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Nutritional Intervention in Heart Transplant Recipients – Dietary Recommendations

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1. Introduction

Timely nutrition assessment and intervention in organ transplant recipients may improve outcomes surrounding transplantation. Because nutritional status is a potentially modifiable risk factor, the development of strategies designed to optimize nutritional status decreases the short-term risks in the post transplant period (Russo et al., 2010).

Despite many advances in surgical techniques, diagnostic approaches and immunosuppressive strategies, survival after heart transplantation is limited by the development of cardiac allograft vasculopathy (CAV) which is the most important cause of death late after transplantation (Hosenpud et al., 1998; Pethig et al., 1997) and by the adverse effects of immunosuppression.

Primary prevention of CAV in heart transplant (HT) recipients should include strict control of cardiovascular risk factors (hypertension, diabetes, hyperlipidemia, smoking and obesity), as well as strategies for the prevention of cytomegalovirus (CMV) infection (Costanzo et al., 2010). The sum of various risk factors has a negative impact on survival (Almenar et al., 2005). In addition, malnutrition increases the risk of infection post transplant and may reduce survival (Hasse, 2001).

It has been referenced that improper dietary habits, low physical activity and the side effects of immunosuppressive therapy might explain the weight gain, the altered lipid pattern and an increase in insulin resistance after transplant (Evangelista et al., 2005; Flattery et al., 2006; Uddén et al., 2003). The metabolic picture after transplantation is also worsened by the immunosuppressive drugs (Anker et al., 1997; Kemna et al., 1994). Therefore, the development of strategies to reduce post transplant body weight and to improve insulin resistance is important (Sénéchal, 2005).

Immunosuppressive agents, such as prednisone, cyclosporine, mycophenylate mofetil and sirolimus, are associated with hyperlipidemia (Bilchick, 2004). The glucocorticoids play a major role in the development of post transplant osteoporosis (Epstein & Shane, 1996; Epstein et al., 1995; Glendenning et al., 1999; Reid et al., 1988; Rodino & Shane, 1998; Shane, 2000; Stempfle et al., 1999) and it is known that side effects of glucocorticoids, such as on

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weight gain and the increase of appetite (Kahn & Flier, 2000; Uddén et al., 2003), may induce insulin resistance and diabetes mellitus.

Osteoporosis is a leading cause of morbidity; the most rapid bone loss occurs during the first three months and in the first two years after cardiac transplantation (Hasse, 2001; Henderson et al., 1995).

In addition, statins are usually required in transplant recipients to achieve low LDL cholesterol levels. High concentrations of these drugs, particularly in combination with cyclosporine, may increase the risk of side effects (Vorlat et al., 2003).

Recommendations for specific levels of nutrients should be made after the following factors are considered: nutritional status, body weight, age, gender, metabolic state, stage and type of organ failure, presence of infection, malabsorption or induced losses, goals and comorbid conditions (Hasse, 2001).

The effectiveness of nutritional education should consider a number of psychological variables, including social, cultural and ethnicity factors. These variables are present when HT recipients return to their usual context. Although not a priority for the survival of the person, they are important to the goal of the nutritional action.

Finally, HT recipients should be provided with a multidisciplinary team, including surgeons, cardiologist, nurses, psychologists and dieticians, among many others including ancillary services, such as home care nursing, cardiac rehabilitation, psychologic support, nutritional planning or patient support groups that can be used as resources in the follow-up of HT recipients (Costanzo et al., 2010).

2. Nutritional assessment

A comprehensive nutritional assessment of transplant recipients should include a variety of parameters including physical assessment, history, anthropometric measurements and laboratory tests (Hasse, 2001). This method has been used in subjects who were followed for four years. During the first year, follow-up visits occurred once a month and they included evaluation of anthropometric measurements, body composition, biochemical parameters and dietary records; afterwards the body weight, the dietary habits, the physical activity level and the biochemical parameters were collected on the phone once a year for three years (Guida et al., 2009).

Various parameters are analyzed in the nutritional status assessment (Sirvent & Garrido, 2009).

2.1 Personal interview

The personal interview is essential to review and investigate certain aspects which may have direct bearing on the dietary pattern. Some key items to be considered are discussed in this paragraph.

In relation to food intake, it is necessary to find out the usual pattern (quantity, quality and distribution of food intake) in the last days, weeks or months. The assessment is directed at whether the intake meets minimum requirements of adequacy and variety. Related to food

intake is the appetite, from which we can detect the presence of eating disorders and likely food intolerances, and delve into the personal history of diseases that alter appetite.

From a functional perspective it is necessary to inquire about ability to swallow and on digestive function and autonomy which enables food intake. It is also interesting to know more about chewing and swallowing patterns, and dental status. Reports on the presence of diarrhea, constipation, vomiting and intolerance in general should be included, and the degree of independence and autonomy of the person in relation to feeding should be checked.

Finally, we must-take into account all the circumstances which may influence and modify eating habits or energy expenditure, like family relationships, group memberships, special diets, type and frequency of physical activity, etc.

2.2 Physical inspection

Most important items when assessing physical condition are hydration, weight aspect, awareness and autonomy. These parameters influence the ability to feed , body temperature, colour of skin and mucous and should be considered as merely indicative. This should be complemented by biochemical data, anthropometric and dietary history of the subject.

2.3 Body composition

Provides information on the percentages of muscle, fat or bone. There are different methods: chemical techniques, electrical bioimpedance and anthropometry, among others. The anthropometric measurements and bioimpedance are widely used non invasive techniques.

2.3.1 Chemical techniques

Measurements of chemical techniques include creatinine and 3-methylhistidine. In relation to the first technique, the total plasma creatinine concentration is used for determining muscle mass, assuming that the creatinine is 98% in muscle tissue and 1 mg of creatinine equivalent to 0.88 kg of muscle. This technique only provides data on muscle mass, does not evaluate other parameters of body composition and has a number of drawbacks. The 3-methylhistidine is also used for determining muscle mass. Generally this shows the same disadvantages as the previous determination and we must add the complexity of the analysis and high cost.

2.3.2 Bioelectrical impedance analysis

Body composition can be determined by conventional bioelectrical impedance analysis (BIA). The subject should rest in the supine position and a weak current (electric current of low voltage high frequency and intensity) is passed between two electrodes placed on one hand and another on a foot. The intensity is conducted differently from fat (it acts as insulation) than fat-free mass, where water and electrolytes are good conductors. The use of this technique has several advantages, including: its relatively low price, ease of equipment transportation and its safety.

Because BIA equations must consider age, gender, race and body habitus of the patient (Dumler, 1997), accuracy of the results also depends on the equations used to determine body composition (de Fijter et al., 1997; Pichard et al., 1999).

Although BIA has become widely available, a single-frequency test may not be valid in transplant candidates due to body fluid shifts (Hasse, 2001).

2.3.3 Anthropometric method

The anthropometric method is highly recommended for several reasons: it is simple, accurate, accessible, comfortable and economical. The reliability depends on the ability of anthropometrics and rigor in making measurements. The protocol must be standardized so that results can be compared (Sirvent & Garrido, 2009).

Nutritional anthropometry is based on the study of a number of somatic measures on proportions of the human body. The data obtained from anthropometry (weight, height, perimeter, diameters, lengths and skin folds) are further processed by application of different regression equations and statistical formulas for information on body composition.

