Circulatory Response to a 50-m Walk in the Coronary Care Unit in Acute Coronary Syndrome

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Summary

Background: **Lack of a standardized and monitored technique to start rehabilitation of patients with acute coronary syndrome (ACS) in the coronary care unit.**

Objective: **To describe the technique of and circulatory response to a 50-m walk (W50m).**

Methods: **Experimental cross-sectional study of 65 patients with ACS; of these, 36 (54%) with acute myocardial infarction (AMI), Killip I, 29 (45.2%) with unstable angina (UA), 61.5% males with age of 62.8 ± 12.7 years. Walk was started 45±23h after hospitalization. Parameters measured: systolic blood pressure (SBP mmHg), diastolic blood pressure (DBP mmHg), heart rate (HR bpm), double product (SBP mmHg X HR bpm), peripheral oxygen saturation (SpO_2%), walking time, and exercise tolerance by Borg scale (BS). Measurements were taken while supine, sitting, in orthostasis (phase 1 [gravitational stress]), end of the walk, and after a 5-minute rest (phase 2 [exercise stress]).**

Results: **Increased HR in response to the sitting gravitational stress (Δ=4.18) and with orthostasis (Δ=2.69) (p<0.001) was observed. At the end of walk, there was an elevation in SBP (Δ=4.84), (p<0.001), HR (Δ=4.68), (p<0.001) and DP (Δ=344.97), (p=0.004), and a reduction in SpO_2 (Δ=-1.42), (p<0.001), with return to baseline values after 5 minutes. Walking time was 2'36"±1'17", and exercise tolerance by BS was good. SBP response ≥ 142 mmHg when sitting was associated with a significant increase (p=0.031) of 11 mmHg at exercise in 13 patients with overweight/obesity and 85% with hypertension. Adverse effects occurred in 19 (29.2%) patients and dizziness in 23.1%, which impaired the walk in three of them.**

Conclusion: **In this sample, patients did not present severe collateral effects to W50m. 24 hours after a coronary event. (Arq Bras Cardiol 2009;92(2):128-135)**

Key words: **Myocardial infarction; unstable angina; rehabilitation; motor activity.**

Introduction

Early physical rehabilitation of patients with acute cardiac events started with the "armchair treatment" proposed by Mitchell et al[1] in Boston, in 1953, for patients with AMI. The objective was to reduce pulmonary, embolic, autonomic and neuromuscular complications resulting from bed rest, which extended for three to six weeks[1]. In 2003, Convertino described that prolonged bed rest after AMI and angioplasty were not uncommon, mainly in the Coronary Care Unit (CCU). He warned about the frequency of orthostatic intolerance and reflex tachycardia, which are common adverse effects in these patients when they assume the standing position[2]. The mobilization program should be balanced between the risk of early mobilization and the harmful effects secondary to bed rest[3].

The practice of in-hospital-phase cardiovascular rehabilitation (CVR1) was introduced in the CCU, applicable to ACS[2,4-9], and starting from 12 to 24 h post-event, if possible[3,7]. Most of the protocols indicate gravitational stress (GS) and walk as components of the CVR1[7-12]; however, there is no consensus as regards the monitoring of the circulatory response that translates the degree of stress imposed to the cardiovascular system[13] by the distance and walking time.

Another point of concern is the failure to warn the interdisciplinary team members on the heterogeneity of this population, which has several associated risk factors[3] that can potentially trigger complications during GS and walk. Based on the empirical practice of CVR1 in a CCU, we sought to describe the technique of W50m in its physical and GS phases

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according to the circulatory response, thus permitting a more rational and safe CVR1 programming.

Material/Methods

Experimental cross-sectional study conducted in the CCU of a private hospital in the city of Salvador, BA, Brazil, from April 2006 to January 2007. Patients with ACS who had medical permission to walk, who had not undergone surgical myocardial revascularization, and were oriented to time and space were included in the study. Patients who had medical permission to walk but refused to give their informed consent, and those who had any condition, such as chest pain, dyspnea, paroxysmal arrhythmia, acute ST-segment and T-wave alterations, baseline HR > 100 bpm, SpO_2 < 92%; 100<SBP > 160 mmHg and DBP >100 mmHg[6], that could put them at risk at the moment of the W50m were excluded.

