Evaluating physical function and daily activity in patients with intermittent claudication

Towards a new outcome measure

Master thesis

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SAMENVATTING

Doelstelling

Patiënten met claudicatio intermittens hebben een vergrootte kans op overleiden wanneer zij een lage fysieke activiteit hebben. Om verergering van de ziekte te voorkomen zou het verbeteren van fysieke activiteiten een primair behandeldoel moeten zijn. Richtlijnen bevelen gesuperviseerde looptherapie aan als primaire behandeling omdat het zeer effectief is in het verbeteren van de fysieke capaciteit. Tot op heden wordt alleen de fysieke capaciteit geëvalueerd om het behandeleffect te meten. In recent onderzoek zijn aanwijzingen gevonden dat de fysieke activiteit niet verbeterd wanneer de capaciteit toeneemt. Het doel van deze studie is om erachter te komen of de gemeten capaciteit en de fysieke activiteit gerelateerd zijn aan elkaar. Tevens is onderzocht of een wandeltest een betere reflectie geeft dan een loopbandtest.

Methode

Een cross-sectioneel onderzoek is uitgevoerd waarbij 46 patiënten zijn geïncludeerd op de afdeling vaatchirurgie van het Catharina ziekenhuis in Eindhoven. De fysieke activiteit is objectief gemeten over zeven achtereenvolgende dagen. De capaciteit is gemeten met de zes minuten wandeltest, een loopbandtest, de short physical performance battery en de timed up and go test.

Resultaten

Van alle patiënten volgde 50% een gesuperviseerd loopprogramma. Patiënten vertoonden sedentair gedrag voor 80% van de totale tijd, in de overige tijd werd 6,6% gelopen. Er waren significante correlaties tussen de functietesten en de loopactiviteiten waarbij de loopbandtest enigszins sterker correleerde dan de zes minuten wandeltest. De overige functietesten waren zwak gerelateerd aan de activiteit.

Conclusie

Ondanks redelijke correlaties tussen de loopband test en de fysieke activiteit wordt nog een overgroot deel niet verklaard door beide determinanten. Toekomstig onderzoek zou fysieke activiteit als aparte uitkomstmaat mee moeten nemen.

Klinische relevantie

Dit is de eerste studie die data rapporteert over objectief gemeten fysieke activiteit in verschillende dimensies. Redelijke correlaties zijn gevonden tussen capaciteit en activiteit echter dit impliceert dat slechts een klein deel wordt verklaard.

ABSTRACT

Introduction

To decrease mortality in patients with intermittent claudication it is more and more recognized that low physical activity levels should be treated. Guidelines recommend supervised exercise therapy as primary treatment option which is proved to be very effective in increasing functional capacity. Recent literature found no difference in activity while capacity increased after exercise therapy. The aim of this study is to investigate the relationship of functional capacity and actual physical activity in patients with intermittent claudication

Methods

A cross-sectional study of 46 patients was performed in the outpatient clinic of the Catharina Hospital Eindhoven. Physical activity was objectively measured for 7 consecutive days and nights. Functional capacity was measured with the six-minute walk test, the graded treadmill test, the short physical performance battery and the timed up and go. Correlations were analyzed.

Results

Of all patients, 50% started a supervised exercise program. Patients were sedentary for 80% of the time and walked only 6.6% of their time. Significant correlations where found between the function tests and physical activity outcomes of locomotion where the treadmill test correlated slightly stronger. Other function tests did not sufficiently correlate with physical activity.

Conclusion

In contrast to what was expected, a moderate relationship is present between treadmill testing and objectively measured physical activity. Certainly a lot is left unexplained about physical activity. Future research should analyze physical activity as separate outcome.

Clinical Relevance

This is the first study reporting data of physical activity in different dimensions in patients with intermittent claudication. Moderate correlations which are found between capacity and activity outcomes implicate that physical activity is only party related with functional capacity. Corridor-based function testing correlates weaker than treadmill testing.

