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Rehabilitation in Cancer Survivors: Interaction Between Lifestyle and Physical Activity

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1. Introduction

1.1 Physical activity, body composition and cancer

Cancer is not a new disease, there are findings of neoplasia in the mummies of ancient Egypt, there are descriptions of the Romans and the Greeks and even remains in the fossil of dinosaurs. The study of the epidemiology of cancer, however, demonstrates an increasing incidence with an alarming progression, which is also involving countries which were considered "protected" or otherwise at low risk until last century.

- The progressive industrialization has led to an increase of environmental pollution with newly synthesized toxic substances, unknown by biological systems during the evolutionary process. Technological innovation has also increased the yield in agriculture, which has resulted in an increased food availability and a profound change in eating habits both for the type and for the amount of introduced nutrients. Technological development has also radically changed lifestyle with a progressive increase in sedentariness, a reduction to the sun exposure, causing a vitamin D deficiency also in children, by altering the circadianicity of circadian rhythms which regulate, depending on sunlight, the correct functioning of our body, including cell proliferation.

In general, the standard of living has increased in many countries, it has lengthened the life expectancy and, with it has increased cancer.

The improvement of recovery rates and survival with the progressive increase in the average age, in association with a greater focus on the quality of life, has led to basic definitions for cancer rehabilitation. This aims to help both to minimize the effects induced by the disease and the treatment (surgery, chemotherapy, radiotherapy, hormone therapy) and to regain control of many aspects of life in order to become an effective means of prevention for recurrences and comorbidity (Carver, JR.; Shapiro, CL 2007).

The rehabilitative intervention, therefore, shouldn't aim only to control physical pain but also to relieve the mental, social and spiritual pain, with all the other symptoms (Mikkelsen T .2009) (Fialka-Moser, V Crevenna, R.. 2003).

Since the 80's, scientific literature has stressed the link between sedentariness and certain types of cancer (Garabrant 1984).

Physical activity is one of the modulators of the cancer risk and survival factors that awakens our attention to the possibility of implementing a strategy within our operational capabilities.

In the history of scientific analysis of data related to physical activity, the capability to monitor it has come up against many methodological difficulties which have prevented to gather uncontaminated data, due to poor sensitivity and specificity of the used methods.

In particular, seven are the highlighted weak points:

1. most of the studies used questionnaires, often in retrospective and self-administration situations , giving many problems related both to their poor reliability of self assessment, typical of overweight people (as they often are physically inactive people) and to the inconsistencies sometimes found between the body mass and the energy expenditure calculation;
2. The quantification considered the so-called occupational (work-related activities) and / or recreational activities. Monitoring involved long periods of time in which the introduced technologies in the workplace have often increased sedentary lifestyle.
3. Most of our literature hasn't revealed the composition of each person's diet both under a calorie and under a composition point of view, right now when we are focusing our attention to glycemic index of food for their capability to induce abnormal insulin elevations, an anabolic hormone but with powerful proliferative activities.
4. We can't very often have reported data on the qualitative composition of lipids or their quantitative distribution during the day: the intake of dietary fat with a "cafeteria" diet (often connected with the type of job) shows the capability to induce inflammation and to trigger a chain of pro-cancerous events.
5. We can't always find reliably identified the duration and intensity of each physical activity and not always the used algorithms are normalized for the mass of each individual.
6. The daily activities are not located in the light and dark temporal space. Furthermore we don't have any idea, even indirect, of the situation of the vitamin D connected with the sun exposure and whose lack, especially in over 60 year people, can be a risk factor for different types of neoplasia.
7. We do not always have signs of body composition, being the BMI (Body Mass Index) the parameter for measuring the individual's structure, but it does not give an idea of body fat (especially in Asian people). This is an important piece of information as body fat is a good parameter to consider the relationship between energy intake and energy expenditure in physical activity. Fat is also an active organ under an inflammatory and hormonal point of view for **carcinogenesis** processes and tumor progression, but it is also a sensitive tissue in its plasticity in physical activity.

