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Original article

Nomogram for predicting the probability of the positive outcome of prostate biopsies among Ghanaian men

F.A. Yeboah [b], E. Acheampong [b,*], C.K. Gyasi-Sarpong [a], K. Aboah [a], E.F. Laing [b], C. Obirikorang [b], B.T. Frimpong [a], G. Amoah [a], E.N. Batu [a], E.O. Anto [b,c], B. Amankwaah [b]

[a] *Department of Surgery (Urology Unit), School of Medical Science/Komfo Anokye Teaching Hospital, Kumasi, Ghana*
[b] *Department of Molecular Medicine, School of Medical Sciences, Kwame Nkrumah University of Science and Technology (KNUST), Kumasi, Ghana*
[c] *Royal Ann College of Health, Department of Medical Laboratory Technology, Atwima Manhyia, Kumasi, Ghana*

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KEYWORDS
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Abstract
Introduction and objectives: Several existing models have been developed to predict positive prostate biopsy among men undergoing evaluation for prostate cancer (PCa). However, most of these models have come from industrialized countries. We therefore, developed a prostate disease nomogram model to provide a basis for predicting a prostate biopsy outcome by correlating clinical indicators and diagnostic parameters among Ghanaian men.
Subjects and methods: The study was a hospital-based cross-sectional prospective one which was undertaken at the Department of Surgery (Urology Unit) Komfo Anokye Teaching Hospital (KATH) from December, 2014 to March, 2016. In all a total of 241 patients suspected of having a prostate disorder due based on an abnormal digital rectal examination (DRE) findings and, or elevated prostate specific antigen (PSA) level underwent Trans-Rectal Ultrasonography (TRUS) guided biopsy of the prostate. Stepwise logistic regression was used to determine the independent predictors of a positive initial biopsy. Age, prostate-specific antigen (PSA), digital rectal examination (DRE) status, prostate specific antigen density (PSAD),

Abbreviations: PCa, prostate cancer; PSA, prostate specific antigen; DRE, digital rectal examination; PSAD, prostate specific antigen density; BPH, benign prostatic hyperplasia; AUC, area under curve; KATH, Komfo Anokye Teaching Hospital; ROC, receiver operating characteristics; TRUS, trans rectal ultrasonography.

* Corresponding author at: Department of Molecular Medicine, School of Medical Sciences, KNUST, Ghana.
E-mail address: emmanuelachea1990@yahoo.com (E. Acheampong).
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history of alcohol consumption and history of smoking findings were included in the analysis. Two nomogram models were developed that were based on these independent predictors to estimate the probability of a positive initial prostate biopsy. Receiver-operating characteristic curves (ROC) were used to assess the accuracy of using the nomograms and PSA and PSAD levels for predicting positive a prostate biopsy outcome.

Results: Prostate cancer was diagnosed in 63 out of 241 patients (26.1%). Benign prostatic hyperplasia was diagnosed in 172 (71.4%) of patients and the remaining 6 patients (2.48%) had chronic inflammation. Significantly elevated levels of PSA and PSAD were observed among patients with PCa compared to patients without PCa ($p < 0.05$). Furthermore, it was observed that age, DRE, PSA, PSAD, history of smoking, and history of alcohol consumption were significantly independent predictors ($p < 0.05$) of prostate cancer. The area under the receiver operating characteristic curve (AUC) of nomogram I and II were 87.3 and 84.8 respectively which were greater than that of total PSA (AUC = 75.8) and PSAD (AUC = 77.8) alone for predicting a positive initial prostate biopsy

Conclusion: We conclude that, nomograms offer a better and accurate assessment for predicting a positive outcome of prostate biopsies than the use of traditional tools of PSA, DRE and PSAD alone.

Introduction

Prostate cancer has been the most commonly diagnosed cancer and the second leading cause of cancer-related death in men in the United States in 2011. It is the number one cancer in both incidence and mortality in Africa, constituting of 13% of all male cancer occurrence and 11.3% of all male cancer related mortalities [1]. In African countries where registers exist such as Nigeria, Uganda, South Africa and Zimbabwe, it has been observed that the incidence of prostate cancer is increasing between the ages of 40 to 70 years [1]. Rretrospective studies of all cancer cases have demonstrated that prostate cancer was the second leading cause of cancer-related mortality among male patients in Ghana [2–4].

Recently, controversy has arisen as to whether an early detection of prostate cancer through accurate determination of DRE, prostate specific antigen (PSA) screening and its derivatives is actually beneficial or not [5]. This diagnostic gap exposes men to intensive diagnostic screening and invasive management strategies that affect quality of life. Prostate biopsies give an absolute diagnosis though it is expensive and aggressive. Due to the pains and associated problems, the procedure should be circumvented in men with a low prostate cancer probability [6,7].

To improve the rates of prostate cancer detection and to reduce associated problems, predictive models for prostate cancer using laboratory, clinical and ultrasound parameters have been developed [8–10]. At present, numerous prevailing models had been developed to predict positive prostate biopsy outcome among men undertaking assessment for cancer of the prostate [11]. However, these models mostly come from industrialized countries. Moreover, prostate cancer is thought to differ epidemiologically and biologically between Western, American, African-American and Asian populations. Furthermore, nomograms developed for other populations cannot directly be applied to the Ghanaian population in Sub-Saharan Africa, where there is a higher incidence of prostate cancer compared to Asian and Western populations [12]. The existing evidence strongly suggests that, evaluation of prostate cancer risk should be tailored along racial lines [13–15]. Consequently, the development and use of a localized nomogram for given population is particularly pertinent. To our knowledge, no nomogram to evaluate the risk of prostate cancer in a Ghanaian population setting has been studied and published to date. It was against this background that this study was carried out to develop a prostate specific nomogram for predicting positive prostate biopsy among Ghanaian men.

Subjects and methods

Study design/setting

A hospital-based cross-sectional prospective study was used to assess the diagnostic accuracy of PSA, DRE and PSAD among men undergoing an initial Trans-rectal ultrasound guided (TRUS) prostate biopsy at Komfo Anokye Teaching Hospital (KATH) between December, 2014 and March, 2016. Komfo Anokye Teaching Hospital is a tertiary referral teaching hospital located in Kumasi, the regional capital of the Ashanti region in Ghana with a total projected population of 4,780,380 according to the Ghana Statistical Service, 2010. It is the second largest Hospital in Ghana.

Study population/subject selection

Non-probability convenience sampling technique was used to recruit 241 patients visiting the Urology Unit at the directorate of Surgery, KATH. Indications for TRUS biopsy were an elevated total PSA, defined as > 4.0 ng/ml or an a digital rectal examination, which reveals an abnormal or suspicion of cancer, defined as the presence of a nodule, areas of induration or asymmetry in the size lateral lobes. A structured questionnaire was used to elicit socio-demographics such as age, educational status, marital status and religion. Furthermore, various identified risk factors including smoking, family history of prostate cancer, number of sexual partners, alcohol, marriage duration, hypertension, diabetes, age at first