

Correlations between Time, Latissimus Dorsi Wrap Properties and Systolic Assistance in Demand Dynamic Cardiomyoplasty?

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Abstract

A certain systolic assistance in Demand Dynamic Cardiomyoplasty (DDCMP) has been suggested. We here evaluate relations between muscular properties of Latissimus Dorsi wrap (LDW) and systolic function using the doppler flow wire combined with LDW mechanogram. On the basis of previous study, we divided the patients in two groups on the time between intervention and start of demand protocol (group 1: 12 months and group 2: 42 ± 21.6 months). A comparative study with a correlation analysis including time variables and the increase in maximal peak aortic velocity (MPAV) among not assisted and assisted beats was made. Time from the intervention (dyn-time) is similar. NYHA class, time between intervention and start of demand protocol (dyn/dem-time) and time from start of demand protocol (dem-time) were statistically different ($p < 0.05$). The increase in MPAV was significantly higher in group 1. A linear correlation has been found between the increase in MPAV and dem-time ($r = 0.82$), NYHA class and dyn/dem-time ($r = 0.76$), tetanic fusion frequency and dyn/dem-time ($r = 0.99$), increase in MPAV and tetanic fusion frequency ($r = 0.73$). In DDCMP systolic assistance is correlated to speed of LDW rapidity and time of demand stimulation. Long time continuous stimulation alters functional performance of LDW and lowers cardiac assistance. Demand stimulation protocol maintains over time contractile properties of the wrap and increases muscle performance.

Key words: Dynamic Cardiomyoplasty, heart failure, intravascular ultrasound.

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Nowadays a certain active cardiac assistance in demand dynamic cardiomyoplasty (DDCMP) has been suggested, but the relationship between muscle properties and systolic enhancement are not yet studied.

After the initial enthusiasm due to the early experience [2, 4, 5, 7, 8, 10], this technique lost part of its consideration also for the poor proofs in human of a true cardiac assistance and the absence of direct evidence of systolic enhancement during Latissimus Dorsi contraction. Recently the cardiac assistance has been demonstrated [12]. We tried to combine measurement of a relative change of aortic flow velocity by Doppler flow guide wire and the evaluation of Latissimus Dorsi muscular properties by mechanogram with several variables for understanding relationship between cardiac assistance and wrap properties in DDCMP patients.

Method

Doppler Flow velocity intravascular study has been tested in a previous study [11-12] performed using an

intravascular Doppler flow guide wire located in descending aorta; both the aortic flow velocity, expression of stroke volume, and clinic mechanogram, expression of muscle contraction speed, were simultaneously recorded [12]. The study regarded seven DDCMP patients (age 57.1 ± 6.2 years; NYHA class 1.43 ± 0.5): we divided them in two groups on the time between intervention and start of demand protocol (group 1: 12 months and group 2: 42 ± 21.6 months) and a comparative study with a correlation analysis with time, clinic variables and the increase in maximal peak aortic velocity among not assisted and assisted beats, obtained with Doppler flow wire, and results of mechanographic study was attempted. The quantitative data, expressed as percent value and calculated as media $\pm$ SD, were analysed with chi test. A value of $p < 0.05$ was considered significant. Continuous values are compared with the correlation coefficient of Pearson. Clinical data and muscle properties of seven patients are showed in Table I.

Demand Dynamic Cardiomyoplasty

Table I. Comparative analysis of the two groups.

	GROUP I	GROUP II	P
Age	53.3±3.5	60±9.9	0.16
NYHA class	1±0	1.75±0.37	0.02
Dyn-dem time (months)	12±0	42±21.6	0.033
Dem-time (months)	32.0±6.9	16±9.1	0.028
Dyn-time (months)	44±6.9	58.3±24.6	0.19
TFF (Hz)	39.3±6	31.7±8	0.237
Δ% pre/assisted	10.1±2.3	5.6±1.9	0.006

Dem-time: time from start of demand stimulation; Dyn-time: time from surgery; dyn-dem time: time between continuous stimulation and start of demand stimulation; TFF: tetanic fusion frequency.

Results

Time from surgery (dyn-time) and tetanic fusion frequency were similar in the two groups. NYHA class, time between intervention and start of demand protocol (dyn/dem-time) and time from start of demand protocol (dem-time), were statistically different ($p < 0.05$) in the two groups. The increase in MPAV was significantly higher in group 1 among not assisted and assisted beat (Table I). A linear correlation has been found between the increase in MPAV and dem-time ($r = 0.82$; figure 1), NYHA class and dyn/dem-time ($\text{corr} = 0.76$; figure 2), tetanic fusion frequency and dyn/dem-time ($r = 0.99$; figure 3), increase in MPAV and tetanic fusion frequency ($r = 0.73$; figure 4).

Discussion

Nowadays there is a new interest in the Dynamic Cardiomyoplasty, due to the cost of the mechanic assistance and the lack of organs in Europe: the vascular delay [6] and the demand stimulation protocol [1, 3] are trying to give to cardiomyoplasty new dignity.