1.2 As regards the management of physical activity after the patient's diagnosis, it should be noted that

1. the American College of Sports Medicine has recommended to everybody, healthy and tumor-bearing, to do physical activity, even if of moderate intensity, for at least 30 minutes for 5 days a week (Haskell 2007, Schmitz 2010);
2. the American Institute for Cancer Research and the Word Cancer Fund recommends to practise physical activity at least 60 minutes a day, even if of moderate intensity, or 30 minutes of intense activity (World 2007) in order to reduce cancer risk.

1.3 As regards the creation of a proper physical exercise for the individual it should be noted that

the relationship between the mass of our body and the height has always been a guide for trainers to do their job. Older clinicians spoke about constitutional types, such as brachytype to mean short people in stature or those who appeared long-limbed, basically thin and tall. Today the relationship between weight in kilograms and height in squared meters, called BMI (Body Mass Index), has become a useful indicator of easy calculation to define the population in terms of normal-weight (BMI between 19 and 25), underweight (BMI <19), overweight (BMI between 25 and 30) or obese (between 30 to 35) or super-obese (> 35). The BMI correlates with the amount of fat, with the production of inflammatory proteins, with blood pressure, with the risk of many disabling diseases or life-threatening conditions such as diabetes, dementia, arthritis, depression, cardiovascular diseases and, with increasing evidence, cancer. The World Health Organization estimates that worldwide there are at least 1.6 billion overweight people (WHO 2006). Obese people exceed 400 millions whose incidence in Western countries has now reached and in some cases exceed 20% of the entire population (CDC 2006).

- The link between the weight gain and the incidence of cancer has been linked to biochemical factors that characterize the increase of fat mass like the increase of insulin, of IGF (Insulin Like Growth Factor), of Adipokine, Steroids, but also hypoxia linked to obesity and the entering into circulation of stromal fat cells (IARC 2002, World Cancer Research 2007, Renehan 2006, 2008, 2009).
- Today there are a lot evidences of a strong correlation between obesity and cancer, with specificity for each sex, with the involvement of a growing type of cancer in different populations.
- The obesity is linked to 20% of all cancer deaths in women and 14% in men (Calle 2003)
- It is evident that in case of obesity, exercise becomes an important moment to fight what described above.
- Tumors associated with increased BMI are cancer of breast in post-menopausal women, of prostate, of kidney, of esophagus, of endometrium, and it was determined that there is an increased risk for each increment of 5 Kg/m^2 at the BMI (Roberts 2010)
- There is a direct correlation between BMI and plasma insulin levels (McKeown-Eyssen 1994, Giovannucci 1995)
- High levels of insulin are associated with insulin resistance and low plasma levels of Insulin like Growth Factor Binding Protein 1 and 2 (IGFBP1/2), proteins which bind IGF-1 (Insulin-like Growth Factor 1) which in turn has an activity to promote cell proliferation. The reduction of IGFBP1 and IGFBP2 increases the levels of free IGF-1.
- Many epidemiological studies have shown that high plasma levels of insulin before eating, C peptide (an insulin secretion indicator of the pancreas), are related to risk of endometrial, pancreatic, colorectal, postmenopausal breast cancer (Goodwin 2002, Pisani 2008; Wolpin 2009)
- Obese individuals usually have high plasma levels of IGF-1 (Frystyk 2004), and high plasma levels of IGF-1 have been linked to high risk for cancer of the colon and the rectum, the prostate and the premenopausal breast (Renehan 2004) and, with less evidence, in the postmenopausal phase (Renehan, 2006). The IGF-1 elevation in adipose tissue results in an increase of aromatase, an enzyme involved in the conversion of androgen hormones into estradiol hormone at high mitogenic activity on the epithelium of the mammary gland (Travis 2003).

1.4 Breast cancer and the management of physical exercise

Breast cancer is the most common female cancer in many countries.

1.4.1 As regards risk factors for breast cancer it should be noted that

these have been identified in the:

- Excess weight
- Excess body fat
- High insulin on an empty stomach
- Insulin resistance
- Increased plasma levels, Insulin Like Growth Factor
- Increased plasma levels of hormones at estrogen and androgen activity

All the listed factors above are involved in the proliferative in vitro and in vivo cancer processes (Stephenson, 2003; Del Giudice 1998; Bruning 1995; Sachdev 2001; IARC 2002).

