Introduction
The heart failure is a major problem in public health, which is in constant increase and has an enormous economic impact in the society. The patients with this ailment suffer high indexes of disability and morbimortality. They have frequent fatigue and / or difficulty in breathing (dyspnea); they are the main restrictive factors in their daily activities. [1] The functional stratification capacity by the symptoms of these population have proved to be an important tool to determine the risk or to evaluate the impact of drugs or none pharmacological interventions.

The symptomatic status in heart failure has traditionally been stratificated by questionnaires. These may overestimate or underestimate their capacity. This is because the auto perception may be influenced by other things such as: humour, personality, future expectative, previous health status, way of asking questions etc. [2]

The direct quantification of central parameters as the ventricular function or hemodynamic measurements, though are objective and reproductive, have scarcely or none relation with the exercise capacity.

The cardiopulmonary test shows a different alternative – though it provides a global evaluation of the response to the exercise- it is an expensive, complex and a bit available method that needs highly trained people to made and interpreted it. As cross- entry to the maximum oxygen (VO2 max), the easy, inexpensive and simple six minutes walk-test (6mwt) had many years on its back since its first description for respiratory patients[2] and although it does not determine the peak oxygen consumption, neither diagnose the cause of dyspnea to effort, nor evaluate the etiology or mechanisms of exercise limitation, it is a useful and well known tool for heart failure patients with mild to severe deterioration of their functional capacity.

Precisely, the feasibility and availability to make this test have been the aspects that have taken to multiple investigation teams to evaluate the walk test and its real possibility. Thus the principal applications for the six minute walk test are the functional capacity quantification, prognostic stratification and the evaluation of therapeutic approaches.

Most works that evaluated the 6mwt performance are heterogeneous due to the characteristic of the studied population, course treatment and technique used while making this test. Most results have been disagreeing, staying much more to discover and discuss with respect to the definitive role of this test in the management of this complex population. In the present paper we will review some aspects of its clinical use, remembering its indications, contraindications and details to its correct realisation and interpretation.

Antecedents
Three decades ago, Mc Gavin et al. described the usefulness of modifying the historical Cooper’s “12 minutes running test” – first describe to estimates functional capacity in healthy young people – to use it in patients with chronic bronchitis. [3]. Later in the year 1982, Butland et al. [4] demonstrated
that if the walked minutes were reduced to 6, the training effect to make the test were reduced too. In this way it was more comparable to the daily activities without loosening reproducibility and facilitating the process for technicians and patients.

Finally, Guyatt et al. 1985 [5], proposed this test as an alternative to evaluate the functional capacity in heart failure patients. In that work, the TC 6m demonstrated to be a promising, simple and reproducible tool which correlates with conventional measurements of functional capacity and ability to act. Almost a year later, Poole Wilson et al remarked the importance of the test as a complementary tool to clinical history and examination, emphasizing that it is less discriminating than the maximum oxygen consumption; but simpler and cheaper, which would facilitate the serial monitoring in this population [6]. Numerous works evaluating the 6mwt were published in the following 20 years; from those publications, some confirms these results, others refute them. Next we will review these antecedents, in order to to define in the light of the present evidence, the true role of this test in the clinical handling of our patients with HF.

**Evidence**

Most of the investigators tried to prove the TC 6m efficiency with respect to some important issues in the management of heart failure patients: quantification of functional capacity, prognostic stratification and evaluation of the effects of some therapeutics approaches.

**Prognosis:** although the first work published on TC 6m in HF tackled the possibility of measuring functional capacity, it was in 1983 by a sub study SOLVD trial of Bitner et al. where the possibilities of establishing prognosis by this test were first evaluated. In this publication, the patients who had walked less than 305 mts of distance, had greater possibility of dying (10.23% versus 2.99%; p = 0.01) of being hospitalized (40.91% versus 19.90%; p=0.002) or being in hospital by HF (22.16% versus 1.99%; p = 0, 0001) compared with those that reached more than 443 mts . In the mentioned study it was concluded that the walked distance was as an independent variable to predict morbidity and mortality [7].