Keywords: Intermittent claudication, physical activity, functional capacity, exercise test, supervised exercise therapy

Introduction

Intermittent claudication (IC) is the most common symptom of peripheral arterial disease (PAD) and is defined as exercise induced muscle pain which relieves after a short period of rest.[1] Prevalence of PAD increases with age. A review that combined large population based studies reported a global estimated prevalence of IC from 2% (at 50 years of age) increasing up to 7% (at 70 years of age).[2] Patients with IC have a 20% risk of a non-fatal cardiovascular event and a five year mortality rate of 10- 15%.[3] According to national and international guidelines, treatment of patients with IC should be aiming to improve walking distance, quality of life, functional capacity and to prevent secondary cardiovascular riskfactors.[1,3-6] Supervised exercise therapy (SET) is proven to be very effective in increasing functional walking distance (FWD) and maximum walking distance (MWD) and improving quality of life. Therefore SET is indicated as primary treatment option for patients with IC.[1,4-6] The effects of SET are evaluated with a standardized graded treadmill test (GTT) and is indicative of a patients functional capacity (FC) which measures someone's maximum capability in a clinical setting.[7]

It is increasingly recognized that patients with IC have lower physical activity (PA) levels compared to healthy peers.[8-12] Physical activity is defined as any bodily movement produced by the contraction of a muscle that substantially increases energy expenditure.[13] Leeper et al.[14] stated that low PA is the most powerful predictor of long-term mortality in patients with PAD. In contrast to FC, studying PA outcomes are not yet recommended in clinical guidelines. Little or incomplete information about PA in patients with IC is known. Until recently, it was not yet possible to study PA objectively to give insight in what patient's actual do in their real life setting. New generation activity monitors allow us to do so. Different PA components can be measured: type, intensity, frequency, duration and the context of the activity. A recent study by Fokkenrood et al. demonstrated that PA did not improve during a three month SET program.[15]

For now, there is little information about the relationship between FC and PA in patients with IC. Investigating this relationship is needed and may help to improve treatment strategies for patients with IC in the future. It is hypothesized that a standardized treadmill test, measuring a patients FC, does not reflect how active a person actually is in real life. In addition, a patients FC measured by corridor-based function tests might be more related to a patients PA level and might lead to clinically more relevant outcomes for patients with IC. Therefore the aim of this study is to investigate the relationship between corridor- and treadmill-based function tests and objectively measured physical activity in patients with intermittent claudication.

Materials and methods

Study design

Cross-sectional study

Participants

Patients were recruited from February until May of the year of 2015 at the outpatient clinic of vascular surgery of the Catharina Hospital Eindhoven and at physical therapy clinics in the region of Eindhoven and Wageningen. The study population consisted of patients diagnosed with IC disregarding the onset of the disease and their treatment history. Patients were eligible for inclusion when they presented symptoms of IC fitting Fontaine's classification II, and presented an ankle brachial index (ABI) <0.90 and/or a drop of >0.15 after a standard treadmill test or showed clearly stenotic visible atherosclerosis on radiological imaging (by angiography or duplex ultrasonography). Exclusion criteria were conditions which seriously affect mobility (e.g. painful arthritis, hemiparesis), the use of walking aids or wheelchair, serious cardiopulmonary limitations (NYHA class 3-4) and previous lower limp amputation. All procedures were approved by the medical research ethics committee MEC-U of the Catharina Hospital Eindhoven and did not have to follow the Dutch law on medical scientific research.

Procedures

After informed consent was signed, eligibility criteria, demographic data and medical history where checked and obtained from the medical records and by interviewing the participants. Patients were thoroughly instructed about the function and wearing of the activity monitor to assess PA. Patients had to wear it for seven consecutive days and nights. It was explicitly said that patients had to continue their normal daily activities. The device is not waterproof and patients were asked not to wear the device when under water. After one week, patients returned to the hospital or clinic to perform several tests to assess FC with the graded treadmill test (GTT), the six-minute walk test (6MWT), the short physical performance battery (SPPB) and timed up and go (TUG).

