

The Use of the Artificial Neural Network for Evaluating the Treatment Outcomes of Single-Channel and Tri-Channel Applicators Used in Cervical Cancer in Based on High-Dose-Rate Brachytherapy for Cervical Cancer

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Authors: Alamgir Hossain, Shahidul Miah, Prodip Kumer Ray, Ashim Kumar Ghosh, and others.

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Abstract

The study aimed to evaluate the treatment outcomes of single-channel and tri-channel applicators for cervical cancer patients based on treated with high-dose-rate (HDR) brachytherapy, using an artificial neural network (ANN). An artificial neural network (ANN) model is proposed to predict the treatment outcomes for the single-channel applicator and tri-channel applicators in cervical cancer for HDR high-dose-rate brachytherapy. Fifty-four patients of cervical cancer per patients who were receiving external beam radiation therapy (EBRT) of 40–50 cGy with concurrent, with chemotherapy, were selected; in this study from 37 patients were with cervical cancer being used to train the model and 17 for to test in this model. An model was developed for intracavitary brachytherapy model was developed to estimate the comparison of the treatment outcomes for the single-channel applicator and tri-channel applicators. The model, demonstrating demonstrated the a sensitivity, specificity, and accuracy of 100%, and specificity 100%, and accuracy and 100% for for training and 87.5%, 77.8%, and 82.4% for testing, respectively, respectively, including with an area under the curve of AUC=0.961. The 2-year survival rate was 85% and 95% for single-channel and tri-channel applicators at 2 years was 85% for the single-channel applicator and 95% for the tri-channel applicator, respectively. A model approach for artificial Thus, the ANN approach for neural networks based on gynecological brachytherapy is a promising method for one for improving patient's treatment outcomes, resulting in by producing the dosimetry output of for the applicator, it can helps; medical physicists can be decided the appropriate applicator for cervical cancer. The Hence the proposed model has shows the potential accuracy in for accurately judging the treatment outcomes for the single-channel applicator and tri-channel applicators in cervical cancer based on survival analysis.

Keywords: Artificial neural network, treatment outcomes, single-channel applicator, tri-channel applicator, high-dose-rate brachytherapy, cervical cancer

Introduction

In the world, cervical cancer is the one of most top most common cancers. It is ranked the fourteenth among all most common cancer overalls and fourth position for most common among women in the world wide.[1] In Western Africa, the it is the most frequent common cancer is cervical for women. Papillomavirus infection, number of sexual partners, economic status, and smoking are the among the risk factors for cervical cancer.[2, 3] According to the statistics While the 2012, the incidence rate of cervical cancer has decreased by 1.3% from 2012 to has decreased in 2015 [4], due to owing to improvements of in lifestyle, vaccination, and early

Please check the changes I have made and use the revised version of the title for future references to this work. The revised title better reflects the contents of the paper.

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Use an en dash (–), not a hyphen (-), to represent closed ranges. In MS Word, an en dash can be obtained from the Symbol list in the Insert menu or by pressing Ctrl and the minus sign on the numeric keypad simultaneously.

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Please check whether the unit is correct; 40–50 cGy is 0.4–0.5 Gy, far below any therapeutic dose.

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detection.[5] ~~Still now, it is the~~continues to have the highest mortality in Asia, ~~counting in the accounting for~~ 53.8% of total cancer cases.[6]

The treatment ~~approach for type of~~ cervical cancers is generally intracavitary, interstitial, ~~and or~~ a hybrid of the two. The American Brachytherapy Society has recommended ~~that~~ cervical cancer patients ~~to be treated the for~~ symptoms such as vaginal extension, pelvic sidewall and bulky lesions, and vaginal apex.[7] Although ~~the a~~ single-channel applicator is used for the non-bulky diseases ~~to avoid limit~~ the dose ~~from the to~~ organs at risk (OARs) ~~like such as the~~ rectum and bladder, a multi-channel ~~applicator is can also be also~~ used to ~~deliver reduce the dose decreased in to the~~ OARs by ~~adjusting the the~~ dwell time of ~~the its~~ applicator. ~~The other literature has~~Studies have reported that ~~discussed that a single channel applicators~~ reduces cost, ~~improve dose~~ coverage ~~for covering doses~~ in tumors, and decreases doses in OARs ~~than compared with~~ multi-channel applicators.[8] In the further article showed that a multi-channel applicator could reduce tumor dose and rectum dose as single-channel applicators with statistically significant, resulting in favor of a multi-channel applicator when a single channel inserted at 5 mm prescription at depth.[9]

