Application of Machine Learning and Artificial Intelligence Techniques for IVF Analysis and Prediction

Satya Kiranmai Tadepalli, Chaitanya Bharathi Institute of Technology, Hyderabad, India
https://orcid.org/0000-0002-1709-9858

P.V. Lakshmi, GITAM Deemed to be University, Visakhapatnam, India

ABSTRACT

Infertility is the combination of factors that prevent pregnancy. It involves a lot of care and expertise while selecting the best embryo to lead to a successful pregnancy. Assistive reproductive technology (ART) helps to solve this issue. In vitro fertilization (IVF) is one of the methods of ART which is very popular. Artificial intelligence will have digital revolution and manifold advances in the field of reproductive medicine and will eventually provide immense benefits to infertile patients. The main aim of this article is to focus on the methods that can predict the accuracy of pregnancy without human intervention. It provides successful studies conducted by using machine learning techniques. This easily enables doctors to understand the behavior of the attributes which are suitable for the treatment. Blastocyst images can be deployed for the detection and prediction of the best embryo which has the maximum chance of a successful pregnancy. This pioneering work gives one a view into how this field could benefit the future generation.

KEYWORDS

ART, Artificial Intelligence, Blastocyst, Deep Learning, Embryo Grading, Embryo Selection, IVF, Machine Learning Techniques, Neural Networks

INTRODUCTION

It involves a lot of care and expertise while selecting the best embryo or the factors which lead to a successful pregnancy. The embryologist plays a vital role by establishing reproductive assistance and clinical help from the fertility consultant, in the initial stages of diagnosis of a couple who come for IVF treatment. The culture of
eggs, sperm and embryos are examined under medical conditions. The main aim is to understand, plan and regulate the defects that are contemplated before fertilization. Embryologists study the embryo morphology including embryo grading, embryo freezing, selecting the best embryo for implantation (Uyar, 2009). Processing an embryo for the fertilization is called a cycle. The embryologists freeze the embryos until they get the best results. Implantation failure occurs when the IVF process cannot be successful even after repetitive embryo transfers (Koot, 2016). Manual embryo grading is a tedious and time-consuming job. It will be easy if a machine can do this process without human intervention. With this thought using artificial intelligence (AI) and deep learning techniques, it is very helpful in determining the best embryo that can be induced (Malinowski, 2014).

The three methods through which IVF can be obtained using AI and ML techniques:

- Building a model to know what the success rate of IVF treatment will be and whether to continue with it or not;
- Predicting the accuracy as to in how many cycles IVF can be successful;
- Selecting the best quality embryo, which increases the chance of pregnancy even before IVF treatment.

In this review, the following sections will help in knowing different Machine Learning and AI techniques and their contributions towards the infertility treatment. In view of this survey, the data has been collected from different search engines and from the previous publications.

THEORETICAL BACKGROUND

According to statistical survey, Infertility is faced by more than 10% of the world population (Haimovici, 2018). Infertility is the inability to achieve pregnancy after one year of unprotected intercourse due to many combinations of factors. On determining the infertility aspect of a couple, an appropriate assisted reproduction treatment is applied in order to conceive a pregnancy successfully. The quality of embryos and oocytes is predicted by using artificial intelligence methods. IVF is one of the types of ART, where man’s sperm and woman’s egg is nourished under medical conditions and then it is inserted into the women’s uterus (Gerris, 2004; Raef, 2019). The reasons for infertility are blocked fallopian tubes, diabetes, age, smoking, alcohol consumption, irregular mensural cycles, hormonal deficiencies, low sperm count, certain genetic diseases, etc. (Haimovici, 2018; Crawford, 2015).

ART has many techniques to deal with different types of issues:

1. In vitro Fertilization (IVF): It is the most successful technique of ART
2. Intrauterine Insemination (IUI): Fertilization of eggs is done inside the woman’s uterus. The success rate is low when compared to IVF. But it is affordable
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