During collection, 94 patients diagnosed with ACS were recruited; 23 were excluded according to the exclusion criteria, one patient dropped and five refused to participate. The sample was comprised of 65 patients whose main clinical and demographic characteristics are shown in Table 1. Of these, 36 (54.8%) had AMI, 24 (36.9%) non-ST-segment elevation and 12 (18.5%) ST-segment elevation, and 29 (45.2%) had UA; the male gender predominated, with 40 patients (61.5%), and the mean age was 62.8 ±12.7 years (ranging from 38 to 94 years); the majority of the patients (30 – 46.2%) had a higher education level, and five (7.7%) were illiterate or had not completed the basic school course; 38 (58.5%) were economically active.

The most frequent associated risk factors were: sedentary lifestyle (76.9%); overweight / obesity (69.2%); male gender (61.5%) and hypertension (63.1%). The mean BMI was elevated (27±4.0 Kg/m^2) in the overweight / obesity range. Coronary angiography performed in 47 patients (72.3%) revealed stenosis ≥70%, one-vessel disease in 11 patients (16.9%), two-vessel disease in 12 patients (18.3%) and three-vessel disease in 8 (12.3%), with nine patients (13.8%) being treated with angioplasty. Vasodilator was used in 52 patients (80%), and beta-blocker in 47 (72.3%).

The research was approved by the Research Ethics Committee of *Escola Bahiana de Medicina* (CEP: 75/2005).

Table 1 - Clinical characteristics and demographic data of 65 patients with acute coronary syndrome performing the 50-m walk

ACS	N(%)
Acute Myocardial Infarction	36 (54.8)
Unstable Angina	29 (45.2)
Coronary angiography	
One-vessel	11 (16.9%)
Two-vessel	12 (18.3%)
Three-vessel	8 (12.3%)
Medication	
Vasodilatador	52 (80%)
Beta-blocker	47 (72.3%)
Gender	
Male	40 (61.5)
Female	25 (38.5)
Age	Mean ± SD
Age (years)	62.8 (±12.7)
Level of education	N (%)
Upper	30 (46.2)
Mid	16 (24.6)
Basic	14 (21.6)
Illiterate	5 (7.7)
Associated risk factors	
Sedentary lifestyle	51 (78.4)
Overweight/obesity	45 (69.2)
Hipertension	41 (63.5)
Male gender	40 (61.5)
Dyslipidemia	32 (49.2)
Smoking	29 (45.6)
Diabetes	24 (36.9)

ACS - acute coronary syndrome; AMI - acute myocardial infarction; UA - unstable angina; BMI - body mass index; SD - standard deviation.

50-m walk

The 50-m distance represented the usual trajectory of the patients in their first post-event walk, which is already performed in the CCU routine, with the physical therapist. The variables chosen for monitoring represented the main indicators of the activity of the heart as a pump, and of the regulation of blood circulation hemodynamics: HR, SBP, DBP, double product (DB) as an indirect reflex of myocardial oxygen consumption, and SpO_2, as a reflex of the peripheral oxygen extraction. The BS complemented the subjective assessment of the response to stress induced by walking.

The circulatory response to W50m was monitored in two phases: Phase 1 – supine position at 0º, sitting on the bed with the legs hanging, and with orthostasis; Phase 2 – after three minutes in the standing position[14], during and at the end of the walk, and in the recovery phase and after 5 minutes[15-16].

All patients underwent clinical assessment, with recording of their clinical and anthropometric data. A W-200 (Welmi - Brazil) anthropometric scale was used to measure weight and height. Body mass index was calculated by the Quetelet index: BMI = Weight in Kg/height in m^2.

