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# BODY COMPOSITION CHARACTERISTICS AND BODY SURFACE AREA

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**ABSTRACT**

Chemotherapy dose calculation for oncologycal patient is using the human body surface area (BSA). BSA is a variable with a difficult constitutional body and physiological assessment. BSA does not reflect the exercise on body composition in relation to the various body modifications: obesity, amputation of body parts, pregnancy. Body surface area despite the documented limitations remains the most commonly used parameter chemotherapy (cytotoxic therapy) of cancer patients.

The new guidelines are intended obese patients is to achieve the same maximum dose rate calculated BSA taking into account the full weight rather than using the statement or reduce weight by restricting intake. Experience shows that there are significant restrictions on the dosage given on BSA in obese patients, amputation of a body part or to become pregnant.

***Keywords**: body surface area (BSA), chemotherapy, body composition characteristics*

Chemotherapy dose calculation for oncologycal patient is using the human body surface area (BSA). Body surface area is expressed in square meters ($m^2$). BSA is a variable with a difficult constitutional body and physiological assessment. But the BSA does not reflect the exercise on body composition in relation to the various body modifications: obesity, amputation of body parts, pregnancy. It is believed that the average BSA value for adults is 1.73 $m^2$ (Table 1).

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Body surface area despite the documented limitations remains the most commonly used parameter chemotherapy (cytotoxic therapy) of cancer patients.[1]

**Table 1.** Body surface area value depending of the age and gender

| Body surface area ($m^2$) |
|---|
| Newborns |
| Children under 2 years of age |
| Children under 9 years of age |
| Children under 10 years of age |
| 12–13 years old children |
| Male |
| Female |

There are different approaches to chemotherapy dose is calculated in a situation where any missing body parts such as amputation. One of the possibilities is the standard BSA determination taking into account height and weight before amputation (Figure 1).

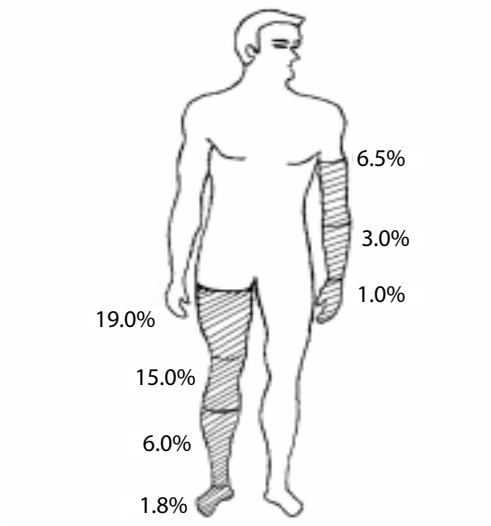


**Figure 1.** The percentage weight loss of total body weight the missing part or all of the limb.

For example, if the patient has a below knee amputation then subtracted from the body weight of 6% for the amputation above the knee, then to subtract 15% of the body weight. If the whole foot is amputated then minus 19%[2].

The dose can be adjusted based on the reduction of BSA by the formula when deprived of the limb volume or dose adjustments are made on the basis of the reduced weight [3,4]. Accurate to calculate the dose of chemotherapy in such cases, a lack of supporting evidence there is no data from clinical trials or guidelines. It does not account for other influencing factors such as age, comorbidities, pharmacogenetics processes and other. There are changes in pharmacokinetics due to altered body composition, decrease in the size of vascular and cardiac ejection fraction, but the drug metabolism and excretion remains unchanged. The renal function is used to assess serum creatinine in the case of amputation is not always an accurate indicator of [5].

Obesity is one of the risk factors which may cause cancer especially in countries with a high standard of living. Obesity affects processes which may cause carcinogenic such as tumor necrosis factor alpha(TNF-α) increase, estrogen production increasing in the fat. [6]. There is an association between obesity and endometrial, colon, pancreas and breast cancer increases the risk of. There is an association between obesity and endometrial, colon, pancreas and breast cancer increases the risk of [7]. Obesity is considered a chronic disease in which the body fat mass than lean body mass (fat free mass) which is measured by the body mass index (BMI) of 30 kg/m$^2$ or more [8,9]. Over the past 25 years obesity as a cause of death is about 14% of men and 20% of women with a diagnosis of cancer. Population of overweight and obesity in the period in 1980 to 2005 year has increased from 15 to 35% [10]. Obese women till 80% increased risk of developing breast cancer stage III and IV low degree of differentiation ($p = 0.014$) than women with normal weight [8]. Recent years have been intensely studied the relationship between obesity and breast cancer as the poor etiological and prognostic factors in patients with an increased body mass. By the 1990$^{th}$ the data published in the literature show that an increase in body weight, increasing the risk of breast cancer recurrence from 1.78 to 1.91, but the relative risk of death – from 1.36 to 1.56 [11]. Taking into account the ratio between total mortality and body mass index the World Health Organization (WHO) has recommended that the desirable BMI is in the range between 20 and 25 kg/m$^2$. If a BMI greater than 25 kg/m$^2$ the patient has overweight (Table 2). BMI <20 kg/m$^2$ is defined as underweight.

