in optimizing outcomes for patients with chronic wounds. Furthermore, the determination of the percentage of healthy granulation tissue in the wound bed is essential in assessing whether a wound is likely to heal or is ready for definitive closure through skin graft or flap procedures.

Keywords : Artificial Intelligence, Wound Assessment, Wound Healing

Correspondence : Gitika Miglani
Email : gitikamiglani20@gmail.com

Introduction

Most commonly the wounds with complexity and chronic in nature can be seen in elderly population. According data of united states around 3% of population have open wounds with age more than 65 years[1]. Not only in United States but the impact of chronic wound can be seen worldwide and lead to persistent problem with the population. Difficulty in reaching the patients with wound for its management

and these lack of regular visits can lead increase in hospitalization rates by 20 times.[1] In order to

decrease the rate of hospitalization and improve the wound care management and its prognosis artificial intelligence and its application in these terms will be helpful in today's era and will be the future of health care[2].

Wound

Whenever a living tissue faces damage or interruption in its continuity either anatomically, physically or cellularly is defined as wound.[1] According to WHO, wound can be clean (normal tissue), contaminated (consists of infective substances), clean contaminated (low level of infection), infected (where pus is present and tissues lose their vitality). [2] Wound can be classified as healing and non-healing. Healing wound can be treated and are not associated with any comorbidity and have the ability to get heal with time whereas the non healing wound which are associated with comorbidity can lead to various medical issues like sepsis, shock, limb amputation and even to death.[3]

Wound Assessment

We assess the wound to evaluate the level of contamination so that professionals can estimate the morbidity, mortality and quality of life. [3] Human body by the virtue of environment and its contact consists of pathogens which can cause potential harm to the human body when the host's defense mechanism is weak or is unable to overcome those microorganisms present inside the human body as in case of cancer patients who have compromised immunity due to the treatment of this disease which consists of chemotherapy , surgery and radiation which works as influencing factor here to boost the potential effect of microorganism leads to infection early and it can be fatal. A complete patient assessment including history of illness and a comprehensive wound assessment by a specialized health professional and its documentation is necessary here to improve the quality of life of patient. [4] In order to assess wound the source, site and type of it must be taken into consideration to provide better care and ultimately to enhance healing. Approach towards the treatment and care of wound

depending upon these factors as it may definitely change with it. [5] There are basically four phases of wound healing- first is exudative phase- in this phase neutrophils are activated leads to formation of fibrin clot; second is resorptive phase- in this phase degradation of fibrin and migration of macrophages towards the wound takes place; third is proliferative phase- in this phase formulation of granular tissue takes place; fourth is regenerative phase- in this phase epithelization and scar formation takes place. Based on immunological aspects wound healing is divided into three phases theses are inflammatory phase, proliferative phase and wound modulation phase. [16]

Wound management

A multidisciplinary team approach, adequacy of knowledge and implementation of evidence based practices related to wound, location, its type, medical and surgical history of patient, ongoing treatment, risk factors associated with the living environment and manifesting bodily changes are required to make a effective therapeutic care plan for the patient.5 Multidisciplinary team includes physicians, surgeons, specialized wound care nurses, counselors, physiotherapists, occupational therapist and pharmacists. For long term treatment of wound this entire team will work together by assigning particular duties to one and all working in team and by maintaining a good communication with clear messages and documentation. [6]

Artificial Intelligence

In today's era artificial intelligence brings a revolution in health care delivery system by not only aided in detecting the disease at its earliest but also to manage, communicate and reach out to the population in need of healthcare. [7] AI will transform the relationship between people and technology, charging our creativity and skills. The future of AI promises a new era of disruption and productivity, where human ingenuity is enhanced by speed and precision. Wound care can be standardized through understanding and training. AI married to human intelligence will allow a more rapid standardization and specialization of wound care. This will be through two main areas: one, the actual ability to standardise practice through the many levels of care delivery and second, the ability, through the application of technology, to "up-skill" its delivery even through less-trained resources (eg,

family or patient). [8] AI may offer the golden opportunity to assist in a "physician-aided" period whereby human and artificial intelligence come together to offer physicians more time to paradoxically make healthcare human again. [14]

AI-Application

Artificial intelligence techniques have a huge impact and prospects in the wound care and its management. AI-based remote consultation systems using the smart phones and tablets for data collection and connectivity is another important development of concern. [9]According the article "artificial intelligence in medical technologies" the principal wings of medicine utilizing artificial intelligence are pulmonology, cardiovascular medicine, orthopedics, hepatology, neurology and oncology. Application of artificial intelligence can be divided into three main categories on the basis of its functionality, first is health data collection which includes detection and data extraction, second is disease data analysis which includes classification and identification of disease and the third is active treatment processes including prediction and prognosis of disease. [10] Image recognition and visualization methods in radiology, is a common approach in oncology treatment. [11] AI-based digital wound assessment tools provides a framework in evaluating wounds. Wound assessment tools helps to measure various wound features and can be adapted to evaluate other AI-based digital image diagnostic tools. [12-13,14] Artificial intelligence holds immense potential to alleviate challenges associated with complex wound management. Caring of chronic and complex wound is difficult as it may comprises of factors like poor vascular supply or vascular damage. For this an AI driven specialized chatbot software is helpful in assessing, diagnosing and treating the wounds with complexity. [17-19]