Physical activity

A Dynaport movemonitor (MM) (McRoberts B.V., The Hague, The Netherlands) was used to assess PA. This MM has a tri-axial seismic accelerometer and contains three acceleration sensors. The MM was positioned on the base of the lumbar spine cranial of the

buttocks with an elastic belt. The MM scores excellent specificity compared to a gold standard (video observation) in seven activities, locomotion, lying, shuffling, standing, sitting and not worn (>91%) in patients with IC.[16] High intraclass correlation coefficients (ICC) were measured for number of steps (0.90) and sensitivity scored >86% for locomotion, lying, sitting and not worn.[16] It was intended to measure a broad spectrum of active and sedentary activity and therefor PA was defined into four classes (lying, sitting, standing, locomotion). These four classes were then defined in mean duration per 24 hours, number of periods and mean duration per period. Additionally, per activity the movement intensity (MI) was calculated.

Functional capacity

The following tests were assessed to provide information about the walking ability, functional limitation, basic mobility functions and lower-limb mobility as outcomes of FC. Patients were measured in a rehabilitation room at the hospital or physical therapy clinic.

The graded treadmill test (GTT) was performed to measure functional capacity as expressed in the maximal walking distance (MWD) described by Gardner.[7] The daily functional impairment could be assessed as functional walking distance (FWD) which expressed the distance a participant would normally stop walking because of calf pain. This outcome is proven to be reliable in patients with IC.[17] Patients were allowed to hold the sidebars only if necessary. This standardized protocol was widely used in the Netherlands and was described in the clinical guideline of the Royal Dutch Society of Physical Therapy.[5] A GTT was chosen since it was more reliable compared to a constant treadmill test in patients with IC and is widely recommended in clinical guidelines.[4,5,18,19]

The six-minute walk test (6MWT) was performed to assess functional limitation with a corridor-based function test according to a standardized protocol. Participants were instructed to walk a 20 meter path and to walk as far as possible in six minutes. The total walking distance (TWD) was reported. The 6MWT was proven to be a valid instrument to measure functional limitation with excellent test-retest reliability.[20-22] In addition, the 6MWT was negatively associated with mortality and mobility loss in patients with PAD.[23]

The short physical performance battery (SPPB) combines data of three separate tests measuring balance, walking speed and chair rise time as described below.[24] The SPPB is a measure of lower extremity mobility that predicts functional independence between 1 – 12.[24] The higher the score the better the physical performance. The original SPPB test protocol was used as described by Guralnik et al.[24] The SPPB was a recommended test for patients with PAD to assess the lower limb mobility.[25] The SPPB is recently validated in two studies with independent and disabled elderly and showed little sensitivity to change, but adequate measurement of lower-limb function.[26,27]

Standing balance measured the balance of participants after holding three standing positions for ten seconds each. The three positions were: standing with two feet together

side-by-side, standing with two feet side-by-side with the toes of one foot adjacent to the heel of the other and standing with one foot in front of the other.

3-m walking velocity measured the time that a participant takes to complete a 3 meter walk in fastest pace. This test was executed twice and the fastest time was used for analysis

Repeated chair rises measured the time that participants needed to stand up and sit back five times as quickly as possible from a straight-backed chair consecutively. Participants have to have their arms folded.

The timed up and go (TUG) was performed to measure basic mobility function by letting the patient sit on a chair, walk for 3 meters, turn around and then sit again. The TUG is a widely used test that takes little time, is easy to asses and gives an adequate view of basic mobility of the lower limb. The test has moderately good inter-reliability as well as test-retest reliability and was validated for quantifying functional mobility.[28]

Outcomes

Physical activity

Outcomes of seven consecutive days of data per activity of sitting, lying, standing, locomotion, shuffling (short walking activities <8 seconds) and not worn.