The parameters commonly used are weight, height and body mass index. The weight is an easily obtainable and reproducible indicator of body mass. Along with weight, the height provides less sensitive information on nutritional deficiencies. However, both parameters can be obtained on body mass index, also known as Quetelet index. In particular, BMI is defined by body weight in kilograms divided by the square of body height in metres.

Obesity is characterized by an excess of body fat. Several methods have been introduced to quantify obesity. The most common are measurement of body fat by the use of bioelectrical impedance techniques and measurements of body density by weighing subjects underwater and subsequent calculation of fat mass (Flier, 2001). As it is difficult to ascertain the exact amount of body fat, a number of markers have been development to quantify obesity.

BMI is the most widely used parameter for characterization of abnormalities of body weight (Kahn et al., 2006). The recommended classification for BMI adopted by the Expert Panel on the Identification, Evaluation and Treatment of Overweight and Obesity in Adults, and endorsed by the National Institute of Health and the WHO is: BMI<18.5 (underweight), 18.5 to 24.99 (normal weight), 25 to 29.99 (overweight), 30 to 34.99 (obesity class I), 35 t0 39.99 (obesity class II) and ≥ 40 (obesity class III) (National Heart, Lung and Blood Institute, 1998).

BMI at the time of transplant is an important predictor of post transplant outcomes, including survival, perioperative morbidity, post transplant cardiovascular comorbities, long-term complications of transplantation and survival on the waiting list. HT recipients across a broad range of BMI (including normal, overweight and obesity I subgroups) achieved good long-term post transplant outcomes. However, recipients at the extremes (e.g. underweight and obesity II/III) have significantly higher morbidity and mortality compared with other groups. This diminished survival in the underweight (BMI<18,5) group resulted from excess morbidity in the first year post transplantation. However, with correction of their heart failure and subsequent reversal of their cachectis state, their risk of death along with the mean BMI, normalized after the initial post transplant period. Obesity II/III (BMI>35) was also associated with diminished survival, however, this appears to result from higher morbidity and mortality over the long-term (Russo et al., 2010).

In cardiac surgery patients, a low BMI increased the relative hazard for death and low S-album increased the risk for infection. Rapp-Kesek et al. suggest that these parameters provide useful information in the preoperative evaluation (Rapp-Kesek et al., 2004).

On the other hand, skin folds and body parameters are widely used (Sirvent & Garrido, 2009).

In this sense, the most common measures used are Triceps skin fold (PT), Circular circumference of the arm (CB) and Arm muscle circumference (AMC). PT allows us to assess fat mass. It is expressed in mm, and its measurement is made with a calliper at the midpoint between the acromion and the olecranon. On the other hand, CB provides information about the total mass and is measured with a tape measure midway between the acromion and the olecranon and expressed in cm. Last, AMC is used to assess muscle mass. It is expressed in cm and is calculated: CMB (cm) = CB (cm) -0.314 x PT (mm).

2.3.4 Biochemical parameters

Biochemical parameters make possible obtaining more information on nutritional status. They are (among others):

- Albumin is one of the most used. This protein has a long half life (18-20 days), so their determination is a few sensitive markers in recent nutritional disorders. Instead it may be useful to assess long and serious situations of malnutrition. The normal concentration for adults is ≥ 3.5 g/dl. Hypoalbuminemia presents low risk values between 2.8 and 3.4 g/dl and hypoalbuminemia high-risk values are below 2.8 g/dl.
- Transferring is also widely used. It has a shorter half life between 8 and 10 days. Its main function is iron transport functions. It is more sensitive than albumin to nutritional changes and responds more quickly to changes in protein status. Normal levels are between 150 and 200 mg/dl. It considers moderate deficiency between 100 and 150 mg/dl and severe deficiency below 100 mg/dl.
- Prealbumin is a transport protein with a half life of 2 days. It decreases rapidly when calorific intake or protein is low and responds very quickly to nutritional rehabilitation. Normal values are between 10 and 40 mg/dl.
- Retinol transport protein has a very short half life of approximately 12 hours. Its values are normal at 7.6 mg/dl. Sensitivity to protein-energy deprivation is high, but lacks (as prealbumin) diagnostic specificity due to the impact of other processes on its levels.
- Fibronectin. Studies have shown low levels in situations of fasting and acute protein-energy malnutrition. Its normalization with nutritional rehabilitation is rapid. Normal values are around 169 mg/ml.
- Nitrogen balance provides information on the protein reserve. We reserve its use to situations where we want to have guidance on protein balance in a given time.
- Lymphocyte count, based on an adequate supply of energy and protein is essential for maintaining normal immune function. The drawbacks are its low specificity because it can be altered by multiple factors and the other limitation is that only the lymphocyte count is altered in situations when malnutrition is established.

Finally, we mention the existence of other parameters used in specific situations, such as vitamin A, vitamin E and so on. Measurement and interpretation of waist circumference and fasting triglycerides could be used among heart transplant patients for early identification of men characterized by the presence of elevated fasting insulin and apolipoprotein B concentration, and small LDL particles. The presence of the atherogenic metabolic triad identifies patients at high risk of coronary artery disease, even in the heart transplant population (Sénéchal et al., 2005).

3. Nutritional intervention

Nutrition is extremely important in the care of patients undergoing transplantation (Helton, 2001). Following an appropriate and strict dietary regimen after the HT reduces risk factors and should be considered seriously (Guida et al., 2009).

During the acute post transplant phase, adequate nutrition is required to help prevent infection, promote wound healing, support metabolic demands, replenish lost stores and perhaps mediate the immune response (Hasse, 2001).

The HT recipient must have two main dietary goals: a healthy and balanced diet (to provide all the necessary nutrients and avoid new heart attacks) and to maintain strict hygiene measures to reduce germs in food (Casado, 2005).

With regard to the rules of food hygiene, there are a number of recommendations among which are: do not take raw food during the first six months post transplant (considered the highest risk); casseroles prepared at home, if not eaten immediately after cooking, should be kept in the fridge covered and consumed within 24 hours; do not add anything raw to the preparation; it is preferable to keep sauces separate (Casado, 2005).

A diet of cardiovascular protection should include the following considerations about certain parameters:

3.1 Overweight

Some investigators have described excessive weight gain following cardiac transplant (Baker et al., 1992; Johnson et al., 2002; Keteyian et al., 1992; Lake et al., 1993). On average these patients gain approximately 10 kg within the first year after the procedure. This weight gain increases the risk of secondary diseases (i.e. hypertension, diabetes and dislipemias) (Williams, 2006).

Patients who were underweight or obese at one year post transplant were at greater risk of rejection over time than patients who were of normal weight or overweight. Post transplant cachexia and obesity are risk factors for poor clinical outcomes after heart transplantation. Grady et al. found that risk factors for increased body weight at one year after heart transplantation included both demographic factors (BMI at the time of transplant, younger age, black race) and clinical variables (etiology of heart disease, immunosuppression) (Grady, 2005).

After HT, regular weight-bearing and muscle-strengthening exercise should be encouraged to reduce the risk of falls and fractures, and to increase bone density. Lifestyle modifications, including weight loss, low-sodium diet and exercise are appropriate adjuncts to facilitate

control of blood pressure in HT recipients (Costanzo et al., 2010). The clinicians may assist patients to make changes in their post transplant lifestyle to return to a normal body weight.