In literature there are few data about the effects of physical activity on women related to the parameters listed above (Schmitz 2005)

- There is evidence that obesity is a risk factor for breast cancer (Stephenson 2003, World Cancer Research Fund 2007)
- The high caloric intake in relation to the energy needs has been indicated as a possible cause of increased risk of breast cancer, but studies have given conflicting results. A positive relationship was described by 7 out of 15 case control studies (Franceschi 1996; Iscovitch 2004; Katsouyanni 1994, Levi 1993; Toniolo 1989; vant'Veer 1990, Yu 1990), 2 out of 10 prospective studies (Gaard 1995; Barrett -Connor 1993), with a relative risk between 1.3 and 3.5. Instead, no relationship was found by other authors (Malin 2005; Graham 1991.1992; Holmberg 1994, Ingram 1991; Katsoiyanni 1988, Miller 1978, Rohan 1995, Yuan 1995, Holmes 1999, Howe 1991, Jones 1999; Kushi Velie 1992 2000; van der Brandt 1993) and an author found an inverse relationship (Knekt 1990).
- In a latest prospective study, 38.660 women aged from 55 to 74 years were monitored in the U.S.A. between 1993-2003. In that period of time, 764 new cases of breast cancer were diagnosed. The use of questionnaires allowed us to quantify the contribution of energy, the amount of physical activity, the weight, the height and the BMI of the population. The relative risk (RR) of breast cancer for patients with the highest quartile of caloric intake compared with women with the lowest quartile was equal to 1.25 BMI > 30Kg/m2 compared with BMI < 22.5 kg/m2 and led to a risk equal to 1.35. Women with intense physical activity > 4 hours weekly reduced their RR to 0.78% compared to less active ones. Patients with the highest energy intake, with a higher BMI, doing less physical activity than the others, have a RR of 2.10 (Chang, 2006).
- Obesity, at the moment of diagnosis, is an unfavorable prognostic factor both for recurrence and for survival (Chlebowsky 2002, Boyd 1981, Goodwin 2002, Kumar 2000, Newman 1986)
- The weight gain after the diagnosis is a common phenomenon (Rock 1999; Demark-Wahnefried 1997, 2001; McInnes 2001; Goodwin 1999; Asiani 1999; Harvie 2004; Freedman 2004; xxDonegan 1978; Donegan 1978; Dixon 1978; Hernandez 1983; Bonomi 1984; Foltz 1985; Heasman 1985; Hunington 1989; Chlebowski 1986, 1993, Goodwin 1988, 1998, Gordon 1990; Levine 1991; Demark-Wahnefried 1983,1997; Faber-Langendoen 1996, Cheney 1997).
- In the Health Eating and Lifestyle Study (HEAL), 514 women with breast cancer, stage 0-IIIA, were monitored for body composition by DEXA for a period of 2 years. At the

end of the first year after diagnosis, 68% showed a weight gain between 1.7 and 4.7 kg and 74% increased their fat mass between 2.1 and 3.9%. Three years after diagnosis, the patients with greater weight gain were those with the higher stage, post-menopausal, younger, with greater reductions in physical activity after diagnosis (Irwin 2005).

- The chemotherapy has an important role in weight gain. The role of Tamoxifen would seem poor, instead, more important is the effect of other drugs such as Cyclophosphamide, Metrotexate, Epirubicin, Fluorouracil (Demark-Wahnefried 1993, Goodwin 1999, Cheney 1998 Fisher 1997; Ascani 1999, Shepherd 2001, Faber-Lanhendoen 1996; Camora 1990)
- Weight gain after diagnosis is a negative prognostic factor for survival (Chlebowsky 1987; Camora 1990; Bonomi, 1985), however, it was denied by other authors (Levine 1991; Heasman 1985, Goodwin 1988, Costa 2002)
- Women with breast cancer have an increased risk for hypertension and diabetes (Aziz 2002; Ganz 1998)

