Evaluation of biomarkers for diagnostic decision making in patients with gout using novel mathematical model. Complex PPPM approach

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From EPMA-World Congress 2013
Brussels, Belgium. 20-21 September 2013

Introduction
Gout is a common metabolic disorder, involving liver, kidney and joints, it is met more often in men. Recently we described specific ultrasound (US) signs of gout nephropathy [1]. We suggest novel mathematical model according to which the medical process is perceived as a complex system like “black box” [2,3]. This process (disease progression) is described by some of the primary indicators (US and laboratory biomarkers). So primary indicators and output rate are stochastic in nature and presented as statistical information. The “best” mathematical model of the medical process is studied using a special algorithm for processing statistical data [2].

The aim
was to assess the complex multiparameter evaluation of biomarkers for diagnostic decision making in patients with gout using novel mathematical model.

Materials and methods
We considered 42 patients (35 men, 7 women) to the first group, mean age was 58 ± 4.5, whom gout was diagnosed, according to disease history, or increased levels of uric acid in blood. The average level of uric acid in patients in group was 465 µmol/L. The control group included 34 patients (16 men, 18 women), mean age 54 ± 6 years without clinical, laboratory signs of nephropathy and liver pathology. All patients underwent ultrasound examination, gray scale, Doppler and sonoelastography parameters of liver and kidneys were recorded and evaluated statistically and assessed with own model [3]. Integrated index (Y) rated ranged 0/1 for disease description and staging was calculated.

Results
In all patients of the first group were US signs of fatty liver, in 38 patients (90%) ultrasonography signs of nephropathy were registered, significantly more frequent (P < 0.01) than in second group. The diffuse fatty liver (P < 0.01) and portal hypertension (P < 0.1) were prevailed in the first group. Transaminase increase was registered only in 7 patients (17%) of the first group. Nephropathy signs included thinning, increasing echogenicity of kidney parenchyma (P < 0.05), detection of fibrotic changes and small hyperechoic inclusions, hilly margins, anechoic strips under the capsule, RI increasing in segmental arteries over 0.7. The revealing of nephropathy (r > 0.85) was correlated with creatinine level increase and with liver fibrosis (r > 0.8). Additional attributes were joint lesions (P < 0.01). Integrated index Y was 0.73 in first group and 0.28 in second (P < 0.01).

Conclusions
Ultrasound can be an effective method for early detection of liver and kidneys involvement in gout patients for performing their personalized treatment. The sensitivity, specificity, positive and negative predictive value and accuracy the gout involvement of liver and kidneys using complex ultrasonography diagnostic criteria were 92.6%, 84.4%, 80%, 95%, and 91.9% respectively. Nephropathy appearance correlates with diffuse liver pathology.
involvement. Integrated index Y could be reliable for disease staging and control treatment follow up.

**Recommendations**
It is recommended to create the system for complex evaluation of biomarkers using suggested mathematical model, based of patient medical records for *prediction, personalized treatment and prevention* gout that may be applicable in still existing closed medical system, obtaining relevant extensive data.

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Published: 11 February 2014

**References**
1. Bubnov RV, Abdullaiev RYa: Ultrasonography capabilities for gouty nephropathy. *EUROSON 2012*, Annual meeting, Madrid 2012, 35, Abstracts Book.
2. Melnyk IM, Bubnov RV: Choice of diagnostic decision making in medicine and intervention mistake prediction using mathematical models. *Int J Inf Models Anal* 2012, 1(1):78-83.
3. Melnik IM: Genetic Algorithm for Solving the Problem of an Optimum Regression Model Construction as a Discrete Optimization Problem. *J Autom Inf Sci* 2008, 40(6):60-71.

doi:10.1186/1878-5085-5-S1-A58

Cite this article as: Bubnov and Melnyk: Evaluation of biomarkers for diagnostic decision making in patients with gout using novel mathematical model. Complex PPPM approach. *EPMA Journal* 2014, 5 (Suppl 1):A58.