- Average duration per day per activity (minutes)
- Number of periods per activity
- Average duration per period (seconds)
- Weighted average movement intensity per period per activity (g)

Physical function:

- Total and functional distance of the standardized treadmill test (meters)
- Total distance of the 6MWT (meters)
- SPPB sum scores (1-12) and subdomains (balance, gait speed, chair rise time)
- Duration of TUG (seconds)

Sample size calculation

Calculating the correct number of patients for this study the following sample size calculation was performed. According to Dancey and Reidy correlations are moderate if r>0.4.[29] To be able to detect significant and clinical meaningful relationships, correlations of ≥ 0.4 were assumed relevant. Conventional significance and power levels are used (α=0.05 and ß=0.80, respectively). Two tailed tests are applied. Sample size calculation revealed 46 participants.

Statistical analysis

Data were analyzed using IBM SPSS Statistics v. 20. Data verification (10% of all data) was performed after entering in SPSS. No missing data was expected since testing should be possible for all participants. If the MM was 'not worn' for more than a day (24 hours) the case was excluded for further analysis. A complete case analysis is performed. Descriptive statistics were presented for all variables. Normality is checked for continuous data. Correlations were calculated between all primary outcome measures. Correlations and plots of FC and PA outcomes were determined. Preferably univariate parametric testing was performed. Pearson's correlations were calculated if normality assumptions were met. If assumptions were not met, non-parametric Spearmen rank correlations were calculated. To control for differences between SET and not following SET, a sub-group analysis (Mann-Whittney U) was performed. Significant differences were analyzed with a multivariate regression analysis to determine whether SET was a significant confounding factor regarding the correlation analysis.

Results

Baseline characteristics

A total of 55 patients were recruited for the present study. Nine patients were excluded for the following reasons: 'not worn' MM >1 day (n=3), withdrawn (n=4) and excluded due to surgical intervention during measurements (n=2). Table 1 shows the baseline characteristics of all 46 included patients.

The mean age of the sample was 66 years and 76.1% of the sample was male. The mean BMI was 25.7. Almost half of the patients (45.7%) had symptoms of IC in both legs. One third of the patients had a known cardiac history. Half of the patients were following or did follow a SET program.

Table 1. Baseline characteristics

	Total study population (n= 46)
Age (years), mean ±SD	66 ± 9.2
Male, n(%)	35 (76.1)
Caucasian race, n (%)	45 (97.8)
BMI, mean ±SD	25,7 ± 3.1
Both legs symptomatic, n (%)	21 (45.7)
Worst ABI at rest, mean ±SD*	0,63 ± 0.17
Worst ABI after effort, mean ±SD*	0,38 ± 0.19
Comorbidity	
Pulmonary , n (%)	9 (19.6)
Cardiac, n (%)	15 (32.6)
Neurologic , n (%)	5 (10.9)
Smoking history, n (%)	44 (95.7)
Treatment history	
Invasive (n=25)	
Dotter, n (%)	16 (34.8)
Stent, n (%)	15 (32.6)
Bypass, n (%)	7 (15.2)
Conservative (n=23)	
Following SET program, n (%)	18 (39.1)
Completed SET program, n(%)	5 (10.9)

Note, BMI = body mass index, ABI = ankle brachial index
*Based on 37 patients

Functional capacity

The median FWD and MWD of patients performing the GTT were respectively 349.0 meters with an interquartile range (IQR) of 130.0 – 508.3 meters and 432.5 (IQR: 199.3 – 702.5) respectively. Six patients (13%) completed the GTT which is 1600 meters. The median walking distance on the 6MWT was 392.0 (IQR: 320.5 – 451.0). The minimum score of the SPPB was 8 out of 12 points and 87% scored between 10 and 12 points. In partial scores 76.1% scored the maximum in balance, 97.8% scored maximum on walking speed and for sit to stand scores 71.7% scored ≥3 points. The median time for the TUG test was 7.70 seconds (table 2). Sub-group analysis did not report any significant differences between patient's receiving SET and patients not receiving SET.