Blood pressure (BP) was measured according to the IV Brazilian Guidelines on Hypertension[17], using the auscultation technique, with a Missouri (Mikatos-Brazil) tensiometer aneroid sphygmomanometer. HR was measured with a Polar (Electro OY - Finland) device, and SpO_2 with a 1001 (Moriya-Brazil) portable pulse oximeter. The walking duration was measured using a Ferrari (Oregon - USA) chronometer. Measurement of the circulatory variables followed this sequence: BP after 5 minutes in the supine position at 0º,

within the first minute after sitting down, at the first and third minutes after standing up, at the first minute at the end of the walk, and at the fifth minute of recovery; HR and SpO_2 were monitored continuously, with the values being recorded at the beginning of BP measurement.

At the beginning of the walk, the patients were questioned whether they were feeling any type of discomfort, whether they were willing to perform the walk, and were advised to stop the walk in case of any type of discomfort. The modified BS (0-10) was used because it is the most up-to-date scale[18]. It was administered at the beginning and at the end of the walk, and the patients were advised not to go beyond level four (slightly tiring), which is the maximum safety limit for physical activity in this phase[6]. W50m was supervised by the physical therapist who recorded HR_{max} and SpO_{2min}; no verbal stimulus was given regarding the walking pace and speed. The patients determined their own pace; at the end of the walk, the circulatory parameters and BS score were recorded.

Statistical analysis

Sample size calculation

Sample size calculation was based on the HR endpoint, which is considered an indicator of the patient's functional response. The alternative hypothesis to be tested was that HR would increase with the W50m physical stress, and the magnitude of this effect (E) was estimated at +4bpm, thus characterizing a one-way analysis. The endpoint variability (HR elevation), in turn, was estimated with base on the standard deviation (S) of the mean HR, which was calculated as ¼ of a HR variation from 70 to 100 bpm (considering that many of these patients were on beta-blockers): thus SD = 30÷4= ±7.5 bpm. The magnitude of the standardized amplitude of the effect (E/S), defined by the quotient of the total interval amplitude (4) by SD (7.5): 4÷7.5 = 0.53 was then calculated. In light of these values and for α=0.05 (significance level) and β=0.20 (study power), an N value of 51 patients was found, which, added by 20% to compensate losses, reached a minimum of 62 patients[19].

The independent variables were: gender, age, physical activity, BMI, type of ACS, dyslipidemia, hypertension, diabetes, smoking, and use of vasodilator and beta-blocker. The dependent variables were: SBP, DBP, HR, DP, SpO_2, BS, and walking duration. The database and the descriptive and analytical analysis were performed with the Statistical Package for Social Sciences (SPSS) software, version 12.0 for Windows. The Kolmogorov-Smirnov test was used to analyze the normality of continuous variables distribution.

Categorical variables were expressed as percentage values (%); continuous variables with normal distribution, as mean and standard deviation (X ± SD); and variables with asymmetrical distribution, as median and interquartile interval.

The chi-square test was used for comparison of the categorical variables; when this test proved inappropriate, the Fischer test was used. The McNemar test was used for the comparative analysis of BS (pre and post).

The statistical significance of the difference between the means of variables in the GS and walk phases was set using the Student's t test for paired samples. The comparison of these variables between the risk predictors was made using the Student's t test for independent samples. When appropriate, these comparisons were made using the Wilcoxon U and T tests, respectively. The significance level was set at 5%.

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Results

50-m walk

W50m was administered 45.0 ± 23.0 hours after hospital admission, ranging from 24 to 48 hours in 27 (41.5%) patients, 10 (27.8%) of whom had AMI; from 48 to 72 hours in 33 (50.8%) patients, and from 96 to 120 hours in four (6.2%); only one patient performed the test on the fifth day of admission. The time of administration varied according to the moment of the last anginal attack and of catheterization and/or angioplasty, with a waiting time of approximately 24 hours.