Chahalin [8] informs that a smaller distance of 300 mts predicts survival in short but not in the long term. Roul et al. on the other hand, conclude that when the walk distance is done about 300 mts or less, the prognosis is worse compared with those than the surpass this mark [9]. Rotagno et al [10] published a study in 2003 where it was found that 300 mts walked was a reliable indicator prognosis for cardiac mortality in moderate HF. In FIRST ( Flolan International Randomized Survival Trial), evaluating the patients class IIIb- IV it was concluded that the reached distance is a strong and independent prognosis to predict mortality and being in hospital. The medium range was of 218 mts, and those that did not reach it had 4, 6 times greater risk of mortality and hospitalization [11]. Curtis et al. studying 541 patients, refer that those who reached less than 200 mts in the test, showed to have a noticeably greater risk death [12]. Nevertheless, Opasich [13] in his investigation publicated in 2001, reports that 6mwt does not offer additional prognosis information to the maximum consumption of oxygen or the traditional classification of functional capacity of NYHA.

Although, the works are not absolutely coincident in their conclusions we can state according to our review and until we have more definite data, to take 300 mts as dichotomizing cut point to qualify a HF as severe or not.

**Therapeutic Evaluation:** since the 6mwt is used in patients with cardiopathy, it has been thought that it could be useful evaluating the therapeutic results. Such supposition was based on the concept that some drugs in evaluation by those years –IECA for example- could improve resting and exercise hemodynamics, without increasing the maximum capacity to exercise. That is why it was considered that a submaximum test would be preferable at the time of measuring the benefit of certain treatments in patients with heart failure. On the other hand, numerous articles about respiratory patients had reported that the 6mwt was useful to evaluate the effectiveness of therapeutic interventions [5]. Thus, the walk test was used to evaluate the therapeutic drug results (IECAs, Beta blockers), devices of ventricular stimulation, cardiac rehabilitation, etc. Most works evaluating IECA or beta blockers did not demonstrate improvement during the walk [2]. This finding can be due not only to limitation of the test, but also to the inclusion of patients with slight symptoms, to the size or design of the trial, to the inadequate standardization of the technique or to the drug incapacities to improve the results. Demers et al. in the RESOLVDTrial(Randomized Evaluation of the Strategies Left Ventricular Dysfunction) inform that 6mwt is highly reproducible and reliable, correlating itself with the functional class of the NYHA and with the quality of life [14].

Likewise Olson [2] in one important revision concludes that the 6mwt has not shown to be a significant test fo the identification of positive therapeutic interventions, although seems to be useful when evaluating the resynchronization cardiac therapy. While more advance the degree HF or functional deterioration is, the greater the value of the test will be; where it would work as maximum oxygen consumption.

Meyer [15] and Wright [16] have reported positive correlation between the results of the cardiac rehabilitation with the performance at the 6mwt in HF patients. In his book, de la Serna [17] states that...
the next step in the use of the walk test would be to find if the increase of the walked distance –after treatment- would also mean increase of survival. With respect to this, Faggiano [18] warns that due to the inherent variability of the test; even though the results indicate statistical significance, the clinical relevance of them must be carefully evaluated, proposing that the change should be at least of the 10% with respect to the previous test to be considered.

In spite of these works, the TC 6m has demonstrated to detect better the clinical deterioration that the improvement [19]. Following O'Keefe, he reports that the smallest walked distance associated with clinical deterioration was, in average, a diminution of 43 meters [17].

In summary, the evidence shows that the utility of the 6mwt as therapeutic evaluation is not yet defined. Nevertheless, its contribution seems to be greater when the population to be evaluated has an important lost in its functional capacity – "it detects better deterioration than improvement" -.

