P024

Prostate cancer diagnosis composite probability index (pPCacomp): A novel multi-parametric mathematical model for predicting detection and ISUP grading of prostatic carcinoma on TRUS biopsy

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Introduction & Objectives: To improve prostate cancer (PCa) diagnosis risk stratification on biopsy, we devised a mathematical model combining multiple clinical and imaging disease associated variables. Aim of the study was to estimate the clinical ability of this model to predict the probability of diagnosing and grading the disease, among men with clinical suspicion of PCa.

Materials & Methods: A total of 40 men (63,4+/-6,9 years) presenting with abnormal DRE and/or serum PSA (6,71±3,46[1,23-16,8]) were subjected to prostate mp-MRI followed by TRUS-guided biopsy. Logistic regression model analysis was used to develop a predictive mathematical index that estimates the likelihood of finding cancer on prostate biopsy termed $pPCa_{COMP}$ (prostate cancer composite probability index) by combining DRE-findings, PCRD-index (measure of the probability of PCa diagnosis devised by incorporating age, prostate volume, total-PSA, free-PSA, f/tPSA-ratio, PSAD) and prostate mpMRI PIRADS-score. The clinical performance of this model in predicting PCa diagnosis and ISUP-grade were assessed compared to DRE, PCRD and PIRADS-score using linear correlations, logistic regression and AUC/ROC curve analyses (SPSS-22© & MedCalc/SciStat©-p<0,05).

Results: Prostate cancer was diagnosed in 27(67,5%) patients. On linear correlation analysis, $pPCa_{COMP}$(p=0,0001) and PIRADS-score(p=0,001) were strongly while, PCRD(p=0,196) and DRE(p=0,658) weakly associated with PCa diagnosis. Likewise, on ROC-curve analysis $pPCa_{COMP}$ was the strongest predictor of PCa (AUC:0,896-p<0,001) followed by PIRADS-score (0,808-p=0,03), PCRD (0,636-p=0,192) and DRE(0,540-p=0,699). ISUP-grade allocation:1(58,8%) -2(17,6%)-3(5,8%)- 4(17,6%). On linear correlations ISUP-grade-1 was significantly associated with DRE (Pearson-r: -0,399-p=0,039), PIRADS-score(-0,638-p<0,001) and $pPCa_{COMP}$(-0,516-p=0,06) while, ISUP-2/3 with PCRD(-0,743-p=0,035) and ISUP-4 with PCRD(0,562-p=0,02). On ROC-analysis $pPCa_{COMP}$ had the highest AUC (0,938) for predicting ISUP-1 while, PCRD and DRE strongly predicted ISUP-2/3 and ISUP-4 (AUCs: 0,933-0,700 and 0,972-0,813 respectively). On logistic regression $pPCa_{COMP}$ yielded the highest predictive accuracy (88%) for ISUP-1 (Sns:89,5%-Sps:87,5%) while, PCRD(+)DRE appeared to best predict ISUP-2/3 and ISUP-4 disease (87,5%-80%-100% and 96,3%-100%-95,5% respectively).

Conclusions: The novel $pPCa_{COMP}$ index, derived by combining eight prostate cancer associated variables (clinical and imaging), was found to accurately predict diagnosis of the disease on prostate biopsy, significantly outperforming established predictors of PCa. Furthermore, it best predicted low grade disease (ISUP-1) while, purely clinical (PCRD, DRE) parameters were more accurate predictors of intermediate (ISUP-2/3) and high (ISUP-4/5) risk prostatic carcinoma.