

The Metrizer: an innovative device for achieving virtual hepatic biopsies

C. Russo, B. Franceschini, S. Di Biccari,
S. Musardo, G. Bosticco and N.
Dioguardi



Background

- Current use of Slide Scanners
 - Digital Archive
 - Comfortable visualization of slides
 - Slide consulting on local network or over the Internet
 - Source digital image for image analysis software



Background

- Advantages of digital archive
 - Images disposable on request via Local Network/ Internet
 - It is possible to apply image analysis SW to quantify exactly the percentage of area, number of cells in tissue, etc...

Background

- Disadvantages of the digital archive
 - Even in high resolution and high color definition, digital archive will not contain same information of the slide itself
 - Huge HDD space requirements
 - Slide are always required for the storage
 - Image analysis is not standardized



The potential to improve precision and objectivity of measurements can be achieved with additional technical equipment

Background

- The Metrizer
 - The aim is to present a machine invented with a calculation potential to facilitate the work of the observer in a medical practice, not only in terms of easy retrieval of images but also as an instrument for the automatic analysis of digital histology

Material and Methods

- The “Metrizer” aims at supplying precise and objective descriptions and measurements of the specimen under observation
- Can be used as a classical Slide Scanner but furthermore the Metrizer gives:
 - 1) custom image analysis algorithms,
 - 2) objective data obtained from elements present in the tissue, and
 - 3) what can be called an Automatic Diagnosis

Material and Methods

- The analysis is done by the Metrizer while the machine is acquiring the image:
 - No need to save and postprocess image (no subjectivity added to the analysis)
 - No need to store Gigabytes of data
 - Easy retrieving of data on final report or over the internet

Material and Methods

- Automatic Diagnosis
 - preset for each pathology
 - is generated by an expert system shaped on a series of data that has been preloaded once diagnosis is known
 - The automatic diagnosis permits to completely abolish operator subjectivity, from image capture to the print-out of final report (no need of additional SW)

Material and Methods

- Testing and validation in the case of Hepatitis C Virus analysis
 - Metrizer data was compared to measurements obtained from a series of 120 patients previously achieved by the automatic reading software of the preliminary model of automatic analysis (Dioguardi N et al, *World J Gastroenterol* 2006, **12**:2187-2194)
 - Metrizer carries out all the steps of the previous work in a few minutes per patient, without involving the operator.

Results

- Comparison was made on the basis of
 - percentage area values and tectonic index of the fibrosis
 - the inflammatory basin located in the biopsies of the 120 cases available
 - The catalogues of located objects in the two different systems were also compared.

Results

- The values are very sensitive to intense light and magnifying lens, however by correctly calibrating the machine it is possible to achieve reproducible data with very low margin of instrumental error

Results

- It is important to say that:
 - The application of quantitative methods in a medical setting faces numerous difficulties because these disciplines involve natural, complex and irregular objects and phenomena, many with characteristics that lead them to be classified as fractal objects
 - Their evaluation describable with traditional linear mathematics and Euclidean geometry, can at times give results that are so distant from reality as to seem caricatures rather than metric descriptions of the object under examination

Results

- In order to obtain measurements as close as possible to reality, Laboratory of Quantitative Medicine uses fractal geometry to correct the metric measurements of irregular objects.
- This method is included natively and automatically in the Metrizer analysis steps.

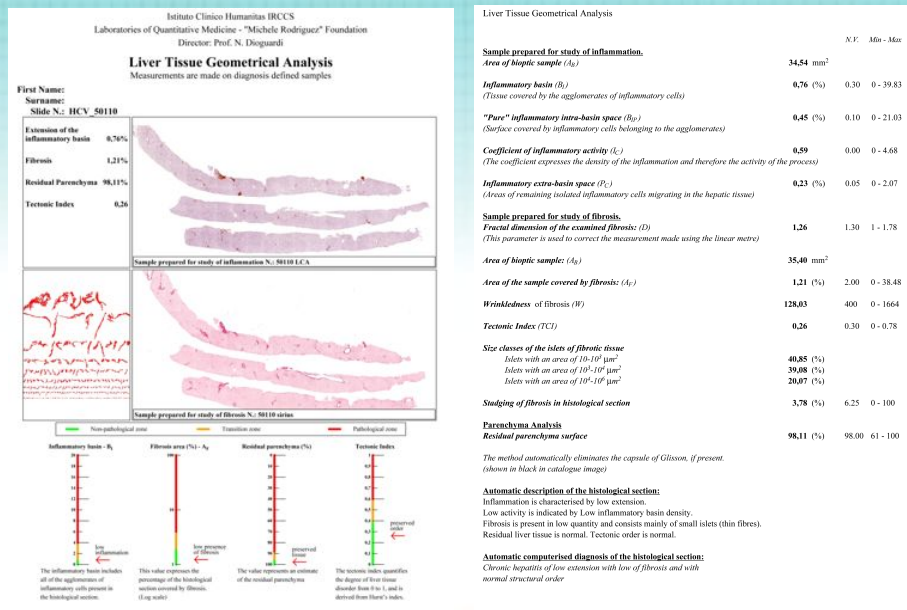
Results

- Correlation coefficient between the two sets of data are $R=0,94$ in fibrosis quantification and $R=0,96$ in the case of inflammatory basin

	A% Fibrosis		A% Inflammation	
Series	Model	Metrizer	Model	Metrizer
Min	0,22%	0,35%	0,02%	0,04%
Max	8,32%	14,44%	11,77%	11,48%
Mean	2,23%	2,99%	1,87%	1,88%
St. Dev.	1,69%	2,33%	2,13%	2,14%
Relative Median Error (Log):	9,14%		7,23%	
Correlation	R=0.94		R=0.96	

Results

- Example of output of the Metrizer in the case of HCV analysis



Conclusions

- The Metrizer, applied on the current study, changes the method of examining liver biopsies since it aims at resolving fundamental problems to measure microscopic structures
- For the first time it enables evaluation with a scalar number, in an absolutely objective and repeatable manner, of the size of the structures that determine the state of the diseased liver

Conclusions

- The automation standardizes measurement and eliminates operator fatigue
- Furthermore, the Metrizer transforms clinical thought (reasoning) into technological terms and gives both a description and a computer diagnosis, which it obtains using new geometries such as fractals for measuring irregular shapes of scars (collagen islets), inflammation, fragments of the biliary and the neoangiogenic microvascular network, etc...

Conclusions

- The Metrizer was created to meet the needs of maturity gained in hepatology.
- To have measurements which can be repeated everywhere using the same method, means the beginning of a world with less hypotheses and real information

Thank you

Laboratories of Quantitative Medicine
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<http://www.metrizer.com>

<http://www.fractal-lab.org>