Guida et al. showed the efficacy of dietary intervention to obtain an early and late weight and metabolic control after HT. All subjects received a dietary plan that was elaborated to fit an energy intake ≥ 25 Kcal/Kg/Ideal Body Weight/day, with 55% of carbohydrates, 15% of protein and 30% of total fat (fatty acids <10% of calories and dietary cholesterol <300 mg/d according the American Heart Association step one diet guidelines) (The Expert Panel, 1988). The patients were prescribed low-salt food in order not to exceed sodium content of 1.5 g/d and they were asked to limit the amount of additional salt to 3 g/d. In this diet plan all subjects were encouraged to increase their physical activity level up to 30 min/d three times a week and they were strongly recommended to modify some of their habits (Guida et al., 2009).

To reach this goal it is indispensable to carry out an early and comprehensive programme providing a plan of nutritional interventions, education and lifestyle counselling. They demonstrated that dietary compliance is helpful to get a good early and late control in weight and metabolic parameters, both in subjects enrolled during the first year from the transplant and after the first year from the transplant, even if high doses of immunosuppressive therapy are used. The beneficial effects of this intervention are still maintained after a 48-month follow-up period (Guida et al., 2009).

Incorporation of a weight loss plan, including diet, exercise and psychologic interventions into the discharge process with subsequent outpatient follow-up is recommended. The psychological interventions are often incorporated into a comprehensive weight loss programme (Grady, 2005).

The scientific literature shows different mood disorders in both the situation prior to transplantation and thereafter; the most common that have been tested are the anxiety disorders, depression and post traumatic stress disorder (Perez San Gregorio et al., 2005; Spaderna et al., 2007) and they have been found to adversely affect the ability to accept the new organ.

This negative emotion affects different areas of the daily life of transplant patients, including nutritional status, either with a decreased or increased appetite, and consequently a loss or weight gain, which is contraindicated in patients transplanted.

Although a variety of weight loss programmes exist, it may be beneficial to consider weight loss plans that are individualized and tailored to incorporate the patient's clinical status, age, cultural background, dietary preferences, exercise history, socio-economic and behavioural factors etc. Many patients also have established patterns of cooking and eating based on cultural background (Grady, 2005).

Moreover, the goal of a dietary intervention should be to optimize the nutritional status and to preserve the long-term renal function by avoiding unnecessary protein loads (Al et al., 2005).

With respect to lipid metabolism, the increase in body weight is correlated with the increase in serum lipid level during the first year after the transplant (Grady et al., 1991; Keogh et al., 1988), whereas a decrease in body weight or energy intake is effective to reduce blood cholesterol level (Kannel et al., 1979; Nichols et al., 1976; Kromhout, 1983).

3.2 Malnutrition

Harrison et al. defined malnutrition as midarm muscle circumference and triceps skin fold measurement <25th percentile (Harrison et al., 1997). The malnutrition diagnosed by subjective and objective nutrition assessment parameters is common in solid organ transplant recipients and leads to increased morbidity and mortality (Helton, 2001).
Because malnutrition is a marker of worsening heart failure (Anker et al., 1997) and is a known risk factor for poor outcomes after surgery (Buzby et al., 1980; Rady et al., 1997) low BMI may in fact be a stronger predictor of poor outcomes than obesity. The BMI is potentially modifiable through medical management and/or lifestyle changes (Russo et al., 2010).

Patients with chronic heart failure are often malnourished as a result of maldigestion, malabsorption and poor nutrient assimilation. This is compounded by the fact that many of these patients have a prolonged catabolic state characterized by increased energy expenditure coupled with anorexia and inadequate dietary intake.

Malnourished patients undergoing transplantation have increased morbidity and mortality, and increased overall hospital charges. Patients surviving transplantation have altered lipid and fat metabolism, and problems with obesity and accelerated atherosclerosis leading to cardiovascular death (Helton, 2001).

3.3 Dyslipidemia

Dyslipidemia is common after cardiac transplantation. Multiple factors in transplant recipients promote dyslipemia: inappropriate diet in combination with reduced physical activity, immunosuppression with cyclosporine and steroids, anti-hypertensive agents and concomitant conditions, such as diabetes, obesity, age and male gender. Total and low-density lipoprotein (LDL) cholesterol are prominent risk factors for major progression of CAV disease (Pethig et al., 2000).

To accommodate the lipid profile the following is recommended: a cholesterol intake below 300 mg per day, to limit total dietary fat to less than 30% of total calories, to limit saturated fats to less than 10% of total calories, to increase mono- and polyunsaturated fat (the latter about 7% of total calories) (Casado, 2005).

In recent years the benefit of certain food components has been referenced. Phytosterol, plant stanol and sterol esters, reduce serum cholesterol by inhibition of cholesterol absorption. Substitution of part of the daily fat intake with stanol ester margarine has been shown to reduce serum cholesterol by 10.2% and LDL cholesterol by 14% after one year (Miettinen et al., 1995).

Margarine containing stanol/sterol esters is a safe, simple and efficient way to reduce total LDL cholesterol in patients after cardiac transplantation. The tolerance of the margarine containing stanol or sterol esters is good. It is possible to reduce the dose of statins while maintaining LDL cholesterol at <115 mg/dl (Vorlat et al., 2003). The concomitant use of statins and stanol esters has shown additional lipid-lowering effects (Blair et al., 2000).

Phytosterol therapy produces an average 10-11% reduction in LDL cholesterol concentration, but it is unknown whether this effect persists beyond two years. Phytosterol

products are well tolerated and have few drug interactions, but their long-term safety has not been established. Current evidence is sufficient to recommend phytosterol for lowering LDL cholesterol in adults (Malinowski & Gehret, 2010).

On the other hand, ω-3 fatty acids have been studied in cardiac transplant recipients treated with cyclosporine and have been found to have beneficial effects on hypertension (Andreassen et al., 1997; Holm et al., 2001) and coronary endothelial function (Fleischhauer et al., 1993). They may also be added to statin therapy in cardiac transplant recipients with persistent hypertriglyceridemia. An ω-3 fish oil preparation consisting of 80% ω-3 polyunsaturated fatty acids (44% eicosapentaenoic acid and 36% dehydroacetic acid) when used with simvastatin has been shown to reduce triglyceride levels by an additional 20-30% (Durrington et al., 2001). When triglyceride levels are >200 mg/dl after LDL-lowering therapy, a trial of an ω-3 concentrate or fish oil (which usually contains approximately 35% ω-3 polyunsaturated fatty acids) is reasonable because of the potential benefits and favourable safety profile (Bilchick et al., 2004).

3.4 Beneficial effects of certain nutrients

There are investigations that demonstrate that single nutrients, such as arginine, ω-3 fatty acids and pyruvate, and the fasted and post absorptive state can dramatically alter the short and long-term function of transplanted organs (Helton, 2001).

Nutrition also may be used to help treat symptoms of end-stage organ failure. For example, an increased intake of calories and protein should help deter fat and muscle loss. Fluid retention can be treated with dietary sodium restriction. Branched-chain amino acid-enhanced formulas may be helpful for patients with intractable hepatic encephalopathy. Adequate intake of iron, folic acid and B vitamins can prevent or treat anaemia. Medium-chain triglyceride supplementation may be useful when steatorrhea and long-chain fat malabsorption are present (Hasse, 2001).

