Chapter 9
Breast Cancer:
Advancement in Diagnostic and Treatment

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ABSTRACT

Breast cancer is the second most common cancer in the world and is difficult to accurately identify and treat. Diagnostic computational tools can be used effectively, with high degree of accuracy, to recognize and differentiate between the two known types of breast lesion, namely benign and malignant. These modelling tools include artificial intelligence techniques such as Artificial Neural Networks (ANNs), Fuzzy Logic (FL), Hidden Markov Model (HMM) and Support Vector Machines (SVMs). These tools can identify the important features that play pivotal roles in the classification task, and can aid physicians to diagnose and prognosticate breast cancer. Moreover, recent advancement in nanotechnology indicates that with the aid of nanoparticles, nanowires, nanorobots and nanotubes, the disease of breast cancer can be potentially eradicated totally. The chapter highlights the limitations of the current therapies used in breast cancer and discusses the concept of nanotechnology as a possible future therapy.

INTRODUCTION

Breast cancer is the most common type of cancer amongst women in the developed world, with approximately 1 in 12 having the disease sometime during their life, with the incidence in Australia being slightly higher at 1 in 11 women (Breast Screen Australia, 2000-2001). While most breast cancer patients fall within the age group of 35-

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54, it is not uncommon to find malignant breast lesion at a much earlier age. Moreover, men have also been diagnosed with breast cancer as breast tissue is identical for male and female. Because of the prolonged, complicated and intensive treatment procedure, early detection of breast cancer is crucial for effective treatment. Although, there have been many different methods for identifying breast cancer (mammography, MRI, and biopsy), all of them produce results which can be interpreted differently depending on the consultant physician's knowledge and experience. This underscores the need for a reliable and imperial automated method to assist the physician to identify breast cancer accurately. There exist a number of automated tools for the diagnosis of this disease. However, these tools are very complex and suffer from poor performance. This suggests there is a need for the development of new effective diagnostic tools. Now-a-days various computer aided diagnostic methods, including Artificial Neural Networks (ANNs), Fuzzy Logic (FL), Hidden Markov Model (HMM) and Support Vector Machines (SVMs) have been proposed to identify and distinguish between the benign and malignant breast lesion with a high degree of precision. Modern microarray technologies produce high dimensional read outs of molecular activities in patient specimens that can describe the characteristic features of the cancer types. A major challenge of these technologies is to identify the most influential gene set from a large number of genes that are responsible for the occurrence of the disease and can be used as predictors for the cancer. However, the advancement of nanotechnology aided with **nanowires**, **nanotubes,** and **nanorobots** for cancer treatment appears to be the most successful choice of option which has the potential to eradicate the cancerous cells and prove to be the future treatment therapy.

DIAGNOSIS AND MODELING TECHNIQUES

It is well recognized that in treatment and diagnostic of breast cancer, clinicians are often presented with identical clinical information. However, unfortunately clinicians can act in different ways depending on their knowledge and experience which highlighted the need to introduce diagnostic tools to support the scientific homogeneity and accountability of healthcare decisions and actions. The benefits expected from such actions include an overall reduction in cost, improved quality of care as well as patient and public opinion satisfaction. Recently, computer-based medical data processing research has yielded methods and tools for managing the task away from the hospital management level and closer to the desired disease and patient management level.

In search of an accurate tool for distinguish and diagnostic cancer lesions various techniques have been proposed. Recent research focuses primarily on the application of computer vision and for early lesion identification in mammograms and breast-imaging volumes through computer-aided diagnostics (CAD) tools with particular emphasis on computational diagnostics methodology for the analysis of molecular disease mechanisms in cancer. To this end, advanced applications of information and disease process modeling technologies have already demonstrated an ability to significantly augment clinical decision making. One of the main obstacles that need to be overcome is the development of systems that treat both information and knowledge as clinical objects with same modeling requirements. Here we briefly describe some of the existing computational models used for classification of the types of breast lesion in brief here.

Artificial Neural Networks: There are a number of studies where ANNs have been proposed to diagnose and prognosticate the two known types of breast cancers: Benign and Malignant. Among these, Fogel et al. (Fogel, Wasson Iii et al., 1995)