1.5 Weight and physical exercise

- Excess weight and reduced physical activity are included in a proportion between one-quarter to one-third of breast cancer carriers (IARC 2002)
- Physical activity is considered a reliable factor for breast cancer risk reduction in postmenopausal women (IARK 2002, World Cancer Research Fund in 2007, Monninkhof 2007; Friedenreich 2008), regular physical activity in itself can reduce the risk up to 20% (Warburton 2007)
- Case-control studies (Vanio 2002, Bernstein 1994, Carpenter 1999, Carpenter 2003; Yang Bernstein 2005) and cohort studies (McTiernan, 2003; Patel 2003; Dallal 2007; Lahmann 2007) demonstrated that the risk of invasive cancer of the breast is reduced by a percentage varying from 15 to 50% in women who do physical activity. Furthermore, a reduction of 50% has been reported in women of childbearing age with 4 hours of physical activity per week or post-menopausal women with the habit of regular and intense physical activity (Carpenter 1999, 2003). The results were confirmed in geographically different populations. They involved Asian and African-American women (Yang) Bernstein 2005). The risk of carcinoma in situ is reduced in women with regular physical activity as well (Patel 2003)
- The California Teachers Study (CTS), a prospective study on 133.000 women, showed that both the invasive breast cancer and the carcinoma in situ show a level of risk inversely correlated with the amount of physical activity as long as women were involved at least 5 hours per week during all their fertile life.
- However, it should be noted that moderate or intense protracted physical activity for a long period of life has demonstrated protection only for the risk of invasive cancer, compared with positive neoplasia for estrogen receptors, but not for invasive cancers which are negative for these receptors (Dallal 2007)
- The EPIC (European Prospective Investigation into Cancer and Nutrition) showed that women with higher recreational or occupational physical activity have a lower risk than those with the lowest quartile of physical activities, both in pre and post menopause. In an absolute sense neither recreational nor occupational activity show a relation with the risk. (Lahmann 2007).
- With regard to breast cancer in postmenopausal women in a meta-analysis of 19 cohort studies and 29 case-control studies showed an inverse relationship between risk and

amount of physical activity (Monninkhof 2007). The evidence is weaker for premenopausal women in which a risk reduction of 6% per weekly additional hour of physical activity, but only in half of the studies considered of the "highest quality".

- In particular, women with breast cancer, who exercise more than 9 MET per week, show a reduction in recurrence between 40 and 67% (McTiernan, 2008; Ibrahim 2010, Irwin 2007) compared with sedentary individuals.

1.6 The management of physical exercise in case of prostate cancer

- There are a lot of studies in literature which suggest a low risk reduction. (Vanio 2002). Instead, physical activity reduces the risk of the prostatic adenoma (Platz 1998)
- There is, however, some evidence that, in the groups, the most active men show a reduced risk of 10-30%, compared with the less active ones, and that the benefit is much more evident when high-intensity physical activity has started early in life (Friedenreich 2002)
- In a case control study of patients with grade 2 or more of prostate cancer, physical activity, which they had started in adolescence and which they had continued at high intensity for the rest of life, showed no substantial risk reduction (Friedenreich 2004)
- Cohort studies didn't demonstrate significant risk reduction, but they reduced the incidence of more severe forms or the ones with a fatal outcome (Friedereich 2004, Giovannucci 2005, Patel 2005)
- The prostate cancer survivors have a reduced mortality of 61% if they do high-intensity physical activity for at least 3 hours per week (Kenfield 2011)

1.7 Cancer of the colon-rectum and the management of physical exercise during cancer disease

Colon cancer is one of the forms of neoplasia with increasing incidence, with a prevalence in some countries, reaching 10% of the population suffering from cancer (Jemal 2010, Bhatia 2008).

The improvement of diagnostics and treatments has led to a substantial improvement in survival at 5 years that has passed through the most severe not localized forms (Altekruse 2010), from 51% in 1975 to 69.5% in 2006.

Survivors are at risk of developing a second cancer of the colon or of other organs, mainly breast, prostate, skin and lungs (Green 2002, Andre 2009, Birgisson 2005).

Most of the survivors of colon cancer are at risk of developing other diseases, mainly cardiovascular, pulmonary and psychiatric (Phipps, 2008, Jansen 2010; Yabroff 2004, Trentham-Dietz, 2003; Brown 1993; Denlinger 2011).

