

# Patterns for heart intraventricular conduction in children with chronic kidney disease

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## INTRODUCTION

Patients with end-stage renal disease (ESRD) often experience heart impairments, induced by fluid overload, arterial hypertension, anemia, uremic toxins, and calcium-phosphate balance disorders. The pathophysiology of cardiac dysfunctions in ESRD children is mainly associated with degeneration and calcification of myocardial cells, as well as with changes in vascular bed. These conditions are consequences not only of increasing uremic toxemia but also of fluid overload, malnutrition, insulin resistance, as well as of erythropoietin administration. Many authors suggest that cardiovascular abnormalities in patients with ESRD are extremely detrimental and lead to a considerable percentage of fatal outcomes. The most common clinical presentation of cardiac impairments in the course of ESRD is probably the left ventricle hypertrophy. The recent reports, concerning dialyzed children, have revealed that systolic function of the left ventricle keeps intact only if there is no concomitant arterial hypertension, anemia or heart failure. Non-invasive, multielectrode system for Body Surface Potential Mapping (BSPM) provides a precise analysis of the heart conduction system functioning owing to a variety of the electrocardiographic signals collected from the thorax surface.

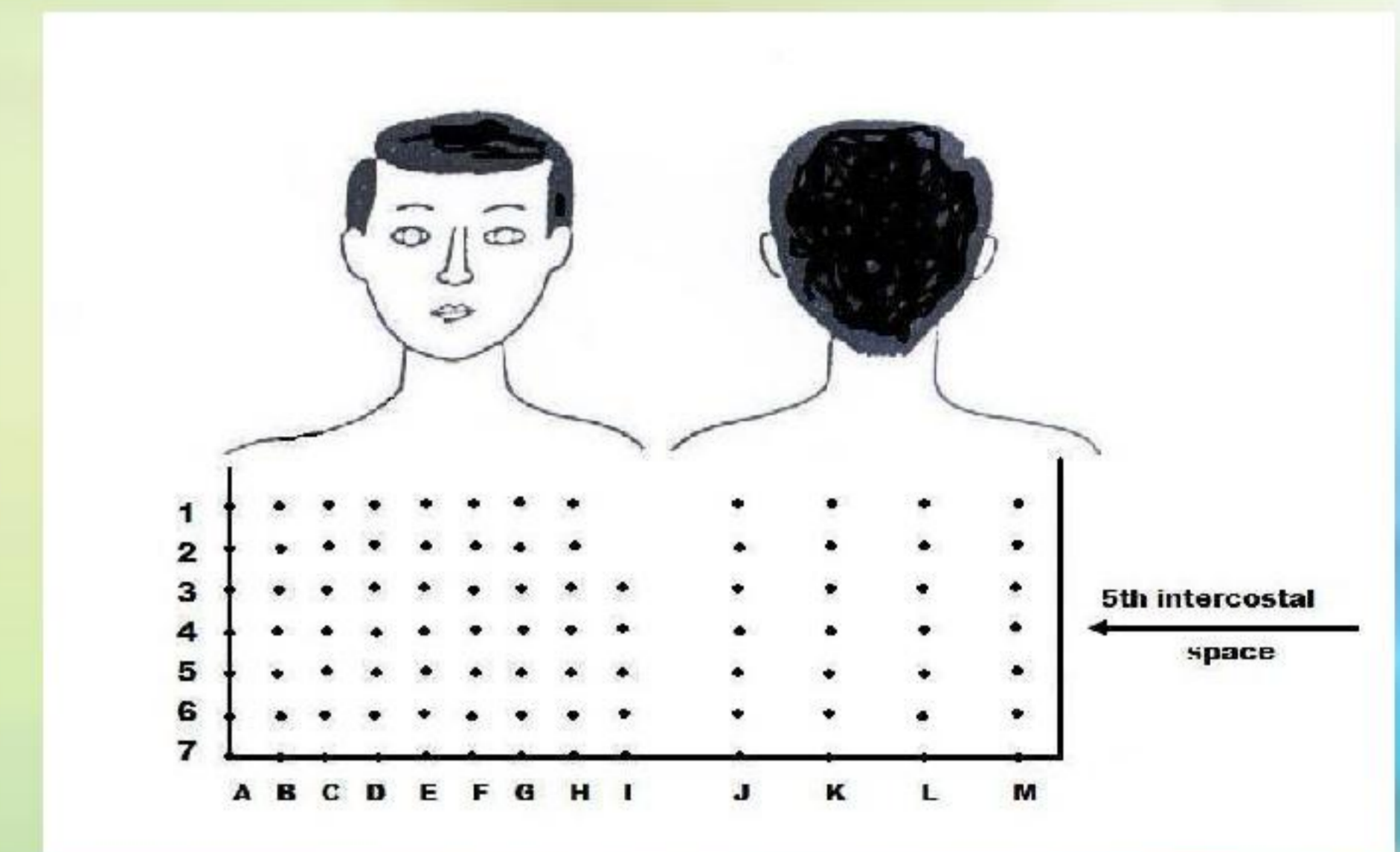


Fig.1. Layout of electrodes on patient's thorax. The tapes are marked with letters, while the electrodes

