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Review article

Obesity in orthopedics and trauma surgery

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ABSTRACT

In 2012, 32.3% of the French population over 18 years of age was considered overweight ($25 \leq BMI < 30\ kg/m^2$) and 15% obese ($BMI \geq 30\ kg/m^2$). Worldwide, 2.8 million people die every year from the complications of obesity. In 2008, the prevalence of obesity was almost double that of 1980. Obesity is a genuine concern for the orthopedic surgeon, as it affects bones and soft tissues on the biomechanical and biochemical level. In traumatology, low-energy trauma is more frequent in obese patients and induces complex comminutive fractures of the extremities. In orthopedics, obesity is an independent risk factor for osteoarthritis, particularly for the knee joint. The goals of this review are to describe specific aspects of the care of obese patients in trauma and orthopedics surgery during the pre-, intra- and postoperative periods, as well as the risk-benefit ratio related to the treatment of the obese patients.

1. Introduction

Obesity is defined as a body mass index (BMI) > $30\ kg/m^2$ [1]. BMI is calculated by dividing a person's weight in kg by the square of their height in metres (kg/m^2) [1]. A normal BMI ranges from 18.5 to $25\ kg/m^2$ [1]. Adults with a BMI between 25 and 29.9 are considered overweight, and those with a BMI ≥ 30 are considered obese [1]. Severe obesity is defined as a BMI between 35 and 40, with morbid obesity defined as $BMI \geq 40\ kg/m^2$ [1]. Children and teenager (ages 2–19) are considered overweight if their BMI is between the 85th and 95th percentile and obese if above the 95th percentile for children of the same age and gender [1]. In 2012, 32.3% of adults above 18 years of age in France were considered overweight ($25 \leq BMI < 30\ kg/m^2$) and 15% were considered obese ($BMI \geq 30\ kg/m^2$) [2]. Obesity is a growing public health problem worldwide [1]. According to 2008 WHO estimates, 1.4 billion adults were overweight and more than 500 million were obese, while more than 40 million children under the age of five were overweight [1]. The prevalence of obesity has nearly doubled between 1980 and 2008 [1]. Each year, at least 2.8 million people die because of the consequences of being overweight or obese [1]. Obesity requires specific considerations during surgery and there is now a peer-reviewed journal dedicated to this problem [3]. The orthopedic surgeon is not immune to this public health problem, and often is not well prepared to deal with it. In daily practice, orthopedic surgeons have to deal with two distinct categories of patients. First, patients who are overweight or moderately obese that are treated without being really prepared for the surgery despite the increased risk of complications related to their condition. The second category of patient includes patient who are severely obese or morbidly obese who wander from hospital to hospital looking for a surgeon willing to operate on them. In this second group of patients, a multidisciplinary team approach is essential; in the least, a nutritionist, endocrinologist and psychologist should be supporting the surgeon-anesthesiologist team.

In France, to our knowledge, this is the first time a review has summarized the care of obese patients during orthopedic and trauma surgery. After reviewing pathophysiological and epidemiological aspects, the main focus will be on establishing broad principles for managing obese patients in the pre-, intra- and postoperative stages of orthopedics and trauma surgery.

2. General data

2.1. Pathophysiology

Obesity has historically been attributed to excessive consumption of high-calorie foods and a sedentary lifestyle, factors, which are more widespread in patients with a low socioeconomic status. However, no strong causal relationship between these factors has been established, probably because several other factors come into play [4].

Obesity should not be viewed simply as a biomechanical problem leading to excessive loads and/or a physical problem complicating imaging, surgical approaches, procedures and skin healing [5]. It has recently been found that certain fat-derived

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hormones (adipokines) are involved in the development of obesity: leptin (pro-inflammatory) and adiponectin (anti-inflammatory). Although the mechanism of action is not fully understood, it is likely related to altered regulation [6] and changes in cell receptor sensitivity [4].

When added to a whole other series of pro-inflammatory and anti-inflammatory agents that are increased in obesity, the result is a low-grade inflammatory condition linked to cardiovascular and metabolic complications and infectious, wound healing or bone healing complications during orthopedics and trauma surgery [5]. These could also explain some of the failures of diet-related treatments.

A recent international, multicentric prospective study gathered demographic, clinical, laboratory and coronary imaging data from 13,874 patients. A clear link between weight and cardiovascular events, high blood pressure and diabetes was established. When looking at patients who were underweight, normal weight, overweight and obese, there was an increase in the prevalence of diabetes (7, 10, 12 and 19%, respectively), high blood pressure (37, 40, 46 and 59%, respectively) and hyperlipidemia (48, 52, 56 and 56%, respectively) as weight increased [7]. Multivariate analysis identified high BMI as an independent risk factor for coronary heart disease and > 50% coronary stenosis. Obese patients also had a higher risk of myocardial infarction leading to death than non-obese people [7]. This can be explained by the role of adipokines in blood glucose regulation and fat metabolism [5] with the complex cascade of biological events that follows. This cascade involves interleukins (namely IL-6, TNF-alpha and IL-12), which results in obese persons having a permanent inflammatory condition [7].