3.4.1 Calcium and vitamin D

Calcium and vitamin D are necessary when patients have osteoporosis or renal osteodystrophy (Hasse, 2001). Magnesium depletion (hypomagnesemia has been documented in cardiac transplant recipients) which may be the results of diuretic therapy, has been implicated as a risk factor for osteoporosis.

After transplantation, there is further acceleration in bone loss. Factors associated with congestive heart failure that may contribute to bone loss include cardiac cachexia, reduced exercise or immobilisation, smoking, alcohol abuse, low calcium intake, heparine administration and loop diuretics (Pisani & Mullen, 2002). Vitamin D deficiency is significantly more common in the patients with more severe heart failure (Rodino & Shane, 1998).

Optimal treatment of osteoporosis requires adequate calcium and vitamin D intake. The Institute of Medicine recommends calcium intakes of 1000 to 1500 mg/d (depending on age and menopausal status) for adults (NIH, 2001) and vitamin D (400-1000 IU, or as necessary to maintain serum 25-hydroxyvitamin D levels above 30 mg/ml= 75 nmol/L) (Costanzo et al., 2010). Of note, bone loss occurs despite supplementation with vitamin D and calcium

(Shane et al., 1997). The use of calcium and vitamin D supplements, although recommended, is inadequate for the prevention of bone loss and complications such as vertebral fractures (Pisani & Mullen, 2002).

3.4.2 Folic acid

The aminoacid homocysteine has recently been identified as a risk factor for native coronary artery disease (Welch et al., 1997) and even mild to moderate hyperhomocysteinemia is associated with premature vascular disease (Kark et al., 1999). Growing evidence suggests that elevated total plasma homocysteine levels (tHCY) are associated with CAV following heart transplantation (Kutschka et al., 2001).

The homeostasis of homocysteine is altered in solid organ transplant recipients and may be partially caused by cyclosporine. The cyclosporine may be associated with secondary hyperhomocysteinemia by inducing renal insufficiency.

Homocysteine is formed by the transmethylation of methionine. Its catabolim is either through a folate-cobalamin dependent remethylation pathway catalyzed by methionine synthase, or by transsulfuration by cystationine-synthasa, a vitamin B6-dependent enzyme (Chan, 2001).

Beside parameters like age (Kark et al., 1999), sex (Selhub et al., 1999), genetic determination (Deloughery et al., 1996) and renal function (Moustapha et al., 1998) are influenced by dietary intake of vitamins B6, B12 and folic acid (Selhub et al., 1999; Verhoef et al., 1996). Hyperhomocysteinemia as well as deficiencies in folate and vitamin B6 are common in HT recipients, especially in older individuals and patients with renal insufficiency (Kutschka et al., 2001).

Folic acid supplementation (5 mg per day) provides a simple and effective measure to lower elevated tHCY concentrations without side effects (Kutschka et al., 2001, Chan, 2001).

3.4.3 L-Arginine

Endothelial dysfunction is associated with the decreased exercise capacity observed in HT recipients. L-Arginine supplementation (LAS) increases nitric oxide (NO) and decreases endothelin-1 plasma concentrations, thereby improving endothelial function and exercise capacity in heart failure or HT patients (Doutreleau et al., 2004; Rector et al., 1996).

The NO/endothelin ratio significantly increases after chronic LAS, suggesting that the beneficial effects of L-Arginine (amino acid precursor of NO production) on the exercise capacity of patients after an HT might, at least partly, be related to an improvement in skeletal muscle vasodilatation and oxygen delivery, and extraction during exercise as suggested by the significant increase in the oxygen pulse after LAS. This pilot study provides support that oral LAS may be a useful adjuvant therapy to improve the quality of life and exercise tolerance in HT recipients (Doutreleau et al., 2010). The L-Arginine-NO pathway has been recognized to play critical roles during infection, inflammation, organ injury and transplant rejection (Helton, 2001).

These dietary interventions, when used in combination with other therapies, may improve the quality of life of patients (Hasse, 2001).

3.5 Side effects of cyclosporine

Cyclosporine has significant effects on the metabolism and disposition of several biomolecules. Hyperglycemia, hypercholesterolemia and electrolyte disturbances are a few of its common side effects. Hyperkalemia (cyclosporine has a direct effect on the renin-angiotensin-aldosterone system which further worsens potassium homeostasis [Bantle et al., 1985]) and hypomagnesemia are the two most frequently observed electrolyte disorders caused by this calcineurin inhibitor.

Patients taking cyclosporine should be educated on their dietary potassium intake (the hypertension is another common side effect of cyclosporine). Most patients will subsequently require oral supplementation of magnesium to maintain a normo-magnesic state and the chronic hypomagnesemia may affect parathyroid function and rennin activity (Ichihara et al., 1993; Mori et al., 1992; Navarro et al., 1999). The altered parathyroid hormone activity can have a secondary effect on calcium and vitamin D disposition, and may indirectly contribute to post transplant osteoporosis (Grenet et al., 2000; Thiébaud et al., 1996).

3.6 Mediterranean diet

It has been suggested that the healthy effects of the Mediterranean diet observed in epidemiologic studies are exerted partly through plausible mechanisms: improved lipid profiles (Bemelmans et al., 2002; Zambón et al., 2000) and reductions in blood pressure (Perona et al., 2004) , insulin resistance and systemic markers of inflammation (Chrysohoou et al., 2004; Esposito et al., 2004). These beneficial effects on surrogate markers of cardiovascular risk add biological plausibility to the epidemiologic evidence that supports the suggested protective effects of the Mediterranean diet (Estruch et al., 2006). Moreover, the Mediterranean diet could protect against the development of coronary heart disease, not only because of its beneficial role regarding cardiovascular risk factors, but also due to a possible effect on body weight and obesity (Kastorini et al., 2010).

4. Drug-nutrient interaction

HT recipients are polymedicated patients; they use multiple medications to manage graft rejection, opportunistic infections and other associated complications. This patient population has a very high risk of drug-nutrient interactions (Chan, 2006). In some cases, the interactions are not identified until serious adverse events have occurred.

The consequences of unrecognized and unmanaged drug-nutrient interactions in the transplant recipient can be very serious and these adverse outcomes represent important contributing factors to post transplant morbidity and mortality (Chan, 2001).

Drug-nutrient interactions can significantly affect the availability and potency of immunosuppressive therapy. Alterations in food intake, inadequate digestion and these interactions can lead to changes in the pharmacokinetics of immunosuppressive drugs leading to either toxicity or organ rejection as a result of inadequate blood drug levels (Helton, 2001).

Drugs have the potential to interact with nutrients, which could lead to the reduced therapeutic efficacy of the drug, nutritional risk or increased adverse effects of the drug.

Food-drug interactions are defined as alterations of pharmacokinetics or pharmacodynamics of a drug or nutritional element, or a compromise in nutritional status as a result of the addition of a drug. Nutrient-drug interactions can result in two clinical effects: either a decreased bioavailability of a drug, which predisposes to treatment failure, or an increased bioavailability, which increases the risk of adverse events and may even precipitate toxicities (Genser, 2008).