## AIM

The aim of the present study was to create from BSPM recordings the simplified patterns enabling a preliminary diagnosis of intraventricular conduction disturbances in CKD.

## MATERIAL AND METHODS

Study group consisted 26 CKD children (mean age:  $13.10 \pm 0.2.5$  years) treated conservatively and 31 control patients. For BSPM recordings, 87-lead HPM-7100 Fukuda Denshi system was used. Values of ventricular activation time (VAT) registered at the all body surface electrodes served for creating the patterns, in which the particular colorful bands corresponded to various VAT values reflecting a distribution of the ventricular activation. Seventeen (17) out of 26 patients were effectively treated with antihypertensive drugs (calcium channel blockers, angiotensin-converting enzyme inhibitors, beta-blocker agents). The other drugs included erythropoietin, vitamin D<sub>3</sub> analogues, vitamin C and B complex, folic acid, iron and ranitidine hydrochloride. Furthermore, the ESRD patients were kept on phosphate-poor diet (phosphate intake < 500–800 mg/day) and treated with phosphate binding compounds in the intestine (calcium carbonate < 35–200 mg/kg/day) in order to maintain serum phosphate concentrations between 4.5 and 5.52 mg/dl. Dietary calcium intake was defined as 500–600 mg of elementary calcium per day to keep serum calcium concentrations between 8.8–10.8 mg/dl.

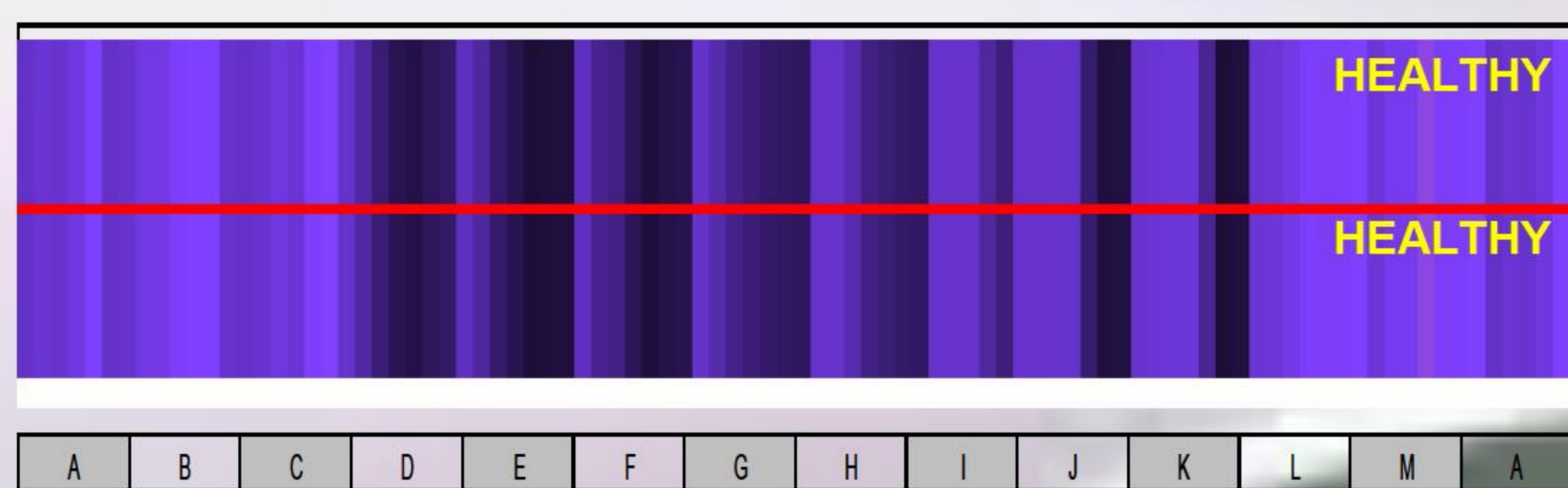


Fig.2. Graphic comparison of VAT patterns: the control template (upper band) – the normal subject's result (lower band)

