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Study of Artificial Intelligence Revolution in Burn Treatment

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Abstract- Artificial Intelligence (AI) is an essential tool in the medical field, particularly in the treatment of burns, as it aids in disease diagnosis, data analysis, and treatment planning. Additionally, it speeds up and improves the accuracy of diagnosis, which helps to improve patient and injured care. In this paper, the focus will be on skin burns which are among the most frequent injuries and need to be diagnosed quickly and accurately in order to assess the extent and severity of the burn. The World Health Organization reported that every year, 300,000 people pass away from burns as a result of improper diagnosis, which can also have major repercussions and long-term issues. Patient's body skin layers with AI and without AI are assessed. Two main mathematical expressions and numerical results are estimated to validate the performance of the study. An open discussion is well introduced at the end of the methodology section.

Keywords- Artificial Intelligence; Skin; Burn; Fluid; Body; Patient

I. INTRODUCTION

As technology has advanced, Artificial Intelligence has had a significant impact on the medical field, particularly in the diagnosis and treatment of burn patients [1]. It reduces potential risks and complications, improves treatment outcomes, and, in certain cases, lessens side effects. By analyzing medical images and examinations, advanced Artificial Intelligence technologies like machine learning and others can more accurately and quickly assess and estimate the depth and severity of burns, enabling the selection of the most effective treatment options [2,3]. It takes more experience to determine the extent of the injury and the degree of burns because burns are regarded as serious injuries that need prompt and precise medical attention. Additionally, the evaluation process for burns is frequently complicated. Clinical data and medical images can be used by Artificial Intelligence to make a prompt and accurate diagnosis [5]. Additionally, by making information available, Artificial Intelligence enhances decision-making procedures [6,7]. In the area of burns, Artificial Intelligence intervention not only helps patients receive better medical care but also increases the effectiveness of the healthcare system [4].

The paper is well organized as follows: Section I introduces the paper, Section II presents the methodology and Section III concludes the paper and predicts with the future.

II. METHODOLOGY

Acute kidney injury is a condition that can result in kidney failure when a person sustains a burn and damages some of the layers beneath their skin, as shown in Figure (1). These injuries start in the first week after the burn, particularly in the first 24 hours [4]. They can lead to an imbalance in bodily fluids and the buildup of toxins in the blood, which can result in a high death rate of up to 30% [1-7]. Traditional vital signs, such as measuring the amount of creatinine in the blood and plasma, are used by doctors to diagnose these injuries, but they are not very helpful. In order to identify it more precisely and save patients' lives, American researchers at the University of California, USA, have turned to Artificial Intelligence. In order to more quickly and precisely forecast acute kidney injury, the researchers created an Artificial Intelligence model. In contrast to traditional methods, which have an accuracy of 80 percent, Artificial Intelligence can predict a person with acute kidney injury with an accuracy of 90 to 100 percent, according to a test done on the model for numerous patients with severe burns within the first 24 hours of exposure to the burn [4-7]. They also discovered that, in contrast to traditional methods, which predict it after 42–7 hours of burning, using Artificial Intelligence predicts it after 10–8 hours, which is up to 90% faster [4,7]. Thus, AI is able to diagnose the case more quickly.

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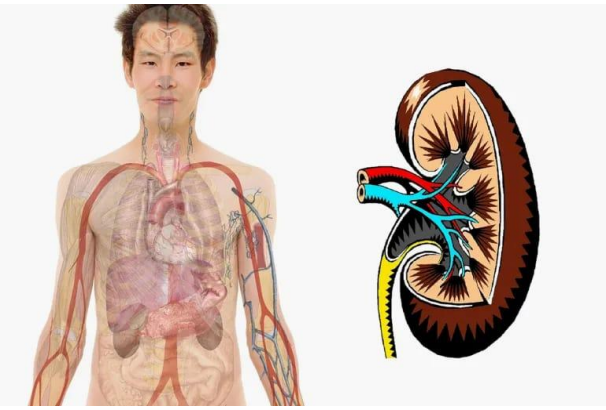
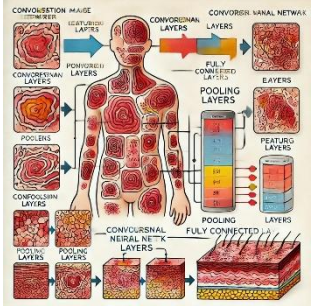


Figure (1): Acute Kidney Injury Condition

Artificial Intelligence can analyze data related to burns such as images and examinations to estimate the severity and depth of burns more accurately and quickly. If we assume that we have a patient with a second-degree burn and we want to know the area of the burned surface and determine the percentage of fluids the patient needs to estimate the severity and depth of the burns, we will do the following [1]:

Area of the Burned Surface: Collecting data where accurate images of the burns are taken from different angles and we collect patient data such as age, weight, height and knowing the type of burn whether it is chemical, electrical or thermal (this is called clinical data). Then the images are processed using Artificial Intelligence through deep learning methods by training a model such as convolutional neural networks (CNN) on a set of images of about 104 burn images classified according to severity and depth, how does a convolutional neural network (CNN) detect burns on a patient's skin?