Often the survivors suffer from the consequences of therapies such as ostomy, neuropathies, chemotherapy, asthenia and depression. These may represent important limitations to the use of physical exercise as a therapeutic tool (Phipps 2008, Rauch 2004, Schneider 2007).

Physical activity has been proposed as a therapeutic but non- pharmacological tool to improve the quality of life and prognosis of patients suffering from colorectal cancer as well as a primary prevention means.

- The National Comprehensive Cancer Network recommends, during and at the end of anticancer treatment, a program of lasting and resistance physical activity to reduce asthenia.
- The American Cancer Society wishes a physical activity program to improve the quality of life, preventing recurrences or the incidence of concomitant diseases (Brown 2003)

- The American College of Sports Medicine, through a consensus, hopes for neoplastic patients a moderate-intensity physical activity of at least 150 minutes per week or 75 minutes per week of intense activity, combined with two/three weekly stretching sessions for the most important muscle groups (Schmitz 2010).

Studies on the role of physical activity in reducing the colon cancer risk are those which oncologists recognize as the most convincing (Vainio 2002). Literature provides numerous prospective studies (Lee 1995; Gerhardsson 1988, Martinez 1997, Wu 1987; Thun 1992; Dancing 1990-Barbash, Albanian 1989, Severson 1989; Lynge 1988, Paffembarger 1987, Giovannucci 1995), and retrospective (Fraser 1983 , Longnecker 1995, Wittemore 1990, Kuna 199 °, Markowitz 1992, Peters 1989, Brownson 1989, Kato 1990, Fredriksson 1989). A meta-analysis of 19 cohort studies showed a reduction in the incidence of cancer in 22% of males and in 29% of women with physical activity (Samad 2005).

Another meta-analysis of 52 observational studies showed that physical activity reduces the development of colon cancer (Wolin 2009).

However:

- data are more convincing in men than in women (Cheblowski 2004);
- the use of hormone replacement therapy alone tends to reduce the risk of cancer and this gives serious problems of interpretation when the examined women were older ;
- the combination of moderate physical activity all life long with high-intensity recreational physical activity has for women little impact on cancer risk (Mai 2007);
- women, who did physical activity in the fertile age at least 4 hours a week, have a 25% lower risk than those whose activities did not exceed 30 minutes per week (Mai 2007)
- post-menopausal women, who didn't do any hormone treatment, have a 46% risk reduction, if they did physical activity for at least 4 hours a week ;
- women with hormone therapy do not have further risk reductions with the regular practice of physical activity ;
- physical activity doesn't give any risk reduction of the rectum cancer.

In a study of 680 patients with colon cancer, who belong to a population of 51.500 subjects, recruited by the Health Professional Follow-up Study, the survivors in the period 1986-2004 were monitored every 2 years with a specific questionnaire for assessing physical activity in MET, the results showed that subjects with an energy expenditure higher than 18 MET per week had a 50% risk reduction of recurrence. An activity over

27 MET per week, compared with patients with MET <3, showed a reduction in mortality risk equal to 0.47. Free from cancer patients were 82.2% with activity <3 MET, 87.4%, those between 3 and 27 MET, 92.1% those with > 27 MET in 5 years. Free of cancer patients were, for 3 MET levels, were respectively 79.4%, 81.2%, 88.3% in 10 years. Mortality in patients with activities <27 MET had a death rate of 50% lower than the sedentary ones; this result was not related to age, disease stage, BMI, tumor location and physical activity before the diagnosis. (Meyerhardt 2009).

- From an observational prospective cohort study, the Nurses' Health Study, conducted among 121.700 subjects in the period 1986-2002, 573 women with a diagnosis of colon cancer, stage I-III, were enrolled. All participants were monitored with a questionnaire and a scale which was able to measure the activity in MET hours/week. If no response was given, they did a research aimed at establishing the evolution of the illness or the death. The level of physical activity before the diagnosis had no effect on the mortality rate.The physical activity after diagnosis reduced, in subjects with <18 MET hours /

week energy expenditure, the index of mortality risk to 0.39 compared with women with <3 MET activity. Mortality in 5 years gave the following percentages: 14.1% for patients with <3 MET activity, 14.4% for those whose activity was between 3 and 17.9 MET hours per week, 62% for the > 18 MET group. Those women who increased their physical activity compared with the pre diagnosis period reduced by 50% their risk of mortality.