Other Controversial Aspects

What must we measure?
The datum princeps in the 6mwt is the amount of walked meters and from it, it was tried to establish the cut points to stratify prognosis or severity criteria of the pathology [19]. When we compare the basal data with the obtained after therapeutic interventions, the effectiveness or not of this intention is concluded.

Cardiovascular parameters: although hemodynamic or even data of ventricular function by radio isotopic ventriculography have been reported; in general, only the basal values and the post effort heart rate are registered (by pulse palpation). Occasionally, the electrocardiography traces or the blood pressure values can also taken in count (telemetry).

Respiratory parameters: some studies have reported data obtained with a portable equipment with gas analyzers, but its applicability is restricted to the experimental field [20, 21]. The measurements of the oxygen saturation in patients with respiratory pathologies is classic, but in general it is not reported in studies referred to heart failure. It could be of utility in patients who have demonstrated desaturation during the cardiopulmonary test or before cyanotic cardiopathies. According to recommendations of the American Thoracic Society its use is optional [19].

Maximum or sub maximum test?
Due to own characteristics, like the individual walk speed election, the 6mwt has been considered a submaximum test. This is true in healthy people where the 6mwt corresponds to a moderate effort, but as the functional capacity is deteriorated, the test becomes progressively harder when HF is severe. It can correspond to an intense stimulus closely to the maximum.

Guyatt, in his original work describe it as stressful, closely related to activities of daily living in patients with HF and moderate to severe functional limitation [5]. Opasich as well finds a poor relation between the walked meters and the anaerobic threshold [13]. In other studies, including patients with greater deterioration, the correlation of the walk test with the maximum oxygen consumption has been high. The measured values of maximum VO2 during 6mwt have even been still greater than the observed during the cardiopulmonary test. Roul observed that the patients with worse prognosis make their life daily activities nearly their maximum tolerance of exercise[9].

Kervio [22], comparing healthy people with heart failure, informs that the respiratory adaptation is different in these population. They have characteristic ventilation components according to its functional capacity: smaller walked distance = more alter respiratory pattern. The work intensity is, near 75% of the VO2 max in healthy people and it is about 90% in HF. Coincidently, Faggiano describes that 73% of the patients evaluated with 6mwt reached the anaerobic threshold with a respiratory quotient to =1 [21].

Besides, the characteristics of the studied populations some technical factors (verbal motivation [23] for example) can influence in the effort made and approximate the work intensity in the 6mwt come near to VO2 peak.

Before the referred evidence; we can say that the 6mwt can be either a maximum or a submaximum test, depending on the population's characteristics or the technique used in the study.

Test of 6 minutes versus VO2max
The 6mwt presents some characteristical virtues that caused it to be considered as an alternative to the cardiopulmonary test. It is a test easy to perform that it reflects the patient's ability to act in his
daily life, similar to the formal quality of life measurements and allows monitoring the patients in series [24]. The cardiopulmonary test is expensive, inaccessible and threatened for the patient, etc. In a study of Cahalin et al. [8] the conclusion was that in patients with severe IC evaluated for transplant, the distance walked in the test predicts the VO2 peak and the survival in the short term. For Zugck et al. [25] the six minute walk test is correlated with with the maximum VO2, and affirms that it provides very similar information prognosis.

According to Rou’s work [9], he states that only when the reached distance is of 300 meters or less it can be correlated with VO2 max. Lucas et al [26] also inform that when the VO2 peak was between 10 and 20 ml/kg/min the correlation with the test of six minutes was weak and the distance done in 6 minutes did not predict survival.