Behavior of circulatory variables and W50m duration

Mean baseline values of the circulatory variables studied, as measured in the supine position at 0º, were: SBP 128.8 ±15.0 mmHg; DBP 73.8 ±12.5 mmHg; HR 70.9±10.4 bpm; DP 10.007 ± 77.07 mmHgXbpm; and SpO_2 95±2.0 %, which are normal values. Change from the supine position at 0º to the sitting position and then to the standing position led to a significant elevation of HR, Δ+4.18 bpm (p<0.001) and Δ +2.69bpm (p<0.001), respectively, however with no clinical consequences (Table 2).

At the end of the walk, increased levels of SBP, Δ +4.84 mmHg (p<0.001), HR, Δ +4.68 bpm (p<0.001), and DP, Δ +344.97mmHgxbpm (p=0.004), as well as decreased levels of SpO_2 Δ -1.42% (p<0.001) were observed, and all these values were significant, however with no clinical consequences. In the recovery phase, after five minutes in the sitting position, the variables studied showed a significant reduction (SBP, Δ -4.53 mmHg, p<0.024, HR, Δ -9.06 bpm, DP, Δ - 869.42mmHgxbpm, p<0.001 and DBP, Δ -3.14mmHg, p=0.006), except for SpO_2 which showed a significant increase, Δ+2.16%, p<0.001, and all returned to baseline levels rapidly (Table 2). The mean W50m duration was 2.5±1.3 min.

Perception of the physical and GS phases by BS revealed a rightward deviation in relation to baseline scores. In the pre-walk phase, 33 (53.2%) individuals reported "no dyspnea" (score 0), 27 (43.5%) reported "very very mild" and from "very mild to mild" dyspnea (score from 0.5 to 2) and two (3.2%) "moderate" dyspnea (score 3). At the end of the walk, the distribution of these scores was 25 (40.3%), 29 (46.8%) and seven (11.3%), respectively, with one additional patient (1.6%) whose dyspnea became more intense (score 4). This patient had UA; she was 64 years old, smoker and obese.

Variation of the circulatory variables among the risk predictors

GS of the sitting position from the supine position at 0º led to a statistically significant divergent variation of Δ SBP,

Table 2 - Behavior of circulatory variables in the gravitational and physical stress phases of the 50-m walk in 65 patients with acute coronary syndrome

Sitting*	SBP	DBP	HR	DP	SpO_2
Supine position	128.8 (15.01)	73.8 (12.53)	70.9 (10.4)	10,007 (71.07)	95.2 (2.05)
Δ Supine-Sitting	-0.31	1.55	4.18†	-548.80	0.45
Sitting	128.7 (14.75)	75.3 (11.91)	75.0 (10.2)	9,655 (1,715.60)	95.7 (2.12)
Standing*					
Sitting	128.7 (14.75)	75.3 (11.91)	75.0 (10.2)	9,655 (1,715.60)	95.7 (2.12)
Δ Sitting - Standing	-2.08	-0.11	2.69†	159.23	0.12
Standing	126.7 (17.28)	75.2 (12.35)	77.7 (11.3)	9,815 (1,788.09)	95.8 (1.8)
Standing - 3 minutes*					
Standing	126.7 (17.28)	75.2 (12.35)	77.7 (11.3)	9.815 (1,788.09)	95.8 (1.81)
Δ Standing - 3 min	-0.47	0.66	-0.16	-30.26	-0.22
Standing - 3 min	126.2 (15.84)	76.0 (11.83)	77.4 (11.6)	9,747 (1,732.99)	95.7 (1,61)
Walk-50 m*					
Standing - 3 min	126.2 (15.84)	76.0 (11.83)	77.4 (11.6)	9,747.1 (1,732.99)	95.7 (1.61)
Δ Standing 3 - W50m	4.84†	1.16	4.68†	344.97¥	-1.42†
Final W50m	131.1 (19.26)	77.1 (12.71)	82.1 (12.8)	10,092.0 (2,064.99)	94.3 (2.42)
Recovery phase*					
Final W50m	131.1 (19.26)	77.1 (12.71)	82.1 (12.8)	10,092.0 (2,064.99)	94.3 (2.42)
Δ Final W50m-Recovery	-4.53‡	-3.14 #	-9.06†	-869.42†	2.16†
Recovery - 5 min	126.5 (16.06)	74.0 (12.35)	73.1 (10.3)	9,222.6 (1,613.26)	96.3 (1.58)