Table 2 Functional capacity outcomes (n=46), median (IQR)

GTT	**Functional walking distance (meters)**	349.0 (130.0 – 508.3)
	Total walking distance (meters)	432.5 (199.3 – 702.5)
6MWT	**Total walking distance (meters)**	392.0 (320.5 – 451.0)
TUG	**Total duration (seconds)**	7.70 (6.76 – 9.86)
SPPB	**Total score (1-12)**	11 (10 – 12)
	Balance (1-4)	4 (3 – 4)
	Velocity (1-4)	4 (4 – 4)
	Chair rises (1-4)	3 (2 – 4)

Note, IQR = inter quartile range, GTT = graded treadmill test, 6MWT = six minute walk test, TUG = timed up and go test, SPPB = short physical performance battery

Physical activity

Data on daily PA is shown in table 3. The median active time (standing, locomotion and shuffling) of the patients was 271 minutes (18.8%) of the total time per day and consequently sedentary for 1169 minutes (81.2%) per day. The median number of steps per day was 6232 (IQR = 3327 – 9104).

Table 3. Physical activity outcomes (n=46), median (IQR)

	Total duration (minutes/day)	Number of periods (#/day)	Average time per period (seconds)	Average MI
Lying	631 (540-716)	9.4 (6.3-9.4)	3681.6 (2560.7-5608.1)	.005 (.004-.006)
Sitting	531 (463-606)	109.9 (89.6-135.8)	265.2 (184.7-367.6)	.019 (.017-.026)
Standing	155 (108-211)	893.4 (306.2-734.9)	9.9 (8.4-13.5)	.051 (.043-.057)
Shuffling	19 (14-33)	436.3 (306.2-734.9)	2.6 (2.5-2.8)	.141 (.131-.151)
Locomotion	77 (43-116)	444.1 (297.2-664.2)	9.3 (8.3-11.0)	.192 (.165-.205)

Total active time per day, minutes (%)	271.1 (18.8)
Total sedentary time per day, minutes(%)	1168.9 (81.2)
Number of steps per day	6232
ECBI per five minutes, median (IQR)	10.9 (5.7-13.9)
Not worn per day, minutes (IQR)	20.3 (5.6-43.0)

Note, IQR = inter quartile range

Functional capacity compared to physical activity

The FWD and MWD distances demonstrated significant correlations with all PA outcomes of locomotion except for the correlation between FWD and movement intensity of locomotion, which was just nearly significant (p=0.06). The 6MWT correlated significantly with all PA outcomes of locomotion except for the number of locomotion events (p=0.09). The FWD and MWD correlated moderate with duration of shuffling (r=.415 and r= .407) and number of shuffling periods (r= .425 and r= .416) respectively. The 6MWT correlated significantly with shuffling duration (r= .388) and number of shuffling periods (r= .373), although these correlations were weak.

The SPPB correlated weak with some PA outcomes varying from r = .313 to .386 significantly. The TUG correlates negatively with active PA outcomes where locomotion intensity was the strongest (r= -.492) and significant (p< 0.01).

Nine patients who received SET continued therapy during the measurement of PA, nine patients received SET but abstained and five patients completed a SET program. Sub-group analysis of patients who receive SET and patients who did not, revealed significant differences on PA outcomes of average duration of locomotion (p=.049), number of periods lying (p=.041) and mean time per period of locomotion (p=.013). In a multivariate regression analysis, SET did not reveal to contribute significantly to the relationship between FC and PA (p≥ .828).