On the other hand, Opasich [13] questions the 6mwt utility comparing it with VO2 max. In his work he informs that in 315 patients with HF moderate to severe as much as the classification of the NYHA as the maximum oxygen consumption offers better information than and that it can not be used like an alternative to cardiopulmonary test. Likewise, the relation between meters walked and functional capacitor indicators is poor. The lack of uniformity in the results of these works speaks by itself. Its reasonable that a test where the patient walks to his own rhythm, with limited aparatology does not contribute with the same way that an exhausting test, with detailed analysis of multi-physiopathological aspects. In that sense, M Schaufelberger & K Swedberg in their editorial of 1998, warn that these tests offer complementary information [27].

Is 6mwt reproducible?
The 6MWT has proved its excellent reproducibility in the short term and even to one year. This aspect is fundamental at the time of deciding its clinical utility. That is why it is necessary to unify strictly the technical details in order to obtain feasible results. To make a practice test and verbal motivation are fundamental.

To make a learning test has been responsible to reduce the variability of the meters walked until a 17%. This detail has been fundamentally mentioned since the first description made by Mc Gavin [3]. The verbal motivation is another aspect that can considerably alter the results either in cardiac or respiratory patients. For this reason, when making it extreme measures must be referred to its uniformity [5].

In addition to the mention points there are some characteristics of the population that can also interfere in the performance of the test such as: low stature, female sex, age etc. (SEE APENDIX 4- [19].

Ingle (28) enumerates the clinical determinants meters walked in the 6mwt:
- Age>75 years old
- IMC high
- Cardiac frequency > 80/1p/m
- Anemia
- Female sex
- Wide of QRS
- NT-Prob BNP
- Self perception of anxiety, depression and quality of life
- Race

Summarizing: to make this test reproducible the details related to the personnel and to the test technique (verbal motivation, previously performed test, etc).

The determining variables of the final performance of our patient in the long walk test are the same in controls and patients with HF. It is necessary to take them into account to increase the reproducibility and to interpret correctly the test results.

- What and how must we inform the results?
  Although the guides and the investigation papers suggest a rigid standardization according to the rules, we do not know if they are with clinical purposes, it is better to express the final result as an absolute value (walked meters) like percentage of change with respect to the basal value (for example: 10% improvements in relation with the previous test), or as a change in the percentage of a predicted value (calculated by means of formulas – SEE APENDIX 3 -).

The recommendations insist to detail the absolute value in meters, but the report of the other two mentioned data previously, would allow to evaluate the individual evolution (change in the percentage) or to establish a comparison with the healthy population (percentage of change in the
Conclusions
The 6mwt is an easy and inexpensive test to make. It is a useful tool to value capacity in HF with at least moderate deterioration of this capacity. To improve its results, it is fundamental a strict observation about the technical details while it is applied. Many aspects must be meticulously considered; related to the personnel who will apply it, and the local where the test will be made.

When the TC 6m is carefully done by the same person, and after a test of practice, the short term reproducibility, including at 1 year is considered excellent.

The 6mwt can give prognostic information in a short term and complements, but it does not replace the information that offers the VO2 max consumption. Its applicability evaluating the response to the treatment or a prognostic tool, seems to fortify itself in the populations that presents greater functional deterioration. Also it can not really define precisely the cut points that would allow evaluate our patients’ risk.

We hope that in the next years the works that evaluate this test will standardize the mentioned technical aspects, and maybe new answers will allow us establishing the definitive role that the 6mwt will play in the management of our patients.

Technical Aspects
It will never be sufficiently repeated the fundamental importance of unifying the technical aspects related to the test, in order that the obtained results in different centers can be comparable. The discrepancy of the results found in the bibliography is due to the heterogeneity of the populations included and because the different protocols were not well detailed by the different authors. Although some aspects do not have definite consensus, the present recommendations aim to uniform the accomplishment of the test, which will improve its reproducibility.

Personal: The person in charge of the test must be trained in the standard protocol of the test and must have been supervised on many occasions before making the test alone. He/she must also be trained in cardiopulmonary resuscitation.

The place: It is needed a close corridor from 20 to 50 meters of length, little visited, with a demarcation each 3 meters. Visible marks must be clearly seen from the beginning to the end.