Recently, we demonstrated a real cardiac assistance in DDCMP by measuring changes among not assisted and assisted beats in aortic peak flow velocity by Doppler intravascular flow wire in DDCMP [11-12]: the relations between these changes and muscle properties are not yet studied. As suggested by Carraro and al. [3] muscular properties of LDW are related with the time of demand stimulation, so we tried to correlate the functional data with the time variables to understand if and how much demand protocol influences cardiac assistance.

Despite of a not significantly difference in the time from surgery, an high difference in dyn-dem-time and dem-time can be observed. The cumulative data of the two groups, show an upward trend of MPAV among not assisted and assisted beats in Group 1, that is simple to relate with the dem-time.

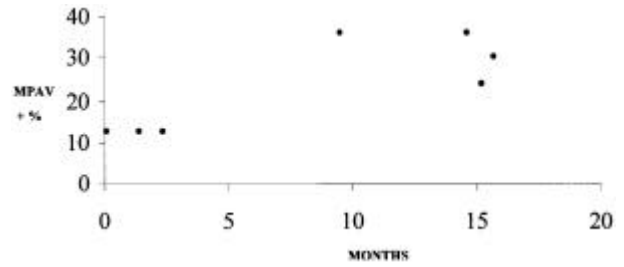


Figure 1. Correlation between the percent increase in MPAV (MPAV + %) and dem-time (months).

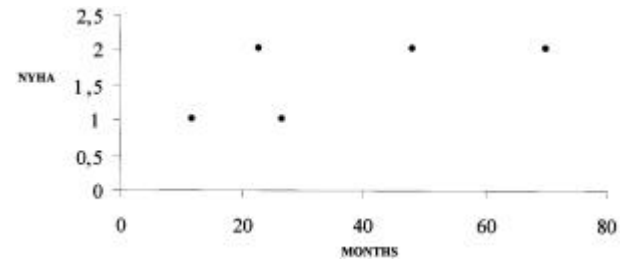


Figure 2. Correlation between NYHA class and dyn-dem time (months).

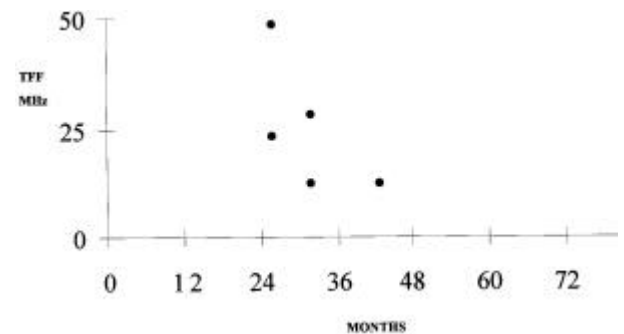


Figure 3. Correlation between tetanic fusion frequency expressed in MHz (TFF MHz) and dyn/dem-time (months).

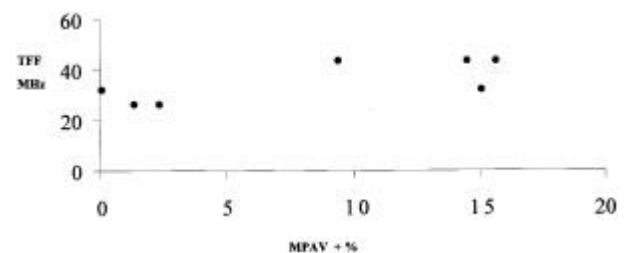


Figure 4. Correlation between tetanic fusion frequency expressed in MHz (TFF MHz) and the percent increase in MPAV (MPAV + %).

Our data show that longer is dem-time and shorter the dyn-dem time, bigger is the value of MPAV and better is NYHA class. The muscle contraction speed seems to decrease with the time of continuous stimulation: as showed by Carraro [3], it causes muscle degeneration and this fact may explain also the correlation between NYHA class and dyn-dem time.

How much LDW properties are fundamental for cardiac assistance is suggested by the relation among values of

tetanic fusion frequency, dyn-dem time and increase in MAPV. LDW properties increase as shorter is the period between continuous stimulation and the start of demand protocol as explained in Figure 1; however, the increase in TFF is followed by an increase in MAVP as showed in Figure 4.

The fail to found a statistical difference between the two groups about tetanic fusion frequency is probably due to the fact that mechanogram measures the contraction velocity of the activated fibres, not the number of them: the effect of demand stimulation is smaller in group 2 due to long continuous stimulation and the related lack of fibres. Despite of about 16 months of demand stimulation, after 40 months of continuous stimulation, LDW velocity of contraction of patients in group 2 didn't yet 1 or never will return to the value of group 4 explaining the low increase of MAVP in group 2.

Conclusion

We believe that demand stimulation could be the most effective protocol in dynamic cardiomyoplasty intervention: the limit of our data is the poor number of patient but however, they clearly suggest that DDCMP maintains and could increase over time, muscle properties after intervention, giving better systolic assistance. We hope that further extensive studies could confirm our data.

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