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Cosmetic Doping: the Problems of Intramuscular Application of Oils

Original Article

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ABSTRACT

Doping in sports world and in the subculture of professional and recreational bodybuilding athletes is very much known and also studied by the academic and scientific community. However, a new problem, which we defined as cosmetic doping, was introduced some decades ago and has grown in importance in Brazil in recent years. It is the systematic injection of oily substances by intramuscular routes, known as ADE (liposoluble vitamins A, D and E), with the purpose to enlarge the muscle volumetrically, what could lead to necrosis, physical deformities or even death. This article introduces the history of the cosmetic use of body fillers and the review of the possible deleterious and lethal effects that could result as a consequence of the use, as well as the mechanisms that are involved after the injection of these substances. Moreover, simple methods for potential observation of its use in athletes are presented. This paper also suggests that health professionals should report cases when these users are submitted due to their complications, since the studies and cases documented until the present time are only a small part of a reality of public health that tends to considerably increase.

Keywords: chronic granulomatous disease; plant oils; vitamins; doping in sports.

INTRODUCTION

There is a tendency originated from the subculture of bodybuilding athletes, which is inserted among the practitioners of non-competitive bodybuilding. This tendency is the systematic practice of injecting by intramuscular routes the polyvitamin known as ADE, with the purpose of increasing the muscle mass volume in some areas. This name is generically used by its users to refer to the veterinarian medications, which contain liposoluble vitamins A, D and/or E in oily vehicle. The commercial names of such medications found in veterinarian pharmacies are Monovin-E (Laboratory Bravet) which is oily concentrated vitamin E; ADE (Laboratory Labovet); ADE (Laboratory Hertape Calier), ADE Thor (Laboratory Tortuga) which are oily concentrated vitamins A, D and E, among other brand names. In the present article, we will call from now on such medications simply by ADE, a term also used among users.

These medications when injected in muscles of humans in amounts much higher than the therapeutic doses used in large-sized animals such as bovines and equines, cause localized volumetric increase. However, this increase is not related to muscle hypertrophy or any other physiological adaptation event, having only a doubtful cosmetic effect, since the result of the muscle appearance may not be similar to the normal muscle anatomy. The injected volume fills a space in the site of the application, within the muscle surface or in the adjacent subcutaneous tissue.

Due to this muscle increase by a simple localized injection, ADE started to call attention of bodybuilding practitioners, and even non-practitioners. There are reports on the lay media, shown here, of subjects having been admitted to hospitals due to complications of the use of this product, which is an easy way of gaining muscle increase with no effort. However, contrary to the common sense and the lay media, the polyvitamins with oily vehicles such as ADE are not synthetic anabolic steroids. The latter are medications which generate muscle hypertrophy through activity on the physiological mechanisms and have known pharmacological actions. Nevertheless, ADE does not have pharmacological action over the muscle hypertrophy or even adverse effects of the anabolic steroids, but can present other pathological effects non-related to the steroid action.

Since ADE contains liposoluble vitamins, it needs oil as vehicle. In many brand names, sterile peanut oil is the choice. The case report articles produced in many countries and found in the literature mentioned here, demonstrate that the products injected with this cosmetic aim are some kind of oil, either mineral, animal or even vegetable. Therefore, it is concluded that what causes the cosmetic and adverse effects of ADE are the oily vehicles, and not the vitamins per se, except for a possible hypervitaminosis caused by administered excess. The suggested doses by the ADE manufacturers in equines and bovines may reach up to 5ml of the medication every 120 days, in fattening periods. Nevertheless, ADE users apply higher doses, and can reach to four times higher by application in each limb, with weekly repetitions. However, hypervitaminosis

cases have not been reported until the present time in these users. Hypervitaminosis probably does not occur since the injected volume is encapsulated in the muscle surface, or in case it is not, it reaches the systemic circulation, and before leading to hypervitaminosis, it would cause pulmonary embolism.

Origin and use of body fillers

The use of substances to fill in anatomic or surgical cavities as well as body contours with reconstruction or cosmetic aims is ancient and began in 1899 with the Austrian surgeon Robert Gersuny, when he injected vaseline in the scrotum of a patient to mimetize a testicle he had lost [1-3]. Heated vaseline in liquid means, when cools inside the organism, solidifies. Later, paraffin began to be used, since its fusion point was higher than vaseline's, and hence more stable[1]. In the 50 and 60 decades of the XX century, the legalized paraffin oil injections were very popular in Italy. Penis, breasts, cheeks, nose and eyelids were target of increase or alterations in their contour by this technique. However, short and long-run complications were reported, such as the paraffin oil migration [2].

One of the most reported injection sites in the literature for volume increase is the penis. Despite being rare in the west, it is a practice which still occurs in some Asian and Eastern Europe countries [4,5]. There are reports of injection in the penis of paraffin oil [4] vaseline oil [6], cod liver oil [5] as well as auto transmission oil in the scrotum [7] and olive oil in the same site [8]. The consequences of the application in the penis of these oils can be deformity, necrosis, compromised erectile function and ulcers besides paraffinoma[9,10]. Paraffinoma is the name given to the tumor caused by oils, and the terminology depends on the injected material, being also known as oleoma, or lipogranuloma sclerosis (the latter term becoming discontinued).

There are many reports in the literature of self-injections of these and other materials which can be harmful to the human body. There are reports of applications of commercial paraffin oil on the cheeks, lips and chin, as well as the oil known by the brand name as Baby Johnson, and a consequent paraffinoma, being the complete removal of the entire tissue which involves the injury necessary [3].

Di Benedetto et al.[2] report 26 cases of patients with many complications by illegal paraffin oil injection in the breasts of women with cosmetic aims, and in the knee or elbow regions for men, to avoid the Italian mandatory military service. The main complications were inflammation, redness, skin stiffness and rupture, extrusion of the oily material from pectoralis and joints and difficulty in performing limb flexion or extension.

Transsexuals use these devices with certain frequency to try to look more feminine [11,12]. Similarly, bodybuilders use oil injections to artificially increase the muscle volume, and such practice has grown among health club goers [13].

History of substances to local increase in bodybuilding

The use of local