- Required equipment:
  - Timer or Chronometer
  - Tachometer
  - Cones to demarcate start line and returning point
  - A chair that can easily be moved along the corridor
  - Oxygen source
  - Sphygmomanometer
  - Telephone
  - Defibrillator

Patient preparation:
  - Wear comfortable shoes and clothes
  - Take their medicines as usually
  - Do not make vigorous exercises 2 hours previously to the test

Measurements and initial cares:
  - The tests must be made at the same time of the day
  - The patient must be sit on a chair 10 minutes before the test starts
  - Check the contraindications, take rate pressure and pulse
  - Complete the first part of the sheet
  - Pulse oxymetry (optional) in case to be made
  - Register cardiac frequency and oxygen saturation
  - Stand up the patient. Check his dyspnea and fatigue values (Borg’s scale)
  - Put the chronometer in cero
  - Give some instructions to the patient
Making of the test:

- Put the patient on the starting line
- Activate the chronometer when the patient begins to walk
- Stay near the starting line during the test
- Do not walk with the patient
- Do not talk during the test
- Use the same standardized phrases for speaking to the patient
- Pay attention to the patient and write down each round the patient makes
- Leave the patient to see you making this, use emphasized corporal language right. There are still 5 minutes to finish"
- Second minute: "Go on, there 4 minutes left to finish the study"
- Third minute: "You are working all right. You have finished half of the work",
- Fourth minute: "Go on as you are working. There are still 2 minutes to finish the study"
- Fifth minute: "You are working very well. There is only 1 minute to finish"

Do Not Use Any Other Words
DO NOT USE CORPORAL LANGUAGE TO HURRY UP THE PATIENT
In case the patient needs a rest, tell him that he must continue when he feels in conditions to work.

DO NOT STOP THE CHRONOMETER
Let the patient stop, he may lain on the wall in case he prefers. If the patient does not want to go on, you decide to stop his study. Sit the patient and write down the walked distance and the reason for stopping.

When there are 15 seconds left to complete the 6 minutes, say:
Within minutes I will ask you to stop. When you stop, stay where you are, I will go over there-
When the time is over say: “Stop”. Walk to the patient and mark the stopping place.

Sit the patient and register the dyspnea and fatigue index using Borg's scale.

Check the cardiac frequency and oxygen saturation with the oxymeter (if it's available)

Calculate the meters walked, write down all the data, congratulate the patient for his effort and offer him a glass of water.

Indications

Evaluation of the functional capacity
- Chronic obstructive pulmonary disease
- Cystic fibrosis
- Peripheral vascular disease
- Elderly

Evaluation of therapeutic efficiency
- Chronic obstructive pulmonary disease
- Pulmonary transplant
- Pulmonary resection
- Lung volume reduction surgery
- Pulmonary rehabilitation
- Pulmonary hypertension
- Heart failure

Prognostic stratification
- Chronic obstructive pulmonary disease
- Pulmonary primary hypertension
- Heart failure

Contraindications

Absolutes:
- Angina pectoris in the last month
- Acute Myocardial Infarction

Relative:

- Basal cardiac frequency superior to 120 beats per minute
- Systolic hypertension
- Diastolic hypertension superior to 100 mm./Hg.

Under some of these findings, the patient must be referred to his family doctor to determine the behavior. The chronic stable angina is not an absolute contraindication to the test, but the ischemic medication must be taken before the test and you must have at hand nitrates.

The patients with the mentioned risk factors might previously present increased risk of arrhythmias or a cardiovascular collapse during the test. Although the experience of hundreds of test made in elderly or in patients with myocardiopathies they have not shown serious events.

The listed contraindications were used taken into account the investigators' criterion with respect to the general security of 6mwt, wishing to be prudent. That is why we do not know precisely if the patients with the mentioned contraindications might suffer events when making the test.