On the other hand, medications can lead to altered food choices. Many drugs are reported to directly affect the sense of taste and smell, and some drugs themselves have an unpleasant taste that might interfere with food intake (Brownie, 2006).

The evidence that water-soluble vitamin E interacts with orally administered cyclosporine is quite convincing. This interaction has only been observed with water-soluble formulation of vitamin E. Further investigations using different dosage forms of vitamin E are necessary.
Grapefruit juice-drug interactions represent some of the most significant examples of drug-nutrient interactions. When a single dose of cyclosporine was taken with 200 mL of grapefruit juice, its absorption was increased. The reported increase in bioavailability of cyclosporine ranged from 17% to 63% (Chan, 2001).

Other drugs with increased absorption when taken with grapefruit juice are atorvastatin and sertralin (Chan, 2006).

5. Conclusion

It is necessary to make more efforts in studying the metabolic syndrome in transplant patients and how this syndrome can affect the transplanted graft.

There are still many doubts about the interactions between different drugs used, nutrients and other substances in the diet. Moreover, further studies are needed to provide information on the potential benefit that some types of diet (such as the Mediterranean), antioxidants or other molecules present in the diet can contribute to the benefit of patients. Moreover, not only is it important to know that various substances can be beneficial, it is also important to know the amount we can use.

6. References

Al, Z.; Abbas, S.; Moore, E.; Diallo, O.; Hauptman, PJ. & Bastani B. (2005). The natural history of renal function following orthotopic heart transplant. *Clin Transplant*. Vol. 19, No. 5, (Oct 2005), pp. 683-689.

Almenar, ML.; Cardo, L.; Martínez-Dolz, C.; García-Palomar, J.; Rueda, E.; Zorio, MA.; et al. (2005). Risk factors affecting survival in heart transplant patients. *Transplantation Proceedings*, Vol. 37, (2005), pp. 4011-4013.

Andreassen, AK.; Hartmann, A.; Offstad, J.; Geiran, O.; Kvernebo, K. & Simonsen S. (1997). Hypertension prophylaxis with omega-3 fatty acids in heart transplant recipients. *J Am Coll Cardiol*. Vol. 29, No. 6, (May 1997), pp. 1324-1331.

Anker, SD.; Chua, TP.; Ponikowski, P.; Harrington, D.; Swan, JW.; Kox, WJ.; et al. (1997). Hormonal changes and catabolic/anabolic imbalance in chronic failure and their importance for cardiac cachexia. *Circulation*, Vol. 96, No. 2, (July 1997), pp. 526–534.

Anker, SD.; Ponikowski, P.; Varney, S.; Chua, TP.; Clark, AL.; Webb-Peploe, KM.; et al. (1997). Wasting as independent risk factor for mortality in chronic heart failure. *Lancet*. Vol. 349, No. 9058, (Apr 1997), pp. 1050-1053.

Baker, AM.; Levine, TB.; Goldberg, AD. & Levine AB. Natural history and predictors of obesity after orthotopic heart transplantation. *J Heart Lung Transplant*. Vol. 11, No. 6, (Nov-Dec 1992), pp. 1156-1159.

Bantle, JP.; Nath, KA.; Sutherland, DE.; Najarian, JS. & Ferris TF. (1985). Effects of cyclosporine on the renin-angiotensin-aldosterone system and potassium excretion in renal transplant recipients. *Arch Intern Med*. Vol. 145, No. 3, (Mar 1985), pp. 505-508.

Bemelmans, WJ.; Broer, J.; Feskens, EJ.; Smit, AJ.; Muskiet, FA.; Lefrandt, JD.; et al. (2002). Effect of an increased intake of alpha-linolenic acid and group nutritional education on cardiovascular risk factors: the Mediterranean Alpha-linolenic Enriched Groningen Dietary Intervention (MARGARIN) study. *Am J Clin Nutr*. Vol. 75, No. 2, (Feb 2002), pp. 221-227.

Bilchick, K.; Henrikson, C.; Skojec, D.; Kasper, E. & Blumenthal, R. (2004). Treatment of hyperlipidemia in cardiac transplant recipients. *American Heart Journal*, Vol. 148, No. 2, (August 2004), pp. 200-210.

Blair, SN.; Capuzzi, DM.; Gottlieb, SO.; Nguyen, T.; Morgan, JM. & Cater NB. (2000). Incremental reduction of serum total cholesterol and low-density lipoprotein cholesterol with the addition of plant stanol ester-containing spread to statin therapy. *Am J Cardiol*. Vol. 86, No. 1, (Jul 2000), pp. 46-52.

Brownie, S. (2006). Why are elderly individuals at risk of nutritional deficiency? *Int J Nurs Pract*. Vol. 12, No. 2, (Apr 2006), pp.110-8.

Buzby, GP.; Mullen, JL.; Matthews, DC.; Hobbs, CL. & Rosato, EF. (1980). Prognostic nutritional index in gastrointestinal surgery. *Am J Surg*. Vol. 139, No. 1, (Jan 1980), pp. 160-167.

Casado, M.J. (2005). Recomendaciones nutricionales para el paciente transplantado de corazón. *Enfermería en Cardiología*, No.34, (2005), pp. 22-24.

Costanzo, MR.; Dipchand, A.; Starling, R.; Taylor, D.; Meiser, B.; Webber, S.; et al. (2010). The International Society of Heart and Lung Transplantation Guidelines for the care of heart transplant recipients. *The Journal of Heart and Lung Transplantation*, Vol. 29, No. 8, (August 2010), pp. 914-956.

Chan, LN. (2001). Drug-nutrient interactions in transplant recipients. *J Parenter Enteral Nutr*. Vol. 25, No. 3, (May-Jun 2001), pp. 132-141.

Chan, LN. (2006). Drug-Nutrient Interactions. In: Shils, ME.; Shike, M.; Ross, AC.; Caballero, B.; Cousins, RJ. (eds): *Modern Nutrition in Health and Disease.* Baltimore, Lippincott Williams & Wilkins, 2006, pp. 1540–1553.

Chrysohoou, C.; Panagiotakos, DB.; Pitsavos, C.; Das, UN. & Stefanadis, C. (2004). Adherence to the Mediterranean diet attenuates inflammation and coagulation process in healthy adults: The ATTICA Study. *J Am Coll Cardiol*. Vol. 44, No. 1, (Jul 2004), pp. 152-158.

de Fijter, WM.; de Fijter, CW.; Oe, PL.; ter Wee, PM. & Donker, AJ. (1997). Assessment of total body water and lean body mass from anthropometry, Watson formula, creatinine kinetics and body electrical impedance compared with antipyrine kinetics in peritoneal dialysis patients. *Nephrol Dial Transplant.* Vol. 12, No. 1, (Jan 1997), pp. 151-156.

Deloughery, TG.; Evans, A.; Sadeghi, A.; McWilliams, J.; Henner, WD.; Taylor, LM.; et al. (1996). Common mutation in methylenetetrahydrofolate reductase. Correlation with homocysteine metabolism and late-onset vascular disease. *Circulation*. Vol. 94, No. 12, (Dec 1996), pp. 3074-3078.

