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Artificial Intelligence-driven analysis of local recurrence factors in nipple-sparing mastectomy for invasive tumor patients

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Objective: To apply a machine learning algorithm to identify risk factors for local recurrence after nipple-sparing mastectomy (NSM) with immediate reconstruction in a Brazilian breast cancer cohort. **Methods:** A machine learning algorithm was employed to classify features associated with local recurrence following NSM and immediate breast reconstruction for invasive tumors. Specifically, the XGBoost algorithm, a tree-based machine learning technique, was implemented, and the SHAP method was used to interpret the prediction outcomes of the model. **Results:** The dataset comprised clinicopathological characteristics, surgical details, and outcome data from 299 breast cancer patients who underwent NSM for invasive tumor treatment. The mean follow-up of patients was 42.3 months (2001–2020). The XGBoost algorithm achieved an average accuracy of 95% in classifying patients into those who experienced local recurrence and those who remained disease-free. SHAP analysis identified the risk factors that most contributed to the prediction of local recurrence in the algorithm, including large tumors, young age, negative progesterone receptor, not undergoing radiotherapy and chemotherapy, positive lymph nodes, and tumor high grade. Additional factors, such as pre-menopausal status, history of previous breast cancer, lobular and metaplastic tumor types, and adjuvant rather than neoadjuvant treatment, also influenced the model, though to a lesser extent. **Conclusion:** These preliminary findings enhance the understanding of the mechanisms underlying local recurrence after NSM in patients with invasive tumors, demonstrating the potential of the XGBoost algorithm to personalize breast cancer treatment.

Keywords: breast neoplasms; machine learning; subcutaneous mastectomy.