APENDIX 1

INSTRUCTIONS FOR THE PATIENT

"The aim of this test is to walk as much as you can during 5 minutes. You must go and return by this corridor. You can experience lack of air or to feel tired. That is the, reason why you can reduce the speed or stop in case of being necessary, but try to return to walk as fast as it is possible. When arriving at the marks of beginning or end, return immediately, as I am going to show to you (- to make demonstration practical -) "Are you ready? Remember that the objective is to walk as much as you can during 6 minutes, but you must not run. Begin now or when you are ready".


APPENDIX 2

BORC’S SCALE

Subjective effort perception

<table>
<thead>
<tr>
<th>Level of effort</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>very, very light</td>
</tr>
<tr>
<td>7</td>
<td>very light</td>
</tr>
<tr>
<td>8</td>
<td>light</td>
</tr>
<tr>
<td>9</td>
<td>something hard</td>
</tr>
<tr>
<td>10</td>
<td>hard</td>
</tr>
<tr>
<td>11</td>
<td>very hard</td>
</tr>
<tr>
<td>12</td>
<td>very, very hard</td>
</tr>
</tbody>
</table>

APPENDIX 3:
FORMULAS TO CONSIDER INFERIOR LIMIT OF NORMALITY

According to literature data, the formula of Troosters would be preferable to the Enright et al., because the first author made tests of practice in his original work. Enright & Sherrill's formula would underestimate the results.

Troosters, 1999

\[ 6 \text{mwt} = 218 + (5.14 \times \text{sex}) - (5.32 \times \text{age}) - (1.80 \times \text{weight}) + (51.31 \times \text{sex}) \]


\[ 6 \text{mwt} = (7.57 \times \text{height cm.}) - (1.76 \times \text{weight kg.}) - (0.02 \times \text{age}) - 309 \text{ m} \]

Alternative equation using IMC (expressed in kg/m²):

\[ 6 \text{mwt} = 11.40 \times \text{IMC} - (6, 51 \times \text{age}) \]

**WOMEN**

\[ 6 \text{mwt} = (2, 11 \times \text{height cm.}) - (2, 29 \times \text{weight kg.}) - (5, 76 \times \text{age}) + 867 \text{ m} \]

Alternative equation using IMC (expressed in Kg. /m²):

\[ 6 \text{mwt} = 1017 \times \text{IMC} - (6, 24 \times \text{age}) \]


With both equations remove 139 m to obtain the inferior limit of normality.

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APPENDIX 4
Factors that reduce the distance walked in the 6mwtd

- Low stature
- Age > 5
- Female sex
- Overweight
- Cognitive deterioration
- Short corridor
- Pulmonary disease
- Cardiovascular disease
- Skeletal muscle diseases

Factors that increase the distance walked in the 6mwt

- High stature
- Male sex
- High motivation
- Previous accomplishment of the test
- Supplement of Oxygen in patients with hypoxemia induced by exercise


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APPENDIX 5
REPORT OF 6 MINUTES LONG WALK TEST

Date:
Name of the Patient:
Age: S/or: Race:
Weight: Height: Basal Adrenal pressure:
Present medication:
Number of rounds: ___________ ___________ ___________ ___________ ___________ ___________ ___________ ___________
Basal End
Hour
Blood Pressure
Heart Rate
Dyspnea (scale of Borg)
Fatigue (scale of Borg)
O2% Saturation

Stopped before the 6 minutes by:
Other symptoms when finalizing the test
Number of finalized laps: Result in mts:
Incomplete final lap (mts):
Total distance of long walk:
Percentage of improvement: %
Predicted distance: mts Percentage of the Predicted one: %
Comments:
CV of the author
- Médico Cardiologista do Serviço de Cardiologia do Hospital Mãe de Deus - Porto Alegre - RS
- Diretor do Centro de Prevenção e Recuperação de Doenças Cardiovasculares - PREVENCOR - Porto Alegre - RS
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