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BALASCOPY AS A TOOL FOR HEURISTIC DIAGNOSIS

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Balascopy is a concept, methodology and applied methods for detection, quantification and visual assessment of single or multiple relationships between parameters of the same or different nature presented as an effective tool for Heuristic Diagnosis. Five types of metabolic imbalances are described. Several methods were developed for detecting and evaluating clinically useful information which is not available from any other existing modalities. This information can be used for diagnosis, monitoring, control of effectiveness of treatment and completeness of recovery from various diseases.

Introduction

BALASCOPY [Balance + Scope] is a general term for the concept and applied methods for detection, quantification and visual assessment of single or multiple relationships between parameters of the same or different nature. Balascopy (Ba.) can provide a new type of clinically useful information for diagnosis, optimal treatment decisions and patient monitoring which is not available from any other existing modalities. It can serve as an effective tool(s) for Heuristic Diagnosis.

HEURISTIC DIAGNOSIS is an immediate correct diagnosis justified by a set of rules, methods, conceptual models, devices, or expert knowledge.

For convenience, this paper will deal only with 12 metabolic screening parameters. However, Balascopy can also be applied to any kind of systems with measureable parameters of any nature, not necessarily confined to the field of medicine.

Five Types of Metabolic Imbalance

Current medical practice utilizes for diagnostic and follow-up purposes some abnormalities in relationship between different metabolic parameters as, Calcium-Phosphorus, Calcium-Albumin, etc. These abnormalities in relationships are usually described in non-quantitative terms: "...out of proportion ...", "…imbalance between…", "…disproportionally high to..." etc., and some of them are expressed in quantitative terms as ratios. But, metabolic parameters are measured quantitatively and expressed numerically each in its own system. Moreover, quantitative level of each parameter is controlled by different regulatory mechanism(s), contains different variability, different adaptive and pathological properties, etc. When a shift occurs in several parameters simultaneously, this multiple shift itself is impossible to measure because numerical values and biological meaning of the shift in each parameter cannot be compared.

These difficulties in comparison can be completely eliminated by translating numerical value of each individual parameter in the same natural quantitative scale into Balascopic Units (B.U.), scored from 0 to 100 (1-3). This translation allows a direct, uniform and quantitative comparison of the relationship between them simply by calculating their quantitative differences in their positions on a Balascopic Scale and expressed as Balascopic Distance (B.D.) in Balascopic Units.

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In a pre-clinical or in an overt disease state, normal relationship (or balance) between parameters can be changed in different ways: B.D. between them may decrease or may increase. Decreased B.D. constitutes Integration Types of Imbalance and increased B.D. - Disintegration Types of Imbalance. Relationship between parameters can be changed not only quantitatively but also qualitatively by changing their character. For example, if in normal state parameter one is greater than parameter two, then when parameter one becomes equal or less than parameter two, we have an inverted relationship between them. Quantitative and qualitative changes in balance by B.D. and by character can occur independently or can coexist. Therefore, we can detect six distinctive types of relationships: one normal and five abnormal.

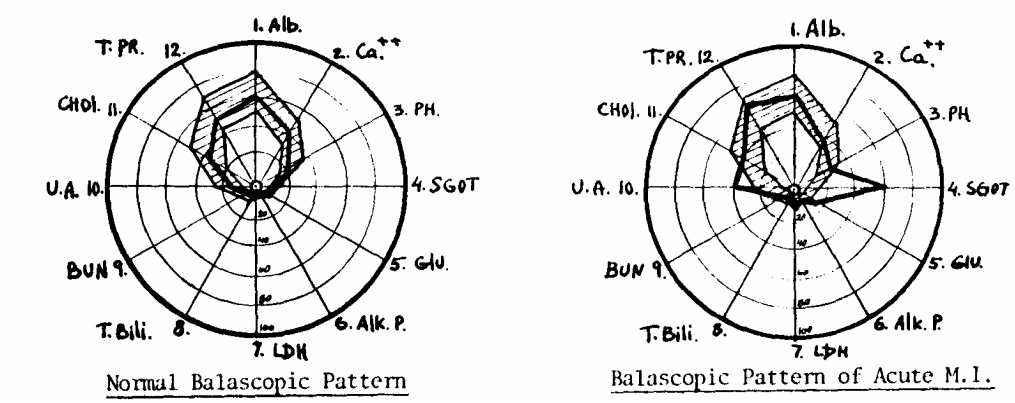
Therefore, all six types of relationships can be presented in the following manner: Normal (N.), Normal but Inverted (Ni), Integrated (I.), Disintegrated (D.), Integrated and Inverted (Ii.), Disintegrated and Inverted (Di).

Abnormal relationships between parameters can also be evaluated by SEVERITY of imbalance and scored in percentages. This graded severity applies to I.-type, Ii- D.-type and Di-type of imbalance.