Table 4.Spearman rank correlations between functional capacity and physical activity (n=46)

Physical activity outcome		Functional capacity outcome				
		FWD	**TTM**	**TWD**	**SPPB**	**TUG**
Lying	**Duration**	-.254	-.233	-.293*	-.201	.289
	#/periods	-.320*	-.268	-.156	-.010	.069
	T/period	.291*	.241	.106	-.034	.011
	Intensity	-.230	-.190	.029	-.062	-.051
Sitting	**Duration**	-.167	-.211	-.078	-.115	-.006
	#/periods	.154	.212	.299*	.157	-.274
	T/period	-.148	-.212	-.229	-.151	.178
	Intensity	-.103	.250	.157	.024	-.268
Standing	**Duration**	.236	.266	.209	.254	-.193
	#/periods	.449**	.429**	.356*	.313*	-.323*
	T/period	.474**	-.407**	-.303*	-.160	.279
	Intensity	.251	.286	.359*	.144	-.334*
Shuffling	**Duration**	.415**	.407 **	.388**	.386**	-.360*
	#/periods	.425**	.416**	.373*	.351*	-.334*
	T/period	.021	.032	.170	.252	-.169
	Intensity	.094	.168	.237	.165	-.192
Locomotion	**Duration**	.636**	.586**	.392**	.326*	-.329*
	#/periods	.473**	.434**	.255	.254	-.262
	T/period	.417**	.368*	.316*	.090	-.128
	Intensity	.277	.323*	.599**	.219	-,492**
Steps	**Number**	.663**	.621**	.425**	.334*	-.362*

Note Duration = time per 24 hours (minutes), #/periods = number of periods, T/period = time per period (seconds), Intensity = mean movement intensity, Steps = number of steps per day, FWD = functional walking distance treadmill test (meters), MWD = Maximum walking distance treadmill test (meters), TWD = total walking distance six-minute walk test (meters), TUG = time timed up and go (seconds), duration = total time per 24 hours, intensity = mean movement intensity, #/periods = number of periods, T/period = mean time per period, * = Correlation is significant at the 0.05 level (2-tailed), ** = Correlation is significant at the 0.01 level (2-tailed).

Discussion

Key results

The primary goal of this study was to identify the presence or absence of a relationship between corridor based and treadmill function tests and objectively measured physical activity. Both FWD and MWD as well as the TWD correlated significant with most walking outcomes of PA. However, in contrast to what was hypothesized the FWD and MWD correlated slightly stronger with locomotion meaning that the GTT as clinical outcome measure does explain more than a corridor-based function test.

Clinically relevant correlations (r≥ 0.4) between the FWD and PA (r>.415) were found in eight active PA outcomes. The MWD correlated moderate (r>.407) in six PA outcomes while the TWD correlated moderate (r>.425) in only two PA outcomes. Other active outcomes of PA (shuffling and standing) correlated just moderate to weak with the GTT and 6MWT meaning that function tests are not sufficiently related to other activities than locomotion.

The SPPB correlates weak with some outcomes of PA. The TUG correlates weak with some outcomes of PA and moderate with the intensity of locomotion. Most patients scored good to excellent on the SPPB and the mean time of the TUG (7.7 seconds) is quicker than healthy elderly in the age of 60 - 69 years (8.1 seconds).[30] This implicates that basic mobility functions are not diminished by CI, at least not in the present study population. The balance and walking speed of patients with IC was good to excellent in this sample also meaning that these determinants are not affected by the disease.

Overall, although correlating moderate, treadmill testing certainly does not explain much about the actual PA of patients with IC meaning that whether one wants to measure the increase in PA, different measurements are needed.

Limitations and strengths

Some patients with IC were actively participating in a SET-program during the present study. Due to the cross-sectional nature of this study, this participation could have influenced the PA-level as patients are encouraged to increase their daily PA. Moreover, patients following SET had some extra treadmill(test) experience, probably favoring FC outcomes during treadmill walking. Therefore the results of the treadmill test might be more accurate due to a learning effect, handling the pain and more efficient walking. This in contrast to the 6MWT which gives more reliable results, when assessed two times or more, due to a learning effect which our protocol did not include.[31] On the other hand, we applied just few exclusion criteria on purpose, to be able to include a broad and heterogenic sample reflecting the average IC patient in the Netherlands.