The process begins with a multi-dimensional picture of the patient's skin that displays burns. Image filters are applied by the convolutional layer. To detect alterations like color shifts or skin peeling, these filters examine tiny regions. Additionally, they identify areas that are red or ulcerated. Convolutional layers are what these are known as. After that, layers known as pooling layers are used to reduce the size of the data, which lowers computational complexity while maintaining crucial information like the intensity of the redness area. These layers are then used to classify burns and assess the extent of the injury by combining the features that were learned from the image. We refer to these layers as fully connected. For example, if the network detects severe redness and ulcers, it can classify the injury as a severe burn.



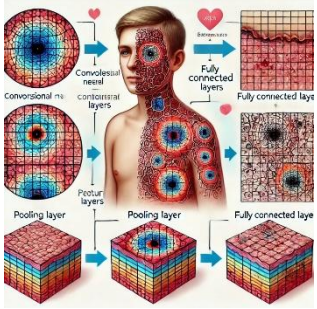


Figure (2): Multidimensional Picture of Patient Skin Layers

As a result, if the burn is of a certain degree, the network provides the final result, which includes a classification of the burn. We use the semantic segmentation technique to separate the burned area from the healthy area in the images. The first, second, or third layer is the output layer for the network outputs. The semantic segmentation technique can be operated, in steps, as follows:

1. A segmentation semantics-based system is fed the image with the burned area.
2. The neural network processes the image; this model is trained on a collection of burn images, where it is given images with both healthy and burned areas. It is also given information about which pixels are in the healthy area and which are in the burned area. As a result of this training, the model is able to differentiate between the characteristics of burned skin and those of healthy skin by looking at the image's color, texture, and pattern.
3. Following model training, pixel classification divides each pixel in the input image into "burned area" and "healthy area" categories based on whether the pixel is burned or not.
4. The output of the classified image; a new image is created with the burned areas highlighted, which helps medical professionals assess the extent and magnitude of the burns. The burned area's surface area is then determined by applying mathematical algorithms.

In order to maintain the stability of the patient's condition and avoid complications like dehydration or organ failure, we use formula equations (Parkland or Brooke equation) based on the patient's weight and the area of the burned surface. The Parkland Formula is the most accurate and commonly used method to compensate for plasma loss and prevent shock.

The total fluid requirement can be mathematically calculated in mille litters (mL) as the following formula [3]:

$$\boldsymbol{Total\ Fluid\ Requirement}\ (\boldsymbol{mL}) = \mathbf{4} * \boldsymbol{Body\ Weight}\ (\boldsymbol{kg}) * \boldsymbol{Percentage\ of\ Burned\ Body\ Surface\ Area}\ (\boldsymbol{BSA}\%) \quad \textbf{(1)}$$

Where
Body Weight (kg): Patient's Weight in Kilograms;
Burned Surface Area (BSA %): Percentage of the Body Area Affected by Burns, usually estimated using the Rule of Nines method

Applying the Equation:
1. Calculate the total amount of fluids that the patient needs during the first 24 hours.
2. Give half the amount during the first 8 hours from the time of injury.
3. The other half is given over the next 16 hours.

The Brooke Formula gives a mathematical expression of the total fluid requirement in mille litters as follows [3]:

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$$\textbf{Total Fluid Requirement (mL)} = 4 * \textbf{Body Weight (kg)} * \textbf{Percentage of Burned Body Surface Area (BSA\%)} \quad \textbf{(2)}$$

The Parkland gives a higher fluid intake compared to that of the Brook.

Each patient has a different formula, and it's critical to monitor vital signs like blood pressure and urine output to ensure that neither too much nor too little fluid is replaced. By dividing the body into relative parts, each of which represents a percentage of the body's total surface area, the Rule of Nines is used to estimate the area of the body burned.

An illustration of applying the rule of nine to estimate the burnt surface area. The burnt surface area is equal to the sum of the percentages of the burned areas (head and neck = 9%, each arm = 9%, front trunk = 18%, back trunk = 18%, each leg = 18%, genitals = 1%). This is how we determine the total burned area.

III. CONCLUSION

In conclusion, we observe that Artificial Intelligence plays a vital role in improving the efficiency of doctors in diagnosing and treating burn patients using advanced technologies such as machine learning, medical image analysis, magnetic segmentation, and CNN models. This has resulted in more precise and timely assessment of burn severity and depth, thereby enhancing diagnosis reliability. Additionally, analyzing patient burn data allows doctors to make more accurate treatment decisions, including determining the required fluid intake during the initial hours of the burn to improve the patient's survival chances. This alliance between AI and healthcare signifies a significant advancement towards improving the standard of medical care and reducing response time for treating patients.

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