*SBP - systolic blood pressure; DBP - diastolic blood pressure; HR - heart rate; DP - double product; SpO_2 - peripheral oxygen saturation. *Data: mean (standard deviation); †p<0.001; ¥0.004; ‡p=0.024; # p=0.006.*

however with no clinical consequences both in sedentary and in diabetic individuals. In sedentary individuals, there was an elevation of Δ SBP by +1.68 mmHg, whereas in physically active individuals there was a reduction by -4.71 mmHg (p=0.030) (Table 3). In diabetics, there was a ΔSBP reduction by -3.5 mmHg, whereas in non-diabetics there was an elevation by +2 mmHg (p=0.012) (Table 3). HR variation was positive in all patients, including those on beta-blockers.

In relation to the GS with orthostasis, no significant variation in SBP was observed, but there was a significant variation of the HR behavior among patients with age lower than or equal to 63 years (median age of the sample), however with no clinical consequences. Individuals with age ≥ 63 years presented a Δ HR of +0.73 bpm, versus an increase by +4.72 bpm in patients with age < 63 years, p=0.002 (Table 3).

After physical stress, the ΔSBP in diabetics was 2.17 mmHg, whereas in non-diabetics it was 6.41 mmHg, with a p value very close to the significance value (0.061). On the other hand, in diabetics, the ΔHR was +8.39 bpm, which was significantly higher than in non-diabetics (ΔHR +2.49 bpm, p=0.017) (Table 3). With the use of beta-blockers, there was a change in HR and SBP, however with no statistical or clinical significance. As for the duration, W50m did not show any significant difference among the risk predictors. However, those with age ≥ 63 years had the highest mean W50m

Table 3 - Variation of delta systolic blood pressure and heart rate in response to gravitational and physical stress to the 50-m walk, according to risk predictors in 65 patients with acute coronary syndrome

Variable*	Δ SBP SP- S	p	ΔHR SP-S	p
Sedentary	1.68	0.003	2.42	0.554
Active	-4.71		3.50	
Diabetic	-3.50	0.012	4.25	0.300
Non-diabetic	2.00		4.15	
	ΔSBP S-ST	**p**	**ΔHR S-ST**	**HR**
Age ≥ 63 years	-4.36	0.137	4.72	0.002
Age < 63 years	0.28		0.73	
	ΔSBP B – E	**p**	**ΔHR B - E**	**p**
Diabetic	2.17	0.061	8.39	0.017
Non-diabetic	6.41		2.49	

Δ The DBP, DP and SpO_2 variables were also analyzed in this phase, but did not show significant changes. Δ SBP SP-S - delta systolic blood pressure from the supine position to the sitting position; ΔHR SP-S - delta heart rate from the supine position to the sitting position; ΔSB S-ST - delta systolic blood pressure from the sitting position to the standing position; ΔHR S-ST - delta heart rate from the sitting position to the standing position; ΔSBP B-E - delta systolic blood pressure from the beginning to the end of the 50-m walk; ΔHR B-E - delta heart rate from the beginning to the end of the 50-m walk.*

duration, of 2 min 52s ± 1.37, *versus* those physically active who had the lowest mean, of 1 min 98s ±0.80.