Different outcomes of PA were measured and the duration and number of periods per activity seemed most valuable. What time is spent during walking, lying, sitting and standing

and how many times someone is performing this activity are new types of measurements which give insight in the domain of PA. These outcomes tell us a lot about the nature of PA in patients with IC. To our knowledge, this is the first study which evaluated PA objectively and presented raw data giving more insight in the actual PA of a patient with IC. By dividing PA in different dimensions it was possible to identify a deeper meaning to the behavior of patients with IC in terms of sedentary and active activities and more importantly dividing active activities in terms of duration, times per day and mean time per activity. Moreover, sedentary behavior seems a substantial part of the daily PA in patients with IC.

Interpretation of findings in relation to current literature

Studying PA in patients with IC is subject of debate. In line with previous research, present population had a total active time of 18.8% per day where Lauret et al.[12] found an active time of 17.2% and Fokkenrood et al.[15] of 22.5% per day in patients with IC. As a result, this means a total sedentary time of 80% per day. One of the treatment goals in patients with IC is to encourage patients to become more physically active, while treatment should be focused on decreasing sedentary behavior as well. Just recently, sedentary behavior is found to be a relevant factor to reduce cardiovascular risk factors (CVRF).[32-34] Reducing the time spent sedentary becomes more emerging to manage CVRF, especially in patients already affected with a cardiovascular disease.[33] Whether the 6MWT or GTT should be the primary test to evaluate walking capacity is still unclear. Arguments in favor for the 6MWT[35] or the GTT[36] are both valid and interesting. The 6MWT which is a better reflection of outdoor walking and is preferred by patients,[35] the treadmill test on the other hand, is worldwide most applied and has stronger theoretical basis.[36] Better understanding of a patient's daily life in terms of walking activity might validate to choose for either one of them. This study contributed to this debate by finding a moderate to strong relationship between objectively measured PA in terms of locomotion and the FWD and MWD. However, the GTT is more related to PA, this test does not explain the whole domain of walking activity let alone physical activity and sedentary behavior. Which is not really surprising, as a laboratory setting is not completely comparable to a patients' home setting. A strong significant correlation of r= .636 between the FWD of the GTT and the total duration of locomotion still explains only approximately 40% of the relationship. So, research to determine which other component explain locomotion in daily living is warranted.

Implications for future research

In current practice and for scientific research purposes, treadmill testing is predominantly used to objectively measure a treatment effect. However, others suggested that corridor-based functional tests (e.g. 6MWT) might provide a better reflection of a patients' actual PA-level. We found weaker correlations between the 6MWT and PA as

compared to the treadmill test. So, treadmill testing is, in contrast to what was expected, a better reflection of daily walking activity than the 6MWT. Nonetheless, these weak to moderate correlations do not cover the domain of PA and therefore PA should be measured separately to adequately measure the success of e.g. SET. Moreover, the domain of objective measured PA is still relatively unknown. More data of PA with different samples of patients with IC contributes to a better understanding of the actual levels of PA which in turn will lead to more understanding of inactive patterns in patients with IC. Information can be used to better advice patients to reduce their sedentary behavior. If low PA is such a powerful predictor of mortality, successful therapy modalities need to be evaluated and reasons of sedentary behavior of patients with IC need to be investigated.

Generalizability

Our results are based on an average and heterogenic population of patients with IC. Therefore the results of this study give a reasonable reflection of a patient with IC in general. It must be considered that in the Netherlands a larger amount of patients with IC receive SET, as compared to other countries in Europe. Therefore PA levels might be somewhat higher as compared to patients in other countries.

In conclusion

Current evaluation of walking capacity measured with the graded treadmill test is moderately related to objectively measured physical activity outcomes of walking and standing. Despite the relation as found, functional capacity does certainly not explain the complete activity level of a patient with intermittent claudication. A lot about the domain of physical activity including sedentary behavior is left unexplained and future research should focus on other components of activity and take activity as separate outcome measure.

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