Furthermore, these adipokines seem to play an important role in the biochemical processes that trigger osteoarthritis [6]. Clinical studies have shown relationships between adipokine levels and cartilage volume loss [6]. For example, leptin triggers the development of an intra-articular inflammatory condition that is responsible for breaking down collagen and then osteoarthritis later on [6]. This may explain why osteoarthritis is more common in the obese, not only in weight-bearing joints such as the knees, but also in the hands [6]. Research is on going to identify new specific antibody-based drugs to control the negative effects of adipokines [5].

2.2. Epidemiology

In 2012, one third of French residents 18 years or older were overweight ($25 < BMI < 30\ kg/m^2$) and 15% were obese ($BMI \geq 30\ kg/m^2$) [2]. The average weight of the French population increased by 3.6 kg over 15 years, while height increased by only 0.7 cm [2]. The average BMI went from 24.3 kg/m^2 in 1997 to 25.4 kg/m^2 in 2012 ($P < 0.05$), an increase of 1.1 kg/m^2 in 15 years [2]. However, the rate of increase in obesity has slowed down recently (+3.4% obesity since 2009, versus +10.7% between 2006 and 2009, +10.1% between 2003 and 2006, +17.8% between 2000 and 2003, +18.8% between 1997 and 2000), while the greatest increase occurred in the 18–35 age bracket [2]. By 2012, more women (15.7%) than men (14.3%) were obese ($P < 0.01$).

Furthermore:

- average BMI steadily increases with age [2];
- there is an inverse relationship between obesity and household income and between obesity and town or city size;
- the prevalence of obesity is highest in the northern part of France (21.3%), followed by the Paris area (17.8%) and then the eastern part (17.1%) [2];
- nearly three times more overweight people have diabetes that is being treated or requires dietary modifications; this increases to seven times more in obese people [2];
- the prevalence in the association of three cardiovascular risk factors is 14 times higher with obesity and five times higher when overweight.

The relationship between osteoarthritis, age, gender, nationality and obesity was evaluated in a two-part French and European study of 63,232 households [8]. Hip and knee osteoarthritis increased significantly with increasing age for both genders, and then become more pronounced in women above 50 years of age [8]. Hip osteoarthritis was most common in the Northern regions (Picardy, Lorraine and Brittany) of France, while knee osteoarthritis was most common in the Northeastern areas (Picardy and Lorraine) in both genders. The prevalence of osteoarthritis was correlated with the prevalence of obesity in every region (R: 0.92 for the hip and 0.54 for the knees) [8].

With the population getting older and heavier, and osteoarthritis being correlated to these parameters, the number of obese arthritic patients needing care will increase [8]. There is currently no accurate data on the number of obese patients getting hip or knee arthroplasty in France. Of the 480 total hip and 420 total knee replacements performed by three senior surgeons in our department in 2012, 40% of patients were overweight, 20% were obese and 5% were morbidly obese.

2.3. Financial consequences

2.3.1. Financial impact

In France, the direct annual cost attributed to treating obesity and its related diseases (hypertension, diabetes, etc.) was estimated at 640 million Euros in 2007, according to a study performed on a representative sample of the adult population [9]. Other findings from this study:

- the direct annual cost reached 1.37 billion Euros when all care was included, even if it was not directly related to the obesity;
- an obese person will need twice as many medical products as a normal weight individual;
- in a 10 year period, the percentage of health expenses attributed to obesity went from 0.7–2% to 1.5–4.6% of the global budget, but this did not include certain costs incurred by and for obese individuals (diets, treatments, specific equipment) that are said to be invisible and difficult to track [9].

The excess cost of performing orthopedics and trauma surgery in obese patients has not been evaluated.

For each operated patients, height and weight must be recorded in the patient's file and discharge summary; depending on the type of procedure, potential comorbidities and duration of hospital study, obesity can increase the cost of the stay [10]. As of January 1, 2013, diagnostic codes were created in France to capture obese children and overweight children and adults. These are in addition to the other codes created in 2006 for obesity (E66), which allows the French Medical Information Ministry to better evaluate the cost of hospital stays attributed to these patients [10]. But these diagnostic codes do not affect the procedure codes and do not take into account the problems encountered by a surgeon caring for an obese patient [10].

2.3.2. Medical imaging

Since obesity has a direct effect on image acquisition, changes must be made when the bones and joints of obese people are imaged. These patients should be referred to a radiology center experienced in managing obese patients, particularly for axial