Pre-operative triage for uterine sarcoma diagnosis: sarcoma-score formulation using artificial intelligence (AI)

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Background

Uterine fibroids represent the most common pelvic neoplasm with an estimated lifetime risk of 70% in white women. Uterine sarcomas are much rarer diseases than fibroids, accounting for 3% of all uterine malignancies, with 0.5/1 new case per 100,000 women per year. The most common symptoms and clinical features of uterine sarcomas overlap with those of patients with uterine fibroids, making it difficult for the clinician to make a preoperative differential diagnosis; this represents one of the most current diagnostic challenges related to the management of uterine sarcoma. Uterine sarcomas are often diagnosed incidentally during or after hysterectomy or myomectomy surgery performed as an indication for treatment of a presumed fibroid. In such cases, conservative surgery or morcellation of the uterine mass, with subsequent peritoneal spread of tumor cells, may lead to worse prognosis and inadequate surgery is associated with a significant negative impact on disease-free survival and overall survival. However, it is not possible in clinical practice to consider all cases of uterine myomas as presumed sarcomas. Equally important priorities, moreover, are to avoid unnecessary surgery to exclude the rare neoplasm and also to offer the option of minimally invasive approaches in patients at low risk of sarcoma, particularly for women in reproductive age who wish to become pregnant. Currently, the sensitivity and specificity of various diagnostic and laboratory tests such as imaging and tumor markers are not satisfactory for differentiating a benign from a malignant mass.

Objectives

The aim of the study is to provide clinical gynecologists with a preoperative score that includes anamnestic, clinical, laboratory variables and ultrasound images that can be used to calculate the probability that a uterine mass is a malignant lesion, improving diagnostic accuracy and thus treatment.

Methodologies

Considering the rarity of uterine sarcoma a multicenter study will be conducted. The study will include a retrospective and prospective data collection of patients with known histological diagnosis of uterine sarcoma referred to the Gynaecology and Obstetrics Division of Brescia, of PGXXIII Hospital in Bergamo and of ASST of Garda, through an electronic archive. Prospective data collection will include all patients with a new diagnosis of uterine sarcoma treated during the next three years in which the project is performed. The representative cohort population of patients with benign lesions will be collected during the course of the project and will consist of patients treated surgically for histologically documented benign pathology at the same Gynaecologic Departments. Descriptive statistics will be used to characterize the population study. Different variables between myomas and sarcomas will be compared in a univariate analysis. Chi-square test will be used to assess the correlation between the dichotomous variables in the two groups, and student's t test will be used for continuous variables. The significance level will be established at $p < 0.05$. Multivariate analysis will be performed with the "Perceptron" artificial neural network model, a binary linear classifier consisting of two layers of neurons able to recognize two different, linearly separated input classes. In the model that will be used, benign VS malignant will be considered as the outcome (output) and the preoperative characteristics of the patients as covariates (input). Then the values of the synaptic weights of each variable will be translated into a scoring system for tumor classification. Next, a score validation phase will be performed on an independent cohort of sarcomas and myomas. A ROC curve will be used to define the cut-off value that optimizes the accuracy of the score, and the sensitivity and specificity of the score will be defined.

Expected Results and Impact

A diagnostic score called sarcoma-score will be developed. The triage score will be based on clinical, anamnestic, laboratory and ultrasound data and will be able to discriminate with moderate to high accuracy between malignant and benign uterine masses prior to surgical planning, providing the clinician with a useful instrument in decision making. The score should be immediate and easily applicable in clinical routine. This would allow gynaecologists to identify a group of patients at higher risk of malignancy to whom radical surgical treatment should be given early, avoiding morcellation; and a group of patients at lower risk of malignancy to whom minimally invasive surgical approaches or conservative therapy could be offered.