

Fractal Analysis of Uroflow Curves

Introduction and Objective: Uroflowmetry constitutes an essential tool for the initial evaluation of all patients with voiding disorders. Being the simplest urodynamic test, it is a widely available, inexpensive and non-invasive procedure which can offer clinically valuable information. Although the related literature is extended, systematic studies on the morphology of the uroflow curves are really limited. In the present study we evaluate the clinical value of uroflow curve complexity, as measured by its fractal dimension (FD).

Material and Methods: Four hundred forty-five uroflow charts from 290 patients (239 males, 51 females) and the relevant clinical data were reviewed. All the studies were performed under the supervision of the same urologist, by using an MMS Flowmaster uroflowmeter. The corresponding charts were prepared and extracted as bmp files with the use of the same time and flow scale settings. The fractal analysis of the curves was performed by using a specially developed application that implements a box-counting algorithm. The parameters included in the final analysis were FD, age, gender, maximum flow rate (Qmax), average flow rate, time to maximum flow, voided volume, voiding time, flow time, voiding pattern (continuous, intermittent) and residual urine volume.

Results: The Qmax was negatively correlated with the curve FD. Thus, uroflows with low Qmax tended to present curves of increased complexity. The correlation was statistically significant. Average flow rate was also negatively correlated with curve FD but the statistical significance of the finding was marginal.

Conclusions: Patient straining as well as irregular sphincter or detrusor contractions of high frequency can produce multiple and high variations in uroflow curve amplitude and may be responsible for our findings. Such an instability which is a known consequence of bladder outlet obstruction seems that can be imprinted in uroflow curve morphology as a quantitative character. Thus, curve FD seems to be an interesting quantity with clinical importance in the diagnosis of low flow rate and potential usefulness in the differentiation between true obstruction and poor bladder contractility.