Multi-Dimensional Visual Profile of Metabolic Imbalance **(MDVP)**

The following laboratory data have been obtained from an actual patient with Acute Myocardial Infarction (M.I.): ALB. 4.2 MG/DL; CA. 8.8 MG/DL; PHOS. 3.6 MG/DL; SGOT 330 U/L; GLUC. 183 MG/DL; ALK.PHOS. 84 U/L; LDH 665 U/L; T.BILI 0.6 MG/DL; BUN 15 MG/DL; UR.AC. 84 MG/DL; CHOL. 218 MG/DL; T.PROT. 7.1 MG/DL. These data were converted into B.U. respectively: 64; 35; 26; 66; 14; 6; 13; 4; 9; 39; 37; 57 and presented simultaneously in graphic display form as MDVP (Fig. 1) MDVP is constructed as a polar diagram with twelve radii. Each radius corresponds to each of the parameters from the chemical profile and calibrated on a scale of 0 to 100 B.U. The sequence of the chemical parameters on the polar diagram follows a definite order which allows more effective visual comparison. The shaded area covers normal reference range of each parameter and represents the normal range for a healthy population chosen by conventional statistical methods. The solid line inside the shaded area represents the statistical mean value of each parameter.

Fig.1 MDVPs for Normal Population and for Actual Patient with Acute M.I.



From MDVP, we can immediately see the internal architecture and individual uniqueness of metabolic response to disease. Also, we can instantly and clearly grasp disproportions in relationship between many parameters and recognize disease-specific and individual-specific disfiguration of normal Balascopic Pattern. MDVP also can be visually analysed by form of distortion, size, shape, contour, relation between the parameters and by many other criteria.

ALB.-PHOS.	N.	PHOS.-ALK.PHOS.	N.	ALK.PHOS.-LDH	5% Di
ALB.-SGOT	96% Ni	PHOS.-LDH	7%I.	ALK.PHOS.-T.BILI	N.
ALB.-GLUC.	6% I.	PHOS.-T.BILI	N.	ALK.PHOS.-BUN	N.
ALB.-ALK.PHOS.	N.	PHOS.-BUN	N.	ALK.PHOS.-UR.AC.	4% D.
ALB.-LDH	9% I.	PHOS.-UR.AC.	Ni	ALK.PHOS.-CHOL.	N.
ALB.-T.BILI	N.	PHOS.-CHOL.	N.	ALK.PHOS.-T.PROT.	N.
ALB.-BUN	N.	PHOS.-T.PROT.	N.	LDH-T.BILI	4% D.
ALB.-UR.AC.	22% I.	SGOT-GLUC.	49%Di	LDH-BUN	Ni
ALB.-CHOL.	N.	SGOT-ALK.PHOS.	58%D.	LDH-UR.AC.	N.
ALB.-T.PROT.	N.	SGOT-LDH	51%D.	LDH-CHOL.	N.
CA.-PHOS.	N.	SGOT-T.BILI	59%D.	LDH-T.PROT.	4% Ii
CA.-SGOT	Ni	SGOT-BUN	53%Di	T.BILI-BUN	N.
CA.-GLUC.	22% I.	SGOT-UR.AC.	Ni	T.BILI-UR.AC.	4% D.
CA.-ALK.PHOS.	3% I.	SGOT-CHOL.	Ni	T.BILI-CHOL.	N.
CA.-LDH	27% I.	SGOT-T.PROT.	80%Ii	T.BILI-T.PROT.	N.
CA.-T.BILI	N.	GLUC.-ALK.PHOS.	3%D.	BUN-UR.AC.	4% D.
CA.-BUN	N.	GLUC.-LDH	N.	BUN-CHOL.	N.
CA.-UR.AC.	20% Ii	GLUC.-T.BILI	2%D.	BUN-T.PROT.	N.
CA.-CHOL.	Ni	GLUC.-BUN	Ni	UR.AC.-CHOL.	Ni
CA.-T.PROT.	N.	GLUC.-UR.AC.	N.	UR.AC.-T.PROT.	22% I.
PHOS.-SGOT	12% Di	GLUC.-CHOL.	N.	CHOL.-T.PROT.	N.