- Physical activity, before the diagnosis, indirectly correlates with the reduced incidence of recurrence (Haydon 2006).
- The amount of physical activity, before the diagnosis, does not affect mortality (Meyerhardt in 2006, 2009).
- The amount of physical activity after diagnosis reduces the risk of recurrence and mortality (Meyerhardt 2006a, 2006 b).

1.8 As regards risk factors for colon cancer it should be noted that

- many studies have shown a relationship between BMI and risk of colorectal cancer (Potter, 1993, Manson 1995, Murphy 1998).
- Fat has an important role, especially in its topographic distribution (Giovannucci 1995).
- High levels of visceral adiposity are related to high levels of insulin on an empty stomach (kissenbach 1982; Bjorntorp 1990; Krotkiewsky 1983).
- The Health Professionals Follow-up Cohort Study conducted on a population of 31.400 men, highlighted that waist-thigh circumference ratio, which is a surrogate of the visceral fat measure, correlated with the risk of colon cancer in the rectum; individuals with the highest quartile showed a 3.4 RR, compared with the ones who had the lowest quartile, (Giovannucci 1995).
- The insulin and the Insulin Like Growth Factor 1 (IGF-1) have a mitogenic activity and induce cell proliferation of colon mucosa cells, in vivo and in vitro (Giovannucci 1995, Singh 1993, Tran 1996).
- Patients with type 2 diabetes have a high incidence of colon adenomas (Hu 1999, Will 1998, Nishi 2001).
- High levels of plasma insulin have been linked to higher risk of colon cancer (McKeown-Eyssen 1994, Shoen 1999, Yamada 1998).
- The observational Cardiovascular Health Study showed the onset of the colorectal cancer in 102 subjects. It was carried out in 5.849 subjects, who were monitored for 3 years. The relative risk was twice for those who belonged to the quartile with the highest glucose on an empty stomach (also insulin on an empty stomach should be tested), compared with the ones with the lowest quartile of blood glucose levels. High levels of plasma glucose and insulin, after the glucose tolerance test were related to a colorectal cancer risk of 2.4. (Shoen 1999).
- High plasma levels of C-peptide in patients with colorectal cancer are related to an unfavorable prognosis for survival (Wolpin 2009).
- High IGF-1 levels in non-cancer subjects have been associated with high risk of colorectal cancer in two important, prospective studies, the Nurses Health Study and the Physicians Health Study. This association was not confirmed by the European prospective study, EPIC (European Prospective Investigation into Cancer) (Giovannucci 2000; McPollack 1999, Rinaldi 2010)
- Two meta-analyses did not confirm the relationship between risk and pre-disease IGF-1 levels (Rinaldi, 2010; Renehan 2004).

- The IGF-1 levels during the disease are not related to the prognosis of the survivors (Haydon 2006).
- The IGFBP-3 (Insulin like Growth Factor Binding Protein-3) levels, a protein whose deficiency increases the percentage of circulating free IGF-1, correlate inversely with mortality. In subjects with higher IGFBP-3 levels, the mortality risk was reduced by 50%.

2. Our point of view with regard to an ideal physical activity in oncological patients to survive

The development of exercise in cancer rehabilitation context has as its primary goal the promotion of a better quality of life, especially in terms of individual perception.
The rehabilitation outcome has to be measured in terms of an individual perception of well-being, and it is also expressed in a collective form, involving all the interested subjects to this topic in its definition.
The outcome, in general, has to do with the return to society of people who experienced the disease, as it happens for other important but not lethal diseases.
After having expressed, in the international review, what is believed to induce positive effects in the body system which survived cancer, through the use of physical exercise, we find useful to propose a rehabilitative treatment which is not limited to recommend regular metabolic activity but aims to recover the remaining capacity of the subject, through a specific approach to the patient and the pathology but, at the same time, it aims to increase his/her residual performance with progressive metabolic load by METs .
Therefore, we divided our therapeutic intervention in 3 phases:
Phase 1 Recovery of Residual Capacity.
Phase 2 Recovery sensory-motor and functional capacity.
Phase 3 Recovery of the quality of Life.