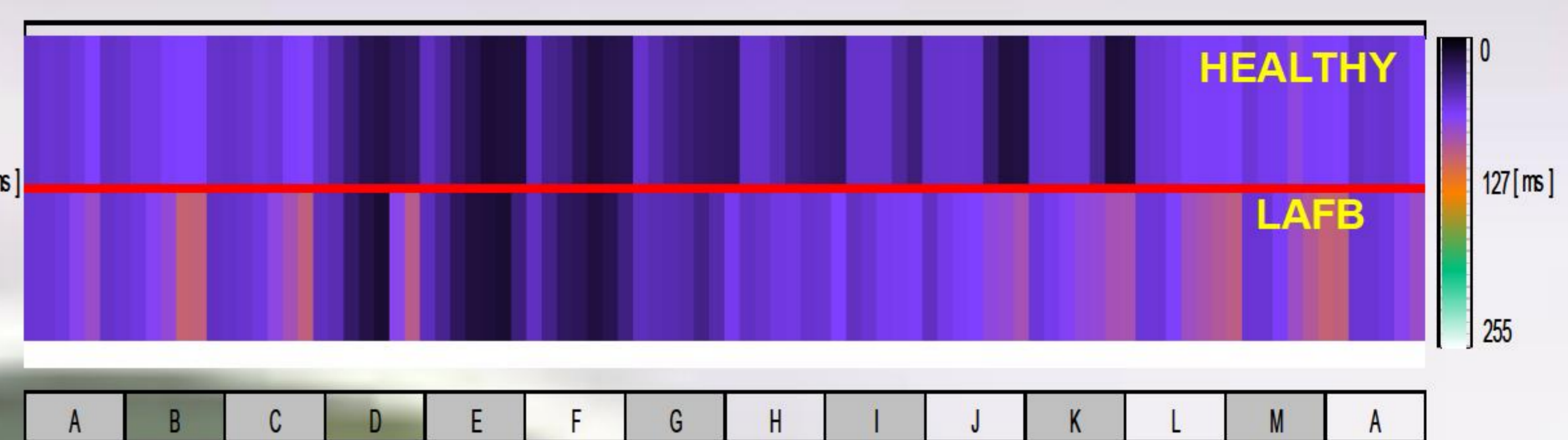


Fig.3. Graphic comparison of VAT patterns: the control template (upper band) – LAFB (lower band).

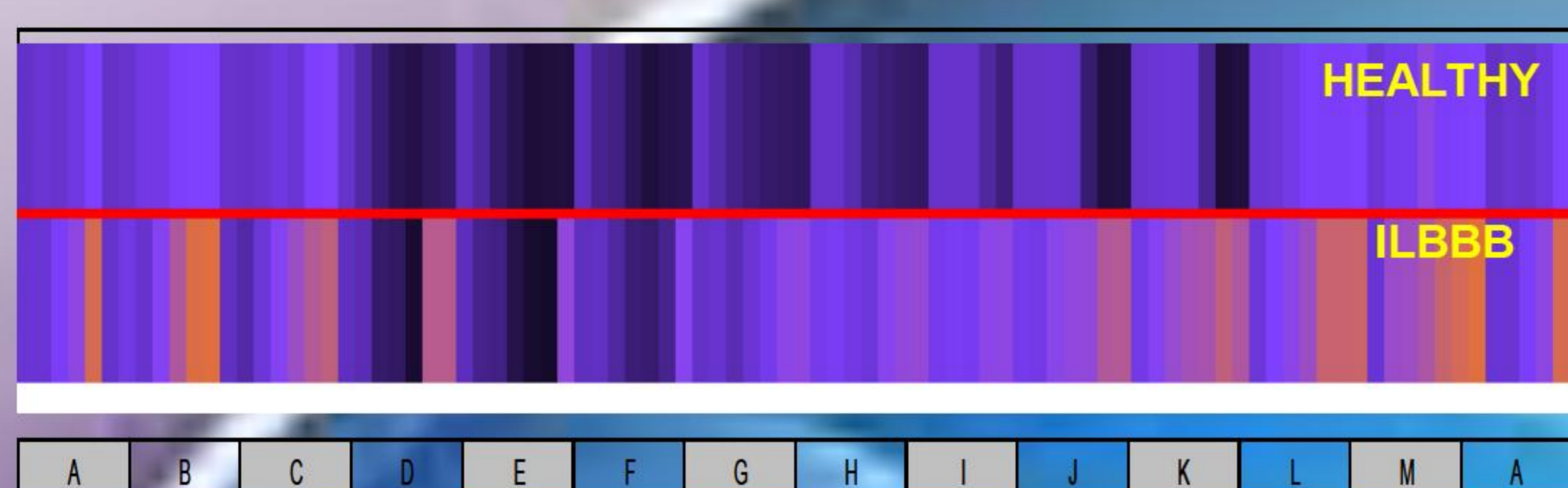


Fig.4. Graphic comparison of VAT patterns: the control template (upper band) – partial LBBB (lower band).