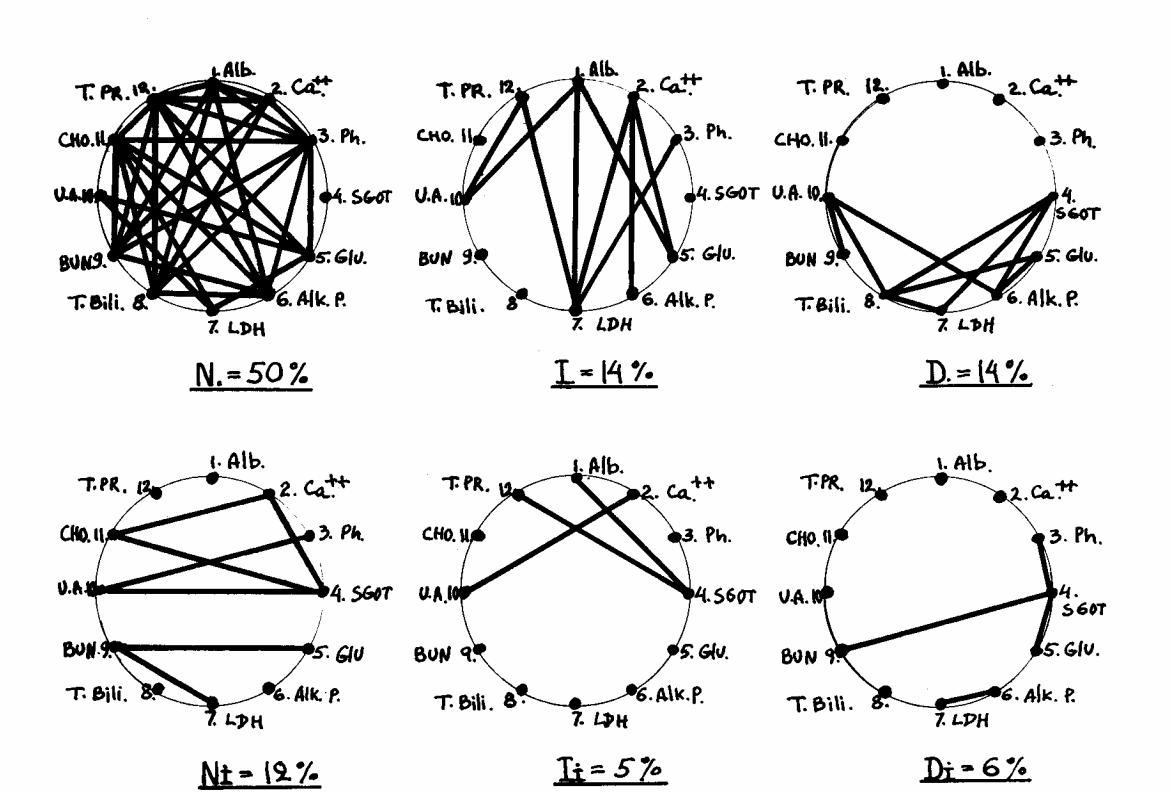
Because it is difficult to draw immediate conclusions from the table form of data, this material is presented in the form of analytical graphs of metabolic imbalance (Fig.2).

Analytical Graphs of Metabolic Imbalance

Data from numerical evaluation of metabolic imbalance (Table 1) is presented in a format of six circular graphs as shown on Fig. 2. Each of the circular graphs represents subsets of different types of metabolic relationships: one network of normal relationship and five networks of different types of metabolic imbalance.

Each part of Fig.2 has 12 dots, numbered 1 to 12, spaced evenly in a circular configuration, each dot representing one of the 12 blood chemistry parameters. In each part of Fig.2 every pair of parameters which have the metabolic relationship specified by the heading of the part is indicated by a line interconnecting the pair of dots representing the parameters which have such a metabolic relationship. In the upper-left graph, the dots for every pair relationship which have a normal relationship, i.e., the relative values of the parameters are in the normal relationship range, are interconnected by a line. In the patient under consideration, the following parameters are in the normal range and hence the following pairs of
dots are joined: 1-2, 1-3, 1-6, 1-8, 1-9, 1-11, 1-12, 2-3, 2-8, 2-9, 2-12, 3-5,3-6, 3-8, 3-9, 3-11, 3-12, 5-7, 5-10, 5-11, 5-12, 6-8, 6-9, 6-11, 6-12, 7-10, 7-11, 8-9, 8-11, 8-12, 9-11, 9-12 and 11-12. (Total pairs = 33). Since half of all existing pairs of parameters are joined in this graph, this is indicated by Legend below (N.=50%), meaning that 50% of metabolic relationships for this patient are normal. Obviously, the more lines that are present in a normal graph, the better the patient blood chemistry condition. The remaining five sections represent abnormal relationships and their percentages are indicated in a similar manner.

Fig. 2. Analytical Graphs for Portraying Metabolic Imbalances (Patient with Acute M.I.)



This format (Fig. 2) allows to realize additional information about structures of metabolic relationships, enables to visualize full networks of metabolic abnormalities and presents significantly more assimilable information than numerical data alone. It greatly facilitates follow-up evaluation of a patient's condition and individual response to treatment.

Conclusion

The above described approach and methodology is not limited to the problems of medical diagnosis, monitoring and follow-up of patient condition, but rather presents a way of readily identifying new and clinically useful information of human pathology. This general approach and practical methods can also be effectively used in any multi-parametric system for a very broad scope of theoretical and pragmatic purposes.

References

1. Kvitash, V. Balascopy: Fundamental concept and applied methods. 1982. 50 pages. Manuscript.

2. Kvitash, V. Balascopy: Method for detecting and rapidly evaluating multiple imbalances within multi-parametric systems. Disclosure Document NO. 110310. U.S.A. Patent Pending.

3. Kvitash, V. Dictionary of Heuristic Diagnosis. In preparation.

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