2.1 Phase 1: Recovery of residual capacity

The rehabilitation strategy is aimed at:

1. recovering joint mobility and elasticity of muscle tissue, according to the existing damage and to the diseases;
2. increasing the uninjured muscle tone;
3. rebalancing the muscle synergies of the body system, by reprogramming the body static and dynamic scheme.

Our rehabilitation method uses instrumental and not instrumental techniques.
The aim of the therapy is to:

- induce the gradual recovery of joint mobility through passive and active exercises;
- induce a sensory stimulus for body perception in the space. This is realized by us by using tools such as PANCAFIT or similar and the postural bench system (TecnoBody, Bergamo, Italy), equipped with six independent sensors, each one positioned at the dorsal, lumbar and sacroiliac level. It allows real-time to assess the load that the patient places on each of the sensors. This feedback visual system allows the operator to assess and to work on deficient areas of the body from the proprioceptive and muscle point of view. It also allows the patient to modify, to learn and to increase his/her perception of the body in the space, inducing the acquisition of a suitable elastic posture for the two hemisomas;

- induce muscular adaptations in the recovery of muscle tone, in this regard we use a focused vibratory acoustic stimulation at high intensity (VISS, VISSMAN, Rome, Italy). Vibrations stimulate bone marrow function and the upper motor centers in order to obtain a better performance of controls, responsible for muscle recruitment; they activate the aerobic metabolism; they have an analgesic effect; they increase local circulation and bone density; they cause an increase in contractile capacity and elasticity of the skeletal muscle tissue;
- recover muscle synergies and elasticity of muscle tissue.

Rehabilitation protocol

2 sessions per week for at least 2 months with a metabolic cost of 18-21 METs.

Physical Therapies:

focused high intensity vibratory stimulation (VISS, VISSMAN, Rome, Italy).
Position: supine in the absence of muscle contraction; frequency: 300Hz; duration: 30 min.

Motor Rehabilitation:

- passive mobilization;
- passive muscle stretching exercises;
- Postural motor training using postural bench (TecnoBody, Bergamo, Italy). Position: supine; duration: 30 min.;
- isometric force exercises.

2.2 Phase 2: Sensory-motor and functional recovery

The rehabilitation strategy aims to:
replan the balance system to ensure that the brain (CNS) can use the sensory systems which are still working;
increase the tone of postural muscles, looking for an enhancement of the lower limbs and trunk muscles.
In our rehabilitation method, we use instrumental or not instrumental techniques.

The aim of therapy is to :

- induce adaptation to the pathological condition;
- induce a sensory readaptation (e.g. placing the patient on a tilting platform demanding stabilization motor tasks in closed and open kinetic chain (I-Moove Allcare Innovations Chabeuil, France);
- support a sensory substitution (e.g. trying to strengthen the role of vestibulo-spinal control by strengthening the ability to use proprioceptive afferents in a patient with sensory and/or motor neuropathy);
- induce a tone recovery and proprioception of the muscle skeletal kinetic chains by creating an unstable environment where the patient has to relate to rebalance the relationship between the kinetic chains, enhancing inter-and paravertebral muscles and searching for a core stability increase with the I -Move system or similar;
- induce a muscle strength increase, especially in the lower limbs.

Rehabilitation protocol

3 sessions per week for at least three months with a metabolic cost of 21-24 METs.

Physical Therapy:

Focused high intensity vibratory stimulation (VISS, VISSMAN, Rome, Italy)
Position: orthostatic; frequency: 300Hz; duration: 10 min

Motor Rehabilitation:

- 20 min of aerobic cycle ergometer, 80-95 bpm.
- Passive muscle stretching exercises.
- Global proprioceptive training (I-Moove Allcare Innovations Chabeuil, France). Position: orthostatic; duration: 30 min.
- Postural motor sense training using postural bench (TecnoBody, Bergamo, Italy). Position: orthostatic; duration: 10 min.
- Isometric force exercises.