Doutreleau, S.; Rouyer, O.; Di Marco, P.; Lonsdorfer, E.; Richard, R.; Piquard, F.; et al. (2010). L-arginine supplementation improves exercise capacity after a heart transplant. *Am J Clin Nutr*. Vol. 91, No. 5, (May 2010), pp. 1261-1267.

Doutreleau, S.; Piquard, F. ; Lonsdorfer, E. ; Rouyer, O. ; Lampert, E. ; Mettauer, B. ; et al. (2004). Improving exercise capacity, 6 wk training tends to reduce circulating endothelin after heart transplantation. *Clin Transplant*. Vol. 18, No. 6, (Dec 2004), pp. 672-675.

Dumler, F. (1997). Use of bioelectric impedance analysis and dual-energy X-ray absorptiometry for monitoring the nutritional status of dialysis patients. *ASAIO J*. Vol. 43, No. 3, (May-Jun 1997), pp. 256-260.

Durrington, PN.; Bhatnagar, D.; Mackness, MI.; Morgan, J.; Julier, K.; Khan, MA.; et al. (2001). An omega-3 polyunsaturated fatty acid concentrate administered for one year decreased triglycerides in simvastatin treated patients with coronary heart disease and persisting hypertriglyceridaemia. *Heart*. Vol. 85, No. 5, (May 2001), pp. 544-548.

Epstein, S.; Shane, E. & Bilezikian J. Organ transplantation and osteoporosis. (1995). *Curr Opin Rheumatol*, Vol. 7, No. 3, (May 1995), pp. 255–261.

Epstein, S. & Shane, E. (1996). Post transplant bone disease: the role of immunosuppressive agents on the skeleton. *J Bone Miner Res*. Vol. 11. (1996), pp. 1-7.

Esposito, K.; Marfella, R.; Ciotola, M.; Di Palo, C.; Giugliano, F.; Giugliano, G.; et al. (2004). Effect of a Mediterranean-style diet on endothelial dysfunction and markers of vascular inflammation in the metabolic syndrome: a randomized trial. *JAMA*. Vol. 292, No. 12, (Sep 2004), pp. 1440-1446.

Estruch, R.; Martínez-González, MA.; Corella, D.; Salas-Salvadó, J.; Ruiz-Gutiérrez, V.; Covas, MI.; et al. (2006). Effects of a Mediterranean-style diet on cardiovascular risk factors: a randomized trial. *Ann Intern Med*. Vol. 145, No. 1, (Jul 2006), pp. 1-11.

Evangelista, LS.; Dracup, K.; Doering, L.; Moser, DK. & Kobashigawa, J. (2005). Physical activity patterns in heart transplant women. *J Cardiovasc Nurs*, Vol. 20, No. 5, (Sept-Oct 2005), pp. 334-339.

Flattery, MP.; Salyer, J.; Maltby, MC.; Joyner, PL. & Elswick, RK. (2006). Lifestyle and health status differ over time in long-term heart transplant recipients. *Prog Transplant*, Vol. 16, No. 3, (September 2006), pp. 232-238.

Fleischhauer, FJ.; Yan, WD. & Fischell TA. (1993). Fish oil improves endothelium-dependent coronary vasodilation in heart transplant recipients. *J Am Coll Cardiol*. Vol. 21, No. 4, (Mar 1993), pp. 982-989.

Flier, JS. (2001). Obesity – definition and measurement. In: Braunwald, E.; Fauci, AS.; Kasper, D.; Hauser, S.; Jameson, J. & Stone, R. eds. *Harrison's Principles of Internal Medicine*, 15th edn. New York; St Louis, MO: McGraw-Hill Book Company, 2001.

Genser, D. (2008). Food and drug interaction: consequences for the nutrition/health status. *Ann Nutr Metab*. Vol. 52, Suppl 1, (2008), pp. 29-32.

Glendenning, P.; Kent, GN.; Adler, BD.; Matz, L.; Watson, I.; O'Driscoll, GJ.; et al. (1999). High prevalence of osteoporosis in cardiac transplant recipients and discordance between biochemical turnover markers and bone histomorphometry. *Clin Endocrinol*. Vol. 50, No.3, (Mar 1999), pp.347–355.

Grady, KL.; Naftel, D.; Pamboukian, SV.; Frazier, OH.; Hauptman, P.; Herre, J.; et al. (2005). Post-operative obesity and cachexia are risk factors for morbidity and mortality after heart transplant: multi-institutional study of post-operative weight change. *J Heart Lung Transplant*. Vol. 24, No. 9, (Sep 2005), pp. 1424-1430.

Grady, KL.; Costanzo-Nordin, MR.; Herold, LS.; Sriniavasan, S. & Pifarre, R. (1991). Obesity and hyperlipidemia after heart transplantation. *J Heart Lung Transplant*. Vol. 10, No.3, (May-Jun 1991), pp. 449-454.

Grenet, O.; Bobadilla, M.; Chibout, SD. & Steiner S. Evidence for the impairment of the vitamin D activation pathway by cyclosporine A. *Biochem Pharmacol*. Vol. 59, No. 3, (Feb 2000), pp. 267-272.

Guida, B.; Perrino, NR.; Laccetti, R.; Trio, R.; Nastasi, A.; Pesola, D.; et al. (2009). Role of dietary intervention and nutritional follow-up in heart transplant recipients. *Clin Transplant*. Vol. 23. No. 1, (Jan-Feb 2009), pp. 101-107.

Harrison, J.; McKiernan, J. & Neuberger JM. (1997). A prospective study on the effect of recipient nutritional status on outcome in liver transplantation. *Transpl Int*. Vol. 10, No. 5, (1997), pp. 369-374.

Hasse, J. (2001). Nutrition assessment and support of organ transplants recipients. *Journal of Parenteral and Enteral Nutrition*, Vol. 25, No. 3, (May/Jun 2001), pp. 120-131.

Helton, W. (2001). The A.S.P.E.N. Research Workshop Nutrition Support in Transplantation *Journal of Parenteral and Enteral Nutrition*, Vol. 25, No. 3, (May/Jun 2001), pp. 111-113.

Henderson, NK.; Sambrook, PN.; Kelly, PJ.; Macdonald, P.; Keogh, AM.; Spratt, P.; et al. (1995). Bone mineral loss and recovery after cardiac transplantation. *Lancet*. Vol. 346, No. 8979, (Sep 1995), pp. 905.

Holm, T.; Andreassen, AK.; Aukrust, P.; Andersen, K.; Geiran, OR.; Kjekshus, J.; et al. (2001). Omega-3 fatty acids improve blood pressure control and preserve renal function in hypertensive heart transplant recipients. *Eur Heart J*. Vol. 22, No. 5, (Mar 2001), pp. 428-436.

Hosenpud, J.; Bennett, L.; , Keck, B.; Fiol, B.; Boucek, M. & Novick R. (1998). The Registry of the International Society for Heart and Lung Transplantation: fifteenth official report 1998. *J Heart Lung Transplant*, Vol. 17, (1998), pp. 656–668.

Ichihara, A.; Suzuki, H. & Saruta, T. (1993). Effects of magnesium on the renin-angiotensin-aldosterone system in human subjects. *J Lab Clin Med*. Vol. 122, No. 4, (Oct 1993), pp. 432-440.