Behavior of extreme values in response to W50m

The group who presented SBP values ≥ 142 mmHg when sitting showed a significant elevation of ΔSBP by +2.00 mmHg (p=0.013) in relation to the supine position at 0º, with maximum SBP value of 154 mmHg; after W50m the ΔSBP increased by +11mmHg, p=0.013, with a maximum SBP value of 160 mmHg. During recovery, the ΔSBP was -3 mmHg, not significant, and the maximum SBP dropped to 153 mmHg (Table 4). There was a significant elevation of HR when sitting, with ΔHR of +4.00 bpm, p= 0.004, peak of 80 bpm, and after walk, ΔHR of +3.5 bpm, p< 0.001, peak of 81bpm, with a significant reduction in the recovery phase (ΔHR-6.50 bpm, p=0.017), peak of 75 bpm (Table 4). In patients who presented SBP ≤ 114 mmHg when sitting, SBP remained stable, whereas there was a significant HR elevation (ΔHR +4.5 bpm, p=0.004) when sitting, with orthostasis (ΔHR +3.0 bpm, p=0.013), and after walk (ΔHR +5.0 bpm, p=0.014), with a cumulative increase by 12.5 bpm and peak of 95 bpm during walk. In the recovery phase, there was a significant deceleration by 10 bpm (p=0.001), and the peak HR dropped to 88 bpm (Table 4).

Among the risk predictors analyzed, all 13 (100.0%) patients who had an extreme response with SBP ≥ 142 mmHg were overweight / obese, when compared with the eight (50.0%) of the 16 patients with extreme SBP response ≤ 114 mmHg , p=0.030, and 11 patients (85.0%) were hypertensive versus 7 (44.0%), respectively, p=0.0524.

Adverse effects to the 50-m walk

Adverse effects were observed in the GS phase of orthostasis in 19 patients (29.2%); the most frequent was dizziness, occurring in 15 patients (23.1%), followed by orthostatic hypotension in four (6.3%). Except for three patients for whom the walk had to be interrupted, one patient presented chest pain, another presented increased blood pressure (BP=168X110mmHg) and the third had hypotension with dizziness (BP=100X88mmHg, with ΔSBP=-18 mmHg). All three patients presented profuse sweating and were on beta-blockers and vasodilators.

Discussion

The present study describes the behavior of circulatory variables to W50m in patients with ACS in the CCU, in compliance with the BSC Guideline, which recommends in-hospital cardiovascular rehabilitation for patients with this clinical profile[6,8,9,11]. However, for a successful rehabilitation, the circulatory response has to be monitored, as was done in this study.

Associated risk factors are common among patients with this type of condition, as demonstrated by the high percentage of sedentary lifestyle, overweight / obesity, hypertension and diabetes, and this is an additional risk for the administration of W50m. This fact shows the importance of the standardization and monitoring of the impact of

Table 4 - Variation of systolic blood pressure and heart rate in the gravitational and physical stress phases of the 50-m walk of **patients with acute coronary syndrome who had SBP ≥ 142mmHg or ≤ 114mmHg when sitting**

	SBP Sitting position ≥ 142 mmHg (n=13)	
Sitting position	SBP(mmHg)*	HRmax(bpmin)*
Supine position	146.0 (140; 150)	68.1 (60;72)
Δ Supine-Sitting	2.00‡	4.00 †
Sitting position	150. 0 (148 ;154)	71.0 (66;80)
Standing position		
Sitting position	150.0 (148 ;154)	71.0 (66;80)
Δ Sitting - Standing	-2.00	2.00
Standing	150.0 (139;154)	76.0 (66;83)
Standing position - 3 minutes		
Standig position	150.0 (139;154)	76.0 (66;83)
Δ Standing - After 3 min	-1.00	-1.50
Standing - 3 min	142.0 (136 ;153)	72.0 (63;78)
50-m walk		
Standing position - After 3 min	142.0 (136 ;153)	72.0 (63;78)
Δ Standing position 3 - End of W50m	11.00‡	3.50¥
End of W50m	150.0 (140;160)	77.5 (72;81)
Recovery phase		
End of W50m	150.0 (140;160)	77.5 (72;81)
Δ End of W50m Recovery	-3.00	-6.50 #
Recovery - 5 min	147.0 (140 ;153)	71.0 (63;75)
	SBP Sitting position ≤ 114mmHg (n=16)	
Sitting position	SBP (mmHg)	HR (bpmin)
Supine position	112.0 (110;118)	76.5 (64;82)
Δ Supine-Sitting	-3.0	4.5†
Sitting position	112.0 (110;112)	80.0 (68;84)
Standing position		
Sitting position	112.0 (110;112)	80.0 (68;84)
Δ Sitting - Standing	0.00	3.0‡
Standing position	110.0 (104; 116)	83.5 (75;92)
Standing position - 3 minutes		
Standing position	110.0 (104; 116)	83.5 (75;92)
Δ Standing - 3 min	-1.0	1.00
Standing position - 3 min	110.0 (103;112)	85.5 (72;89)
50-m walk		
Standing position - 3 min	110.0 (103; 112)	85.5 (72;89)
Δ Standing 3 - End of W50m	-1.0	5.0≠
End of W50m	110.0 (100; 118)	88.0 (79;95)
Recovery phase		
End of 50 - m walk	110.0 (100; 118)	88.0 (79;95)
Δ End of W50m Recovery	0.00	-10#
Recovery - 5 min	111.0 (103; 120)	79.5 (66;88)