Result and Discussion

The primary factors that drive costs and outcomes in chronic wound care are the time it takes for wounds to heal, the frequency of treatment, and the occurrence of wound complications. These factors heavily rely on accurate wound assessments, which are crucial for developing effective treatment plans. Artificial intelligence (AI) is increasingly being utilized to optimize diagnostic and therapeutic workflows, and it is now making an impact in the field of wound care. However, reaching a consensus among expert clinicians regarding wound assessments has proven to be challenging, making it difficult to accurately measure key indicators of wound healing. Clinicians require clear, efficient, and precise wound analysis to guide their clinical practices effectively. Therefore, it is necessary to further standardize the testing and implementation of AI-based digital wound assessment tools. We propose that adopting a structured approach to wound assessment using advanced technologies like AI can enhance treatment effectiveness and lead to improved outcomes for patients with chronic wounds. In the future, it is important to expand the assessment methods to include other wound characteristics and to track the progress of the same wounds over time, considering relevant demographic and clinical factors, to evaluate their impact on wound progression. Additionally, there is potential to utilize machine learning to identify wounds that may have slow healing rates or require immediate medical attention. This would enable efficient triage of care and alleviate the burden on healthcare resources.

References:

[1] Nagle SM, Stevens KA, Wilbraham SC. Wound Assessment. [Updated 2023 Jun 26]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK482198/.

[2] Herman TF, Bordoni B. Wound Classification. [Updated 2023 Aug 17]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK554456/.

[3] Whitehouse JD, Friedman ND, Kirkland KB, Richardson WJ, Sexton DJ. The impact of surgical-site infections following orthopedic surgery at a community hospital and a university hospital: adverse quality of life, excess length of stay, and extra cost. Infect Control Hosp Epidemiol. 2002 Apr;23(4):183-9.

[4] Improving the accuracy of surgical wound classification documentation. AORN J. 2021 Dec;114(6):P10-P12.

[5] Nagle SM, Stevens KA, Wilbraham SC. Wound Assessment. [Updated 2023 Jun 26]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 Jan-. Available from:
https://www.ncbi.nlm.nih.gov/books/NBK482198/

[6] Long CD, Granick MS. A multidisciplinary approach to wound care in the hospitalized patient. Clin Plast Surg. 1998 Jul;25(3):425-31. PMID: 9696902.

[7] Bhatt P, Liu J, Gong Y, Wang J, Guo Y. Emerging Artificial Intelligence-Empowered mHealth: Scoping Review. JMIR Mhealth Uhealth. 2022 Jun 9;10(6):e35053. doi: 10.2196/35053. PMID: 35679107; PMCID: PMC9227797.

[8] Queen D. Artificial intelligence and machine learning in wound care-The wounded machine! Int Wound J. 2019 Apr;16(2):311. doi: 10.1111/iwj.13108. PMID: 30887702; PMCID: PMC7948899.

[9] Mai Dabas, Dafna Schwartz, Dimitri Beeckman, and Amit Gefen Application of Artificial Intelligence Methodologies to Chronic Wound Care and Management: A Scoping Review, Advances in Wound Care 2023 12:4, 205-240.

[10] Bitkina OV, Park J, Kim HK. Application of artificial intelligence in medical technologies: A systematic review of main trends. Digit Health. 2023 Jul 18;9:20552076231189331. doi: 10.1177/20552076231189331. PMID: 37485326; PMCID: PMC10359663.

[11] Hosny A, Parmar C, Quackenbush J, et al. Artificial intelligence in radiology. *Nat Rev Cancer* 2018; 18: 500–510.

[12] Howell RS, Liu HH, Khan AA, Woods JS, Lin LJ, Saxena M, Saxena H, Castellano M, Petrone P, Slone E, Chiu ES, Gillette BM, Gorenstein SA. Development of a Method for Clinical Evaluation of Artificial Intelligence-Based Digital Wound Assessment Tools. JAMA Netw Open. 2021 May 3;4(5):e217234. doi: 10.1001/jamanetworkopen.2021.7234. PMID: 34009348; PMCID: PMC8134996.

[13] Gupta S, Gupta SS, McMath K, Sugandh S. Enhancing complex wound care by leveraging artificial intelligence: an artificial intelligence chatbot software study. Wounds. 2023 Aug;35(8):E265-E267. doi: 10.25270/wnds/23073. PMID: 37643453.

[14] Helm JM, Swiergosz AM, Haeberle HS, Karnuta JM, Schaffer JL, Krebs VE, Spitzer AI, Ramkumar PN. Machine Learning and Artificial Intelligence: Definitions, Applications, and Future Directions. Curr Rev Musculoskelet Med. 2020 Feb;13(1):69-76. doi: 10.1007/s12178-020-09600-8. PMID: 31983042; PMCID: PMC7083992.

[15] Sen CK. Human Wound and Its Burden: Updated 2020 Compendium of Estimates. Adv Wound Care (New Rochelle). 2021 May;10(5):281-292. doi: 10.1089/wound.2021.0026. PMID: 33733885; PMCID: PMC8024242.

[16] Kujath P, Michelsen A. Wounds - from physiology to wound dressing. Dtsch Arztebl Int. 2008 Mar;105(13):239-48. doi: 10.3238/arztebl.2008.0239. Epub 2008 Mar 28. PMID: 19629204; PMCID: PMC2696775.

[17] 26. Lindholm C, Searle R. Wound management for the 21st century: combining effectiveness and efficiency. Int Wound J. 2016;13(suppl 2):5-15. doi:10.1111/iwj.12623.

[18] He J, Baxter SL, Xu J, Xu J, Zhou X, Zhang K. The practical implementation of artificial intelligence technologies in medicine. Nat Med. 2019;25(1):30-36. doi:10.1038/s41591-018-0307-0

[19] Mamone V, Fonzo MD, Esposito N, Ferrari M, Ferrari V. Monitoring wound healing with contactless measurements and augmented reality. IEEE J Transl Eng Health