Johnson, DW.; Isbel, NM.; Brown, AM.; Kay, TD.; Franzen, K.; Hawley, CM.; et al. (2002). The effect of obesity on renal transplant outcomes. *Transplantation*. Vol. 74, No. 5, (Sep 2002), pp. 675-681.

Kahn, BB. & Flier, JS. (2000). Obesity and insulin resistance. *J Clin Invest.* Vol. 106, No. 4, (Aug 2000), pp. 473-481.

Kahn, J.; Rehak, P.; Schweiger, M.; Wasler, A.; Wascher, T.; Tscheliessnigg, KH.; et al. (2006). The impact of overweight on the development of diabetes after heart transplantation. *Clin Transplant*. Vol. 20, No. 1, (Jan-Feb 2006), pp. 62-66.

Kannel, WB.; Gordon, T. & Castelli, WP. (1979). Obesity, lipids and glucose intolerance. The Framingham Study. *Am J Clin Nutr*. Vol. 32, No. 6, (Jun 1979), pp. 1238-1245.

Kark, JD.; Selhub, J.; Adler, B.; Gofin, J.; Abramson, JH.; Friedman, G.; et al. (1999). Nonfasting plasma total homocysteine level and mortality in middle-aged and elderly men and women in Jerusalem. *Ann Intern Med*. Vol. 131, No. 5, (Sep 1999), pp. 321-330.

Kastorini, CM.; Milionis, HJ.; Goudevenos, JA. & Panagiotakos, DB. (2010). Mediterranean diet and coronary heart disease: is obesity a link? - A systematic review. *Nutr Metab Cardiovasc Dis*. Vol. 20, No. 7, (Sep 2010), pp. 536-551.

Kemna, MS.; Valentine, HA.; Hunt, SA.; Schoeder, JS.; Chen, YDI. & Reaven GR. (1994). Metabolic risk factors for atherosclerosis in heart transplant recipients. *Am Heart J*, Vol. 128, No. 1, (Jul 1994), pp. 68–72.

Keogh, A.; Simons, L.; Spratt, P.; Esmore, D.; Chang, V.; Hickie, J.; et al. (1988). Hyperlipidemia after heart transplantation. *J Heart Transplant*. Vol. 7, No. 3, (May-Jun 1988), pp. 171-175.

Keteyian, SJ.; Marks, CR.; Fedel, FJ.; Ehrman, JK.; Goslin, BR.; Connolly, AM.; et al. (1992). Assessment of body composition in heart transplant patients *Med Sci Sports Exerc*. Vol. 24, No. 2, (Feb 1992), pp. 247-252.

Kromhout, D. (1983). Body weight, diet and serum cholesterol in 871 middle-aged men during 10 years of follow-up (the Zutphen Study). *Am J Clin Nutr*. Vol. 38, No. 4, (Oct 1983), pp. 591-598.

Kutschka, I.; Pethig, K.; Strüber, M.; Dieterich, C.; Harringer, W. & Haverich, A. (2001). Homocysteine - a treatable risk factor for allograft vascular disease after heart transplantation? *J Heart Lung Transplant*. Vol. 20, No. 7, (Jul 2001), pp. 743-746.

Lake, KD.; Reutzel, TJ.; Pritzker, MR.; Jorgensen, CR. & Emery RW. (1993). The impact of steroid withdrawal on the development of lipid abnormalities and obesity in heart transplant recipients. *J Heart Lung Transplant*. Vol. 12, No. 4, (Jul-Aug 1993), pp. 580-590.

Malinowski, JM. & Gehret, MM. (2010). Phytosterols for dyslipidemia. *Am J Health Syst Pharm*. Vol. 67, No. 14, (Jul 2010), pp. 1165-1173.

Miettinen, TA.; Puska, P.; Gylling, H.; Vanhanen, H. & Vartiainen, E. (1995). Reduction of serum cholesterol with sitostanol-ester margarine in a mildly hypercholesterolemic population. *N Engl J Med*. Vol. 333, No. 20, (Nov 1995), pp. 1308-1312.

Mori, S.; Harada, S.; Okazaki, R.; Inoue, D.; Matsumoto, T. & Ogata, E. (1992). Hypomagnesemia with increased metabolism of parathyroid hormone and reduced responsiveness to calcitropic hormones. *Intern Med*. Vol. 31, No. 6, (Jun 1992), pp. 820-824.

Moustapha, A.; Naso, A.; Nahlawi, M.; Gupta, A.; Arheart, KL.; Jacobsen, DW.; et al. (1998). Prospective study of hyperhomocysteinemia as an adverse cardiovascular risk factor in end-stage renal disease. *Circulation*. Vol. 97, No. 2, (Jan 1998), pp. 138-141.

National Heart, Lung and Blood Institute. (1998). Clinical Guidelines on the Identification, Evaluation and Treatment of Overweight and Obesity in Adults. Bethesda, MD: National Heart, Lung, and Blood Institute; 1998.

Navarro, JF.; Mora, C.; Jiménez, A.; Torres, A.; Macía, M. & García, J. (1999). Relationship between serum magnesium and parathyroid hormone levels in hemodialysis patients. *Am J Kidney Dis*. Vol. 34, No. 1, (Jul 1999), pp. 43-48.

Nichols, AB. ; Ravenscroft, C.; Lamphiear, DE. & Ostrander, LD. (1976). Independence of serum lipid levels and dietary habits. The Tecumseh study. *JAMA*. Vol. 236, No. 17, (Oct 1976), pp. 1948-1953.

NIH Consensus Development Panel on Osteoporosis Prevention, Diagnosis and Therapy. (2001). Osteoporosis prevention, diagnosis and therapy. *JAMA*. Vol. 285, No. 6, (Feb 2001), pp. 785-795.

Pérez-San Gregorio, M.A.; Martín-Rodriguez, A. & Galán- Rodríguez, A. (2005). Problemas psicológicos asociados al transplante de órganos. *Int J Clin Health Psychol*, No. 5, (2005), pp.99-114.

Perona, JS.; Cañizares, J.; Montero, E.; Sánchez-Domínguez, JM.; Catalá, A. & Ruiz-Gutiérrez, V. (2004). Virgin olive oil reduces blood pressure in hypertensive elderly subjects. *Clin Nutr*. Vol. 23, No. 5, (Oct 2004), pp. 1113-1121.

Pethig, K.; Fischer, H.; Wahlers, T.; Harringer, W.; Oppelt, P. & Haverich A. (1997). odesursachen nach Herz-transplantation: Einfluß auf die klinische Langzeitbetreuung. *Z Kardiol*, Vol. 86, S3, (1997), pp. 98.

Pethig, K.; Klauss, V.; Heublein, B.; Mudra, H.; Westphal, A.; Weber, C.; et al. (2000). Progression of cardiac allograft vascular disease as assessed by serial intravascular ultrasound: correlation to immunological and non-immunological risk factors. *Heart*. Vol. 84, No. 5, (Nov 2000), pp. 494-498.

Pichard, C.; Kyle, UG. & Slosman, DO. (1999). Fat-free mass in chronic illness: comparison of bioelectrical impedance and dual-energy x-ray absorptiometry in 480 chronically ill and healthy subjects. *Nutrition*. Vol. 15, No. 9, (Sep 1999), pp. 668-676.