**Data: median (minimum and maximum); †p=0.004; ‡ p=0.013; ¥p<0.001 ; # p=0.017; ≠0.014.*

physical and GS of W50m on the cardiovascular system, as a means to ensure an early rehabilitation process. Considering the pathophysiological changes resulting from bed rest, the literature shows the importance of increasing GS and walk as soon as possible[2]. However, this is only indicated for patients with stable ACS[6,8,9,11].

The mean W50m administration time reflects the caution to be taken that active rehabilitation should be started in stable conditions, with a 24-h wait after chest pain and/or catheterization. The findings in the literature are discrepant as regards the period in which walking should be started after an acute coronary event, the initial distance to walk, and the convenience of circulatory variables monitoring in the GS and walk phases[6-9,11]. In this particular, we found Debusk et al's study (1986) which monitored BP in the sitting and standing positions before starting the walk[20], and, more recently, Nogueira et al[21] study in which the 6-minute walk test was successfully performed in the first week post-AMI with the objective of assessing the functional capacity.

Few data on the circulatory response to GS of patients with ACS who had been at rest in the supine position are available in the literature. In this study, the response of SBP and DBP to GS in the sitting and standing positions showed a small variation, thus suggesting that the majority of these patients when undergoing rest for 24 hours or longer and taking vasodilators and beta-blockers had maintained their postural reflexes active; the integrity of the peripheral circulatory adjustment to body position changes was also maintained[16]. This fact suggests a positive response to the pre-rehabilitation physical therapy, with a reduction of the risk of orthostatic hypotension after bed rest[2].

HR response to GS in the sitting and standing positions was adequate, thus showing the physiological performance of this sensitive mechanism of adjustment to body position changes mediated by an increase in the sympathetic activity[22,23]. The result of this physiological adjustment between the BP and HR variables is a mild reduction of DP, with the myocardial oxygen consumption kept stable, which is also demonstrated by the SpO_2 stability[22]. These data reveal that the GS phase to W50m does not lead to hemodynamic instability, provided that the patients are appropriately selected and monitored. However, approximately ¼ (23.1%) of the patients reported dizziness in response to GS. Although mild, this finding suggests that physical therapeutic maneuvers in the supine position are adequate during the pre-gravitational stress phase with the purpose of reducing the frequency of this type of complaint, which indicates that the gravitational adjustment was not fully satisfactory.

The physical stress phase represented by W50m showed a positive cardiovascular response, as demonstrated by the physiological variation of the circulatory variables triggered by the sympathetic autonomic reflex leading to increased cardiac output in order to meet the increased muscle oxygen demand in response to exercise[13,24]. The degree of variation of these circulatory parameters showed that W50m triggered a physical stress appropriate to the functional capacity of these patients, with no clinical consequences. Thus, the mean W50m duration proved to be enough to assess the impact of exercise on the cardiovascular system[13,24], maintaining exertion at a low-risk limit for this population in the acute phase of a coronary event. In corroboration to this statement, a recent protocol describes that the first walk after a coronary event should be short, with a mean duration between one and two minutes[3]. The physiological response to the exercise load was observed in the fifth minute of the recovery phase, when the values of the circulatory variables returned to values close to baseline.

