Health quality evaluation on the basis of GDV parameters

P. Bundzen, K. Korotkov

Contemporary medicine focuses mainly on treatments based upon both clinical acumen and biomedical diagnostics. An important clinical problem is the assessment, control and maintenance of the functional capacity of a relatively healthy person, a child's state during the dynamic growth phase and the sick during remission. Therefore, the search for an easy, cost effective method and associated criteria for objective evaluation of health status for both relatively healthy people (RHP) and sick patients appears intuitively obvious and necessary.

Several questionnaires which address particular aspects of the human clinical state are available. Health quality can be well estimated by measuring a number of physiological parameters. However, these questionnaires have several restrictions: a) they are unsuitable for small children; b) they strongly depend upon cultural and other factors of the people questioned. Therefore, the development of a user-friendly, inexpensive method for objective instrumental evaluation and control of one's health level is highly desirable. One solution is the technique of GDV diagrams.

Experiments on large RHP groups from various countries results in a distribution of a J*S* parameter calculated in the *GDV Diagram* program which follows a quasi-Gauss law. This parameter is graphically represented as a logarithm of the area of GDV-grams of fingers, normalized according to the area of the inner oval and GDV-grams of fingers for an average healthy person. J*S* does not depend upon the sector divisions of GDV-grams. It is defined only by the total area and represents the deviation of the measured GDV-gram value from the 'ideal' state.

Fig. 5.11 demonstrates the distribution of J*S* values for the left hand in a RHP group of 146 people. Baseline GDV-grams were taken within a USA and Russia. Inspection of the cure finds it asymmetric relative to zero, due to the specific properties of the logarithmic function. Therefore positive and negative values should be considered separately. By statistical analysis, the sections of data (Fig 5.11) are taken using the aggregate with a normal distribution. The average value (0.072) is close to the median (0.078). The median is located approximately between the 25th and 75th percentile (-0.078 and 0.217 respectively). Moreover, 96%f of the values are concentrated within two standard deviations from the average. Limits of this area can

be taken as norm for the given group. Corresponding negative and positive values will be –0.52 and +0.65.

The derived data of Fig. 5.11 yields a frequency histogram; that is, the distribution of a number of people meeting a definite J*S* range can be constructed. Expanding the database using examination results from 41 RHP in Sweden and 20 RHP in the USA collected during the years 1999 and 2000 with the existing data from Fig. 5.11 results in a composite histogram represented as Fig. 5.12. A total of 135 relatively healthy people were tested. This graph proves that statistical tendency is preserved: 99% of the tested RHP meet the range [- 0.6 / +1.0]. Taking into account that these 207 people were selected without knowledge of their health state and represent a stochastic (изменяется хаотически) selection of RHP involving people with compensated chronic or latent diseases, we can take the range JS to be -0.6 to +1.0 for the value of a relatively statistical norm of health. The deviations calculated for a given range provide evidence for the variations of physical and/or psychophysical states relative to the statistical norm. This range may be taken as a 'good health' range and appears similar in various countries providing a means to cross check the data.

Naturally, a value's dispersion about the mean should help define the limits of the ranges. This parameter is calculated by the GDV Diagram software and the arrangement of patients according to health groups is defined by the GDV Stress software.

All discussed above data were measured for RHP between 35 and 60 years old. From our experimental data it is follows that range of “Good health” should depends on age. We define it in our programs as follows:

younger then 20 years old [-0.6 / + 1.3],
20 – 60 years old [-0.6 / + 1.0],
elder then 60 years old [-0.6 / + 0.6].

Of course, these ranges should be taken as a first indication only. An added benefit is seen in applying the filter, which differentiates physical from psychophysiologic components of the GDV-gram, resulting in separate estimations of clinical value.

To validate this differential state, Fig.5.13 demonstrate comparison of histograms of 280 RHP and 280 patients with gastro-duodenal non-pathologic diseases tested in St. Petersburg during 2000-2002. The histograms demonstrate that for patients the measured values concentrate mostly in the negative area, with the median shifting to the values -0.14.

At the same time it is clear that it is impossible evaluating health state basing on the GDV Diagram data only. As we see from Fig.5.13, a lot of patients' data correspond to the 'good health' range. We should take into consideration data of all other GDV programs.

Table 5.7 demonstrates analysis of data for a group of 56 people measured in St. Petersburg Medical Academy in 2002. AVI files from 5L finger were measured for 10 seconds that allowed getting the sequence of about 290 measured points for every person. All data were averaged between measurements and between the groups. Group 1 was relatively healthy yang males 20-22 (19-27) years old. In Group 2 and Group 3 were patients of both genders 22-55 (32-50) years old with different stages of hypertension and Ishemia. As we see from the results of t-test there was statistically significant difference between the most of measured GDV parameters for healthy and un-healthy groups and no significant difference between different groups of patients.

From the other hand, as it was demonstrated in a lot of clinical studies, GDV parameters are very sensitive to the changes of organism state after different influences and treatment. As one more example we can present data of people's response to abdominal surgery, received in St. Petersburg Medical Academy in 2001-2002. Patients were measured with GDV before the surgery, one hour after the operation and 4-5 days afterwards. 43 from 56 patients demonstrated similar type of response: increase of JS parameter after the operation and subsequent slow decrease to the initial value (fig. 5.14). The amplitude of increase and the time of decrease depended on the severity of surgery.

This example confirms abovementioned statement:

to make evaluation of health state we should use a complex set of GDV parameters.

And, of course, we should remember, that to obtain data for adequate comparison the calibration of GDV software parameters is essential. For standardization, the following protocol should be followed:

1. Having cleaned the lens of GDV Camera with alcohol, take 10 GDV-grams of test-object.

2. Select such "Level Background" value in the GDV Processor software that no noise is present on the processed images.

3. Set this value for all GDV software.

4. Pres "Calibration" button in GDV Diagram program and load the GDV-grams of test-object taken. When all the necessary calculations are finished, make certain that the coefficient of variation does not exceed 5-6%. Press the "Quit & Save" button. In case of wide variations repeat

all the operations, having cleaned the glass with alcohol. If the variations exceed 10% contact the manufacturer.

Before starting routine clinical testing every particular GDV Camera and computer *must* be calibrated. Afterwards, routine recalibration should be performed at least twice in 6 months and after any adjustment or change in GDV settings.

It will become a natural extension to obtain a worldwide collection of measurements across geographical, racial and national variables, and derive absolute limits of ranges through an analysis of statistical data of RHP for various countries. As information from GDV-grams is shared, a more universal set of values and ranges can be incorporated into updated programs.

Table 5.7. GDV parameters averaged for a group of 56 people (Group 1 – relatively healthy people, Group 2 and Group 3 – patients with different stages of hypertension) (Data by L.Buyantseva, St. Petersburg, 2002).

GDV Processor	**Group1**	**Group 2**	**Group 3**	**t-test 1-2**	**t-test 2-3**
Median Area	0.45	0.30	0.18	0.06	0.87
Gaps	0.43	0.46	0.45	0.01	0.35
Density	0.49	0.53	0.52	0.00	0.57
Colors distribution	1.51	1.64	1.61	0.00	0.56
Excess	0.93	1.08	1.22	0.01	0.58
Fractality	0.13	0.22	0.13	0.11	0.06
Fragments	0.65	0.88	0.87	0.12	0.92
Brightness	14.71	19.79	16.86	0.13	0.37
Entropy G	2.00	2.07	2.10	0.16	0.52
Form coefficient	1.41	1.68	1.60	0.19	0.69
Abs Area	256.52	225.61	290.62	0.45	0.18
Spectral width	16.62	13.58	10.48	0.41	0.19
GDV Diagram					
JS L	0.047	-0.476	-0.369	0.05	0.50
JS R	0.049	-0.350	-0.112	0.02	0.10
JS LF	0.641	0.179	0.443	0.00	0.32

Conclusions

Building upon the fundamental precepts on GDV-processing for relatively healthy people (RHP) and in view of additional clinical studies to date, the following conclusions and inferences can be noted:

- As an objective index of health quality parameter J*S* is proposed, calculated in GDV diagram program based upon estimating parameters of all 10 fingers. This index is calculated separately for the right and left hand and does not depend on the selection of method of finger sector division.
- The following JS ranges of "Good health" are defined depending on age of a person:

  younger then 20 years old [-0.6 / + 1.3],
  20 – 60 years old [-0.6 / + 1.0],
  elder then 60 years old [-0.6 / + 0.6].

- This index is a measure of average level of homeostasis of the organism of a relatively healthy person (RHP) in the state of calm awakeness.
- In evaluating states of activity beyond calm, both physical and mental, the index deviates from equilibrium values and is a measure of the organism's reaction to energy imputs. For example, in altered states of consciousness the index value becomes distinctly negative.
- Identification of an index in the zone of 'relative health' does not indicate the absence of chronic diseases. The presence of the latter should be revealed using other complementary methods employing alternative ways of processing GDV-grams. Location of a J*S* parameter in the 'good health' range might be better interpreted as a compensated state for the organism.
- The ratio between J*S* index of the right and left hand is a measure of lateralization of functional states and to a first approximation can be interpreted as a generalized index of physical (J*S*R) and mental (J*S*L) state.
- Improvements and refinements to this clinical application for GDV-processing through continued integration of additional clinical patient populations is needed; subsequent analysis of questionnaires and tests to improve upon the accuracy of the ranges for 'normal' through statistical methods and study is forthcoming.