**Table 2.** The degree of obesity

| The degree of obesity | BMI (kg/m$^2$) |
|---|---|
| I | 25–29 |
| II | 30–39 |
| III | ≥ 40 |

Relationship between obesity and breast cancer prognosis is widely studied. Studies since 1988. the prognosis is worse for patients with obesity, especially in post-menopausal women at diagnosis [12]. In one of the last statements has shown that obesity is associated with poor prognosis in pre-menopausal and menopausal women. Obesity as a prognostic indicator associated with a less favorable prognosis, especially for a large breast tumors and an increased amount of lymph nodes involved. Is the dominant hypothesis of adipose tissue volume effect of hormone levels. Increased body fat volume is associated with elevated serum estrogen levels. This increase is achieved by converting androgens by the aromatase enzyme in adipose tissue and reduced sex hormone binding globulin which lowers estrogen activity. The growing influence of estrogen in the blood of breast cancer development and growth rate. It should be noted that pre-menopausal and menopausal women have different hormone levels and it is important that breast cancer is dependent on estrogen receptors [12]. Pharmacokinetic studies have shown that chemotherapy dose calculation should take into account the actual (real) rather than the ideal body weight [13]. Chemotherapy-induced neutropenia may be a pharmacokinetic marker (surrogate). Several studies have shown that the incidence of neutropenia after the course of chemotherapy improving the "disease-free" or overall survival outcomes in the later years [14, 15]. Retrospective study (Lopes-Serrão, etc.) have been reported [16] a common practice – the maximum doses of chemotherapy in obese patients undergoing cancer chemotherapy. The duration of treatment and hematologic toxicity were compared with patients with obesity receiving cancer chemotherapy based on a cap body surface area of 2.2 m$^2$, and normal weight patients. Hematological toxicity for cancer patients with the risk of obesity receiving a full or nearly full doses of chemotherapy no greater than normal weight patients receiving full dose according to body weight. There are studies that show that up to 40% of patients with obesity receive reduced doses of chemotherapy which are not based on actual body weight[17].

In view of the foregoing the ASCO (American Society of Clinical Oncology) the organization has proposed to develop evidence-based clinical practice guidelines on the application of chemotherapy for cancer patients with obesity. A group of experts from various clinical disciplines aimed at collecting the most common questions raised by oncologists in their daily practice. To address these issues and to create a practical evidence-based recommendations, the expert group stressed the need for retrospective and prospective studies. One of the new trends of modern chemotherapy is a target therapy (biological and molecular therapy) and combination with conventional myelosuppressive cytotoxic agents for cancer patients. Targeted therapy needed for evidence-based clinical practice guidelines to determine the dose of chemotherapy for cancer patients with obesity. This is to reduce persistent uncertainty a more coherent dosing and improved clinical outcomes.

Approximately from 0.02 to 0.1% of pregnant women are diagnosed cancer. More common are the neck, breast cancer (10% for women younger than 40 years), Hodgkin's lymphoma and melanoma. The chemotherapy during pregnancy do not intend and does not. The theory recommending chemotherapy take into account several parameters: lipophilicity, drug molecular weight, protein binding capacity of P-glycoprotein and CYP (cytochrome enzyme) in the blood. During pregnancy prolonged drug elimination half-life time, deficiency of the metabolite, can have all kinds of toxicity. For the purposes of dose is not entirely clear data on the treatment schedule (every one to three weeks), which is the standard dose (insufficient or excessive), take into account the continuous changes in body weight [38lu]. Clinical and pharmacokinetic studies in such cases is difficult because the pregnancy is hormonal, bioavailability and distribution, metabolism and excretion changes, increasing water and fat in the body, in addition to take into account the amniotic fluid. Blood flow through the liver and kidneys increases by 50–80% [18]. There is still a lack of information on the optimal chemotherapy dosing strategies, with benefit / risk. It is impossible to predict the risk for the mother and the fetus / baby. Each new clinical case must be examined individually.

American Oncology Association has developed a general agreement that obese patients should be given the optimal chemotherapy dose that provides clinical benefit in reduced dose intensity may compromise disease-free survival (DFS) and overall survival (OS). Historically dose determination in obese patients has been problematic and so far there has been no standard approach.

The new guidelines are intended obese patients is to achieve the same maximum dose rate calculated BSA taking into account the full weight rather than using the statement or reduce weight by restricting intake. However, experience shows that there are significant restrictions on the dosage given on BSA in obese patients, amputation of a body part or to become pregnant.

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