The sensation of respiratory discomfort during W50m, as assessed by the modified BS[18], showed little changes in relation to the pre-walk phase. However, it is worth pointing out that these sensations were neither accompanied by hemodynamic abnormalities nor by the finding of respiratory discomfort as examined by the researcher. Only one patient (1.6%) reported mild tiredness, thus indicating that W50m was not a physical exertion beyond the patients' cardiorespiratory capacity. Therefore, the complaints more likely represented the patients' apprehension about early mobilization, despite the previous briefing on the benefits of walking.

Among the risk predictors analyzed, patients with a sedentary lifestyle, diabetes, and age equal to or higher than 63 years showed a SBP and HR behavior significantly different from that of active, non-diabetic patients with age < 63 years in response to GS and/or physical stress. This finding may be a reference as to the possible behavioral differences between these groups, thus allowing a more careful observation and possible preventive measures when W50m is performed in the routine of CVR1 in the CCU. Thus, sedentary patients showed increased SBP to gravitational stress in the sitting position, a response that may be due to a poor physical fitness[25]. Diabetics showed decreased SBP when assuming the sitting position and a greater HR elevation during walk, which can be related to the neuropathy and dysautonomia that are common in these patients[26]. Patients with age ≥ 63 years had a significantly lower chronotropic response than those with age < 63 years, which may be partly attributed to the physiological reduction in the chronotropic response of the sinus node with age[27], and to the use of beta-blockers, which occurred with 63% of the patients.

Although there was no significant difference in walk duration between the groups, we could observe that the mean time was higher among those with age ≥ 63 years and high frequency of sedentary lifestyle, whereas the shortest time was observed among physically active patients, the majority of whom were < 63 years old. The reduction in exercise capacity with aging should also be considered[27].

The behavior of patients with extreme responses to GS in the sitting position revealed different responses to physical stress. In the group of patients with SBP≥142 mmHg, the mean SBP elevation reached a peak of 160mmHg, which was the safety limit of the study protocol[6,8,9]. The HR also increased by 7.5 bpm. This type of response suggests an increased sympathetic activity beyond that required for the circulatory adjustment resulting from physical and GS. This can be related to the fact that all 13 patients were overweight, and 11 had associated hypertension, and these conditions are accompanied by increased sympathetic activity[13]. In the patients with SBP < 114 mmHg, all the circulatory adjustment in response to GS in the sitting position and physical stress was

made through HR elevation, with the peak HR reaching 95 bpm, close to the safety limit of 100 bpm[6,8,9]. SBP variation was low, however with a downward trend. In the analysis of the different circulatory responses between these two groups, it is worth considering that of the 16 patients with the latter behavior, 50% had normal BMI and 66.3% were normotensive. We should point out the care and surveillance of the relative risk to the SBP peak required in the first group, and of HR in the second group, in the process of CVR1.

Despite the occurrence of adverse effects in approximately 1/3 of the patients, few events had any clinical consequence that required interruption of the rehabilitation process, which occurred in three (4.8%) of them. In the remaining patients, the effects were mild, thus permitting that the walk was performed within the pre-established criteria. Dizziness, which was the most frequent complaint, was mild and occurred when assuming the standing position, thus certainly resulting from a lack of stimulation of the postural reflexes due to bed rest[2] and to the use of vasodilators and beta-blockers.

Interruption of rehabilitation in three patients followed the safety criteria of the protocol, and permitted a ready recovery of the patients.

Conclusions

W50m may be considered a well-tolerated physical rehabilitation method for patients with ACS in the ICU, as from 24h post-event, provided that the safety limits of the protocol are observed. Basic conditions for its performance are that the patient be stable, in Killip class I, has a cardiologist's permission, is well instructed by the physical therapist, and SBP, HR and SpO_2 are monitored in the different phases.

Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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Study Association

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