~~Traditionally~~Conventionally, logistic regression (LR) is used ~~worldwide to predict the evaluate~~ developed models and analyze medical outcomes.[10] However, ~~there is it has some~~ limitations based on the ~~in its~~ ability to predict ~~the model outcomes~~ with accuracy. For example, LR ~~is the models the~~ relationship between ~~the~~ independent and dependent variables ~~based on the assumption that the, demonstrating the normal distribution of~~ independent variable ~~exhibits a normal distributions~~. [11] Therefore, ~~LR is not appropriate for~~ modeling complex systems, ~~such as the like~~ treatment outcomes of a single-channel applicator and tri-channel applicators, ~~LR is not appropriate for because it cannot capturing capture~~ the complex relationship ~~between the and finding the accuracy of~~ the independent variables ~~such as treatment outcomes~~.

In contrast to LR, ~~artificial neural networks (ANNs)~~ ~~is are~~ a type of artificial intelligence ~~that is being applied extensively to, demonstrating~~ problem-solving ~~methods in~~ medicine and biomedical engineering ~~enormously~~ worldwide.[12] ~~It is used in~~ They are used in biomedical science, drug development, ~~medical~~ treatments, health-care, and medical image processing. ANNs are ~~the model for~~ information-processing ~~models that composed of describes the~~ interconnected neurons ~~resolving the that work together to solve~~ problems.[13] Provided that ~~it is~~ANNs are trained ~~to the ANNs to~~ generalize, ~~it will be suitable they can to~~ predict results quickly ~~on data~~ other than ~~the~~ training data.[14] ~~In ANNs is used based on a are commonly trained using a~~ backpropagation algorithm.[15] A training set is ~~feeded to to the ANNs network, which for processings~~ the input and output data to learn. The output is ~~then~~ compared ~~to with~~ human-provided output. If the prediction is ~~in not~~ correct, the algorithm learns through ~~the~~ backpropagation, ~~methods to adjust the mathematical equation its parameters for to minimizing minimize~~ the errors ~~in the during~~ training period.[16]

In a volumetric dose analysis ~~study~~, Rajković et al. proposed ~~the artificial neural network an ANN~~ with a genetic algorithm to optimize brachytherapy parameters.[17] ~~In addition, Jaber et al. developed An an~~ ANNs model ~~was to predict the developed for~~ intra-fractional OARs dose, ~~in Jaber et al., describing the~~ applicator changes to compensate ~~for changes in the the~~ treatment plan.[18] ~~and is also use~~ANNs are ~~d in also used in~~ business, credit and fraud detection, speech recognition, and image processing.[19] ~~The model They have further been was~~ applied ~~for to~~ traumatic brain injury[20], ~~the~~ lumbar spine canal stenosis[21], cancer identification ~~with outcomes~~[22], ~~the~~ detection of posterior lumbar spine fusion[23], and the diagnosis of my cardinal complexation.[24] ~~The ANNs offer have unique distinct~~ benefits such as ~~supporting~~ decision making, improving treatment outcomes, and ~~reducing~~ treatment costs.[16] ~~The The~~ treatment outcome ~~in cervical cancer iss are considered based on the defined by the~~ patient's

There should not be a space between a numeral and the

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status at the last follow-up ~~after treatments and~~ and -the survival rate ~~for associated with the the~~
applicator types used in cervical cancer treatment. ~~Therefore, we~~ Therefore, in this study, we
~~have~~ developed a model to predict the treatment outcomes based on a survival analysis of the
single-channel and tri-channel applicators used in cervical cancer treatment.