A New Tool to Identify Still's Murmurs

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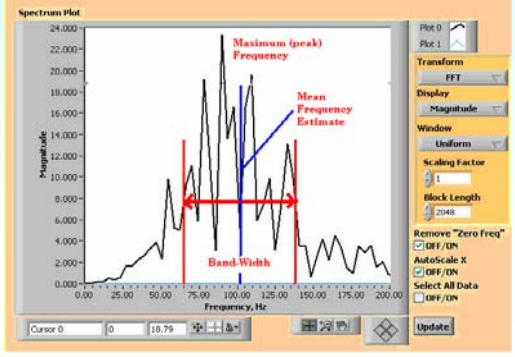
BACKGROUND

While 80% of children have a murmur during childhood, less then 1% of these murmurs are due to organic heart disease. Of 970 new patients referred to the out-patient clinics of the IWK Children's Heart Center in Halifax, Nova Scotia in 2003, 64.2% were shown to have an innocent murmur, the greatest percentage being the vibratory (Still's) murmur. Sub-optimal auscultation skill has been shown to exist in office based pediatricians and a distinctly unsatisfactory level in family physicians. In this study, objective analysis of heart sounds using a new computer software technique is carried out; the objective being to make available to pediatricians and family physicians an easy and inexpensive method to identify functional murmur heart murmurs in their office.

OBJECTIVE

To evaluate pitch (frequency spectrum) of pediatric heart murmurs and to identify characteristic features of the Still's murmur utilizing the phonocardiograph and Fast Fourier Transform (FFT) and power plots (Figure 1).

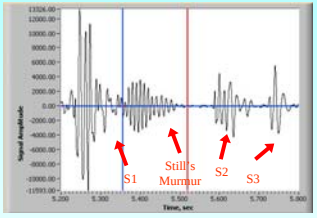
Figure 1 – Representative Murmur Showing Pitch (frequency) Peak, Mean, and Bandwidth.



DESIGN/METHODS

Computer software was used to evaluate pediatric murmurs collected from patients seen over a period of 15 years at IWK Children's Health Center by one of the authors of this study. This clinical dataset includes 205 studies in 34 patients with Still's murmur. For each case six different murmur recordings were analyzed and the resulting data averaged (Figure 2). Time averaged mean frequency and frequency band width were measured in each study (Figure 3). These characteristics of Still's murmurs were compared with the characteristics of pathological murmurs (Figure 4). Bsignal Phonocardiograph Monitor software was utilized in the study.

Figure 2 – Representative Heart Sound Recording of Still's Murmur in Child with an S3.



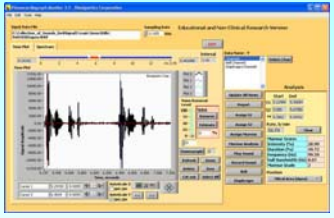


Figure 3 – Representative Pitch (frequency) of Still's Murmurs in 4 Children.

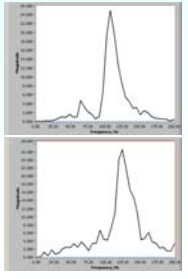
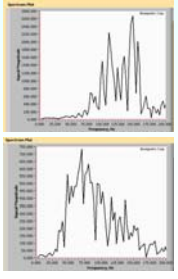


Figure 4 – Representative Pitch (frequency) of Aortic (top) and Pulmonic (bottom) Stenosis.



RESULTS

Sixty three percent of clinically diagnosed Still's murmurs had very narrow frequency band-width within 40Hz, with mean frequency being 110Hz. Eighty percent were within 55Hz band-width. This is consistent with the clinical characteristic of the Still's murmur as being musical (vibratory). By definition, musical sound must be closely contained with one single tone. In comparison average frequency band-width for the systolic murmur of pulmonary stenosis was shown to be 84Hz., with mean frequency being 124Hz (Figure 5). FFT plots demonstrated the Still's murmur to have a unique and characteristic obelisk-like form.

Using the student t-test and ANOVA statistical analysis, the difference in the maximum frequency between the Still's murmurs and pathological murmurs was NOT statistically significant (p-value of 0.138). However, the difference in the band-widths between the Still's murmurs and pathological murmurs was statistically significant to a p-value of <0.0001.

Figure 5 – Maximum Frequency and Frequency Band of Still's and Pulmonary Stenosis Murmurs.

Condition	*Variable*	*Mean Value*	*Stand. Dev.*
Still's Murmur	**Max.Freq. (Hz)**	**110.49**	**18.09**
	Band-width (Hz)	**38.72**	**25.50**
Pulmonary Stenosis	**Max.Freq. (Hz)**	**124.40**	**31.30**
	Band-width (Hz)	**85.34**	**35.20**

CONCLUSION

Innocent Still's murmurs can be easily and inexpensively identified using computerized software to analyze their frequency spectrum and by demonstrating the characteristic obelisk-like form, thus negating the necessity of other expensive diagnostic procedures.

FUTURE DIRECTIONS

- Automate grading of murmur intensity.
- Automate murmur diagnosis.
- Conduct clinical trials with unknown heart sounds.
- Conduct clinical trials to determine the role of this technology in evaluating children with murmurs.