Pisani, B. & Mullen, GM. (2002). Prevention of osteoporosis in cardiac transplant recipients. *Curr Opin Cardiol*. Vol. 17, No. 2, (Mar 2002), pp. 160-164., pp. 473-481.

Rady, MY.; Ryan, T. & Starr, NJ. (1997). Clinical characteristics of preoperative hypoalbuminemia predict outcome of cardiovascular surgery. *J Parenter Enteral Nutr*. Vol. 21, No. 2, (Mar-Apr 1997), pp. 81-90.

Rapp-Kesek, D.; Stahle, E. & Karlsson, T. (2004). Body mass index and albumin in the preoperative evaluation of cardiac surgery patients. *Clinical Nutrition*, Vol. 23, No. 6, (Dec 2004) pp. 1398-1404.

Rector, TS.; Bank, AJ.; Mullen, KA.; Tschumperlin, LK.; Sih, R.; Pillai, K.; et al. (1996). Randomized, double-blind, placebo-controlled study of supplemental oral L-arginine in patients with heart failure. *Circulation*. Vol. 93, No. 12, (Jun 1996), pp. 2135-2141.

Reid, IR.; King, AR.; Alexander, CJ. & Ibbertson HK. (1988). Prevention of steroid-induced osteoporosis with (3-amino-1-hydroxypropylidene)-1,1-bisphosphonate (APD). *Lancet*, Vol. 331, No. 8578, (January 1988), pp. 143–146.

Rodino, M. & Shane, E. (1998). Osteoporosis after organ transplantation. *Am J Med*, Vol. 104, No. 5, (May 1998), pp. 459–469.

Russo, M.; Hong, K.; Davies, R.; Chen, J.; Mancini, D.; Oz, M.; et al. (2010). The effect of body mass index on survival following heart transplantation. Do outcomes support consensus guidelines? *Annals of Surgery*, Vol. 251, No.1, (January 2010), pp. 144-152.

Selhub, J.; Jacques, PF.; Rosenberg, IH.; Rogers, G.; Bowman, BA.; Gunter, EW.; et al. (1999). Serum total homocysteine concentrations in the third National Health and Nutrition Examination Survey (1991-1994): population reference ranges and contribution of vitamin status to high serum concentrations. *Ann Intern Med*. Vol. 131, No. 5, (Sep 1999), pp. 331-339.

Sénéchal, M.; Lemieux, I.; Beucler, I. ; Drobinski, G. ; Cormont, S. ; Dubois, M., et al. (2005). Features of the metabolic syndrome of "hypertriglyceridemic waist" and transplant coronary artery disease. *The Journal of Heart and Lung Transplantation*, Vol. 24, No. 7, (July 2005), pp. 819-826.

Shane, E. Pathogenesis and management of transplantation osteoporosis. (2000). In *Harrison's Online*, edn 15, Chap 342. Edited by Braunwald E, Fauci AS, Isselbacher, KJ, et al. New York: McGraw-Hill; 2000.

Shane, E.; Rivas, M.; McMahon, DJ.; Staron, RB.; Silverberg, SJ.; Seibel, MJ.; et al. (1997). Bone loss and turnover after cardiac transplantation. *J Clin Endocrinol Metab*. Vol. 82, No. 5, (May 1997), pp. 1497-1506.

Sirvent, J.E. & Garrido, R.P. (2009). Valoración antropomética de la composición corporal. Cineantropometria. In: Publicaciones Universidad de Alicante. Alicante, España, 2009. ISBN 978-84-9717-052-9.

Spaderna, H.; Smits, JM.; Rahmel, AO. & Weidner G. Psychosocial and behavioural factors in heart transplant candidates - an overview. *Transpl Int*. Vol. 20, No. 11, (Nov 2007), pp. 909-920.

Stempfle, HU.; Werner, C.; Echtler, S.; Wehr, U.; Rambeck, WA.; Siebert, U.; et al. (1999). Prevention of osteoporosis after cardiac transplantation: a prospective, longitudinal, randomized, double-blind trial with calcitriol. *Transplantation*, Vol. 68, No. 4, (August 1999), pp. 523-530.

The Expert Panel. (1988). National Cholesterol Education Program: report of the expert panel on the detection, evaluation and treatment of high blood cholesterol in adults. *Arch Int Med*. Vol. 148, pp. 36-69.

Thiébaud, D.; Krieg, MA.; Gillard-Berguer, D.; Jacquet, AF.; Goy, JJ. & Burckhardt P. (1996). Cyclosporine induces high bone turnover and may contribute to bone loss after heart transplantation. *Eur J Clin Invest*. Vol. 26, No. 7, (Jul 1996), pp. 549-555.

Uddén, J.; Bjo¨rntorp, P.; Arner, P.; Barkeling, B.; Meurling, L. & Ro¨ssner, S. (2003). Effects of glucocorticoids onleptin levels and eating behaviour in women. *J Intern Med*, Vol. 253, No.2, (2003), pp. 225-231.

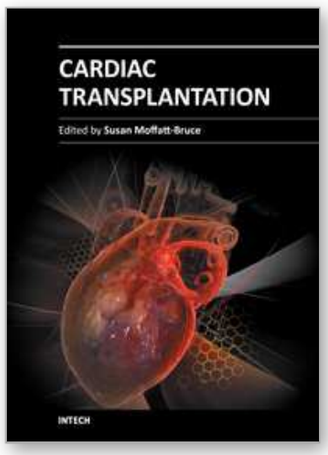
Verhoef, P.; Stampfer, MJ.; Buring, JE.; Gaziano, JM.; Allen, RH.; Stabler, SP.; et al. (1996). Homocysteine metabolism and risk of myocardial infarction: relation with vitamins B6, B12 and folate. *Am J Epidemiol*. Vol. 143, No. 9, (May 1996), pp. 845-859.

Vorlat, A.; Conraads, VM. & Vrints, CJ. (2003). Regular use of margarine-containing stanol/sterol esters reduces total and low-density lipoprotein (LDL) cholesterol and allows reduction of statin therapy after cardiac transplantation: preliminary observations. *J Heart Lung Transplant.* Vol. 22, No. 9, (Sep 2003), pp. 1059-62.

Welch, GN.; Upchurch, G. & Loscalzo, J. (1997). Hyperhomocyst(e)inemia and atherothrombosis. *Ann N Y Acad Sci*. Vol. 811, (Apr 1997), pp. 48-58.

Williams, JJ.; Lund, LH.; LaManca, J.; Kunavarapu, C.; Cohen, DJ.; Heshka, S.; et al. (2006). Excessive weight gain in cardiac transplant recipients. *J Heart Lung Transplant*. Vol. 25, No. 1, (Jan 2006), pp. 36-41.

Zambón, D.; Sabaté, J.; Muñoz, S.; Campero, B.; Casals, E.; Merlos, M.; et al. (2000). Substituting walnuts for monounsaturated fat improves the serum lipid profile of hypercholesterolemic men and women. A randomized crossover trial. *Ann Intern Med*. Vol. 132, No. 7, (Apr 2000), pp. 538-546.



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We are truly in an era of change not only in terms of technology but in the type of patient we are caring for. That is why I feel this book is exciting in that it presents the team approach to the transplant patient. I am confident that the pioneers of cardiac transplantation would be pleased with our response to challenges in healthcare today and be pleased with the final product.

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