2.3 Phase 3: Recovery of quality of life

The rehabilitation strategy is aimed at strengthening of the recovered **sensorimotor** capacity to allow the patient a gradual return to society, improving his/her quality of life Increasing the muscle strength needed for walking and for the orthostatic position, developing proprioception and requiring motor tasks more and more difficult and functional in daily life. In our rehabilitation method, we use instrumental or not instrumental techniques.

The aim of therapy is to:

- induce a proprioceptive increase using instruments for monitoring the performance which is achieved by biofeedback (e.g. I-Moove allows you to balance the muscle synergies through its helical movement, taking the natural, spiral course of the muscle fascia. The special movement of the platform can be expanded and strengthened specifically for the patient by increasing and improving proprioception, mobility and strength. (I-Moove Allcare Innovations Chabeuil, France);
- increase selectively the muscle strength (e.g. isotonic and isokinetic exercises, load of 60% RM for 12 repetitions for 4 series);
- stimulate motor learning;
- create a cardio circulatory metabolic adaptation.

Rehabilitation protocol

3 sessions per week for three months with a metabolic cost of 25-29 METs.

Physical Therapy:

Focused high intensity vibratory stimulation (VISS, VISSMAN, Rome, Italy). Position: supine in the absence of muscle contraction; frequency: 300Hz; duration: 30 min.
Global vibratory stimulation (PhysioPlate FIT, Globus Italy srl, Codognè (TV), Italy). Position: orthostatic; frequency: 50Hz; duration: 10 minMotor Rehabilitation:

- 40 min of aerobic cycle ergometer, 100-110 bpm;
- active and passive stretching;
- global proprioceptive training (I-Moove Allcare Innovations Chabeuil, France). Position: orthostatic; duration: 30 min;
- coordination exercises and complex motion;
- isokinetic and / or isotonic strength exercises. Our protocol is repeated after 3 months from the end of the entire project, by repeating phase 2 and 3 with a duration of 1

month per each phase in 24 months from the end of the specific medical or surgical oncology treatment.

3. Conclusions

Cancer patients suffer from persistent emotional and social distress, because of functional deficits, all that results in a reduced quality of life (QOL). The QOL assessment should include at least four functional dimensions: physical, the emotional, the social and the cognitive function. These dimensions are positively influenced by a proper rehabilitation program which includes physical exercise. It is well known that phyisical activity is an important means to prevent and to fight the problems of inactivity and disuse, and to reduce fatigue.

The information about the role of physical activity in oncology has been increasing over the years, and now is possible to confirm that **" the physical activity decreases the risk of disease; in patients who suffer from cancer, it prolongs survival, reduces the occurrence of concomitant diseases and improves the life quality" in (U.S. Department of Health and Human Services, 2008).**

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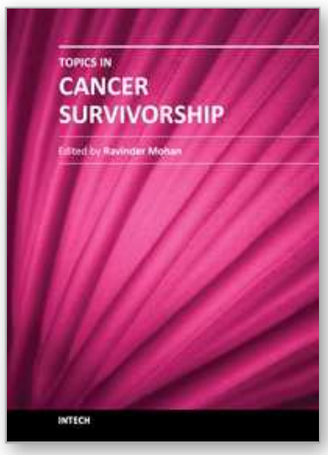
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Cancer is now the leading cause of death in the world. In the U.S., one in two men and one in three women will be diagnosed with a non-skin cancer in their lifetime. Cancer patients are living longer than ever before. For instance, when detected early, the five-year survival for breast cancer is 98%, and it is about 84% in patients with regional disease. However, the diagnosis and treatment of cancer is very distressing. Cancer patients frequently suffer from pain, disfigurement, depression, fatigue, physical dysfunctions, frequent visits to doctors and hospitals, multiple tests and procedures with the possibility of treatment complications, and the financial impact of the diagnosis on their life. This book presents a number of ways that can help cancer patients to look, feel and become healthier, take care of specific symptoms such as hair loss, arm swelling, and shortness of breath, and improve their intimacy, sexuality, and fertility.

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