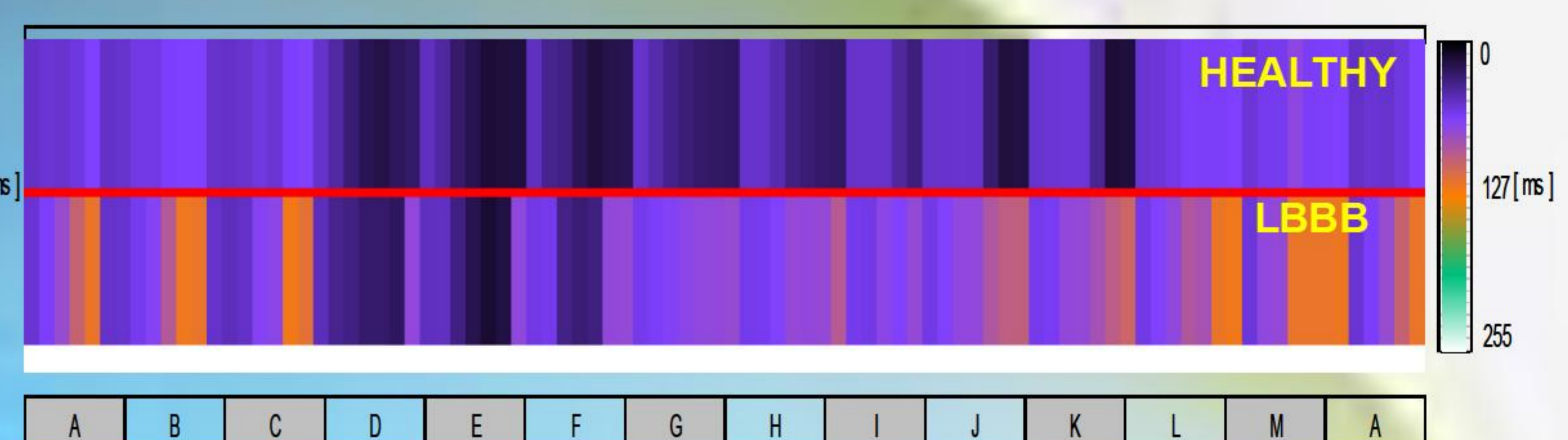


Fig.5. Graphic comparison of VAT patterns: the control template (upper band) – LBBB (lower band).

Red line separate the bands between the compared patterns.

Letters A – M designate the electrode row distributed on the body surface of the examined person in the BSPM FUKUDA DENSHI system.

## RESULTS

Our previous investigations using BSPM method in the children patients with chronic kidney disease (CKD) revealed various abnormalities located within the left branch of His bundle. Based on the results, the statistical patterns for the control children (HEALTHY), for left anterior fascicle block (LAFB), partial left bundle branch block (ILBBB), and complete LBBB were elaborated. Those patterns are designed as useful templates for rapid diagnosis of intraventricular conduction disturbances in the considered patient. The presented herein figures display a graphic comparison of the particular pathology patterns with the reference standard in order to show the areas reflecting disturbed conduction occurring in children with CKD. In case of each newly examined person, the program will display on the PC screen the colorful band of VAT values, registered with BSPM method, under each of the three mentioned above pathology patterns. A diagnosis can be performed through the automatic comparison of the array of colorful strips, showing VAT values registered in the given subject, with the pathology band patterns. On this ground, a qualification of the individual result to the one of the diagnostic groups, with the validation of extension and severity of the intraventricular conduction impairment, can be established.

## STUDY LIMITATION

The main limitation of the present study was the limited number of patients. However, it is just a pilot study, with plans of continuation. Besides, one should keep in mind that the population of children with terminal stage of renal failure is relatively small. Moreover, our study could exclusively include patients of one clinics, both for legal and logistic reasons.

## CONCLUSIONS:

The novel method of colorful patterns of VAT values based on BSPM recordings could be useful in a rapid preliminary screening of the initial conduction disturbances in the heart of children with CKD which are undetectable using standard ECG examination.