

Factor Analysis: Its Place in the Evaluation of Ventricular Regional Wall Motion Abnormalities

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There are well known limitations in detecting abnormalities of superimposed anatomical structures during equilibrium gated cardiac studies. For example if only one left anterior oblique view is available abnormalities of the infero-posterior wall can be missed. The advent of phase analysis with the resulting phase image has brought some help but is still limited by the relative proportion of abnormal versus normal motion in superimposed segments and by the amount of anatomical superposition. The amplitude image while helpful also, is difficult to evaluate quantitatively or even semiquantitatively. For these reasons we have evaluated factor analysis, which in theory has less limitations and attempted to document its practical usefulness, in conjunction with the amplitude image.

Method: Patient population: 13 normals and 19 patients all with RWMA documented by contrast angio graphy and 8/19 had in addition TI-201, surgery or autopsy. Computer acquisition and processing: 64 frame acquisition of SOPHA Simis 4 computer. The algorithm developed by Basin and DiPaola is based on Barber's calculation of oblique factors and submitted to a positivity constraint which gives them physiologic significance. Only the region of interest corresponding to the two ventricles was evaluated. A valid result (2, 3, or 4 factors) was considered when no significant negative image was present, nor any zero amplitude type image (corresponding in effect to a blood pool image).

Results: In the 13 normal cases, 2 factors were found in 8/13 and 3 factors in 5/13. In all 13 cases the image corresponding to the ventricular factor (also referred to as the "first" factor) was identical in appearance to the amplitude image and had corresponding time activity curve of typical ventricular shape. The second factor image corresponded to a flat curve and the image usually delineated a LV base "peninsula" or "crescent" and identified very clearly the area of the pulmonary outflow tract. In the 5 cases where 3 factors were identified no further split of the ventricular (first) factor image was found, and no interpretable pattern emerged from the split of the second factor image and/or its corresponding time activity curve.

In the abnormal population all but one case resulted in the identification of 3 factors. When considering the 2 factor display alone, the ventricular factor image was similar to the amplitude image in 9/19 cases: those were cases without dyskinesia. In the remaining 10 patients the ventricular factor appeared different when compared to the amplitude image: in general the more pronounced the difference, the more accentuated dyskinesia was found. Out of the 18 patients in which 3 factors were found the resulting three images and corresponding curves generated additional useful in-

formation concerning the number and site of abnormal areas and/or the type of abnormality (hypokinesia, akinesia and dyskinesia). In all cases, the combined information given by the two and three factor displays correlated well with most of the regional wall motion abnormalities. In 13/19 correlation was better than phase analysis as far as number of locations within a given ventricle; in 17/19 correlation was better as far as type of abnormality suggested. In no case was factor analysis worse, than phase analysis. This improvement was particularly striking for septal abnormalities and for small dyskinetic areas. Factor analysis also suggested abnormality in 2 patients where extensive hypokinesia was not detected at all by phase analysis.

In conclusion, factor analysis used in conjunction with phase and amplitude images improved significantly the detection of regional wall motion abnormalities. This was particularly true for cases with multiple abnormal ventricular areas or with small dyskinetic areas or with septal involvement. Such improvement confirms the theoretical possibility of a significant amount of three dimensional information offered by factor analysis, when compared to phase analysis.