#1584 - Posters

If Your Lump Is Bigger Than A Golf Ball And Growing, Think Sarcoma

Orthopaedics / Musculoskeletal Tumors / Epidemiology, Prevention & Diagnosis

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Introduction
Primary care consultations regarding new soft tissue lumps (STL) are common, however only 1 in 100 of these are malignant. Hence, STL provide a diagnostic challenge for clinicians when identifying the infrequent but crucial diagnosis of Soft Tissue Sarcomas (STS). An average General Practitioner only encounters one STS per twenty years of practice, with inexperience manifesting in delayed referral or inappropriate treatment. Late diagnosis leads to increased size at presentation, incidence of metastasis at presentation and increased risk of surgical complications and poorer outcomes.

Objectives
To generate a Bayesian Belief Network (BBN) to estimate the likelihood of malignancy in patients when evaluating their STL and to demonstrate the conditional relationships between variables suggestive of malignancy. Following validation these variables will be recommended as red flag referral criteria.

Methods
Analysis of patients referred to the Royal Orthopaedic Hospital for assessment of a STL between 1996 and 2007, identified from a prospectively maintained database.
The features extracted for statistical analysis included: size of mass; location of lump; lump growing; painful; patients age; duration of symptoms (DOS); anatomic location; diagnosis. Patients were also subdivided into golf ball category (less than or greater than 43mm). In order to represent the relationships between features, and to estimate the likelihood of malignancy, we developed a BBN using commercially available machine learning software (FasterAnalyticsTM; DecisionQ, Washington, DC, USA). All features were considered as candidate features for inclusion in the model. Prior to modelling, missing data for the features was imputed using a passive imputation algorithm. We used an equal-area binning process for continuous features, based on prior distributions learned from the training set. Ten-fold cross validation was performed, and the Area Under the Receiver Operator Characteristic (ROC) curve (AUC) generated.

Results
In total, 3018 lumps were analysed in this study. 1563 (52%) were benign and 1455 (48%) were malignant. The mean age of patients with benign lumps was younger than those with malignant lumps (46 vs 56. years $p < 0.001$). Patients with malignancy also reported shorter duration of symptoms (70 vs. 126 days $p<0.001$) and larger lumps. Interestingly large size, combined with increasing in size appeared to be the strongest combination with a PPV of 78.5% (Sensitivity 89.4%, Specificity 63.6%, NPV 80.1%).
When dichotomizing size into larger than a golf ball (>43mm) or smaller (43m) the model revealed four first degree associates with outcome benign vs malignant, with an AUC of 0.75

on cross validation. Following lift analysis the outcome (risk of malignancy) of interest is most conditionally dependent on increasing size, increasing age, shorter DOS, and larger than a golf ball. Although we established a model utilizing size larger or smaller than a golf ball the inference tables, describing conditional probability (priors) for each permutation of first-degree associates suggests this feature is heavily dependent upon increasing in size and DOS and age to calculate malignant risk.

Conclusions

We have successfully devised a statistical model that identifies the clinical features that are first-degree associates in determining whether a soft tissue lump is benign or malignant. We have also, for the first time, described the hierarchal relationship between these factors and in doing so created an aide memoire, larger than a golf ball and growing, to trigger referral to tertiary tumor units. In hope this will lead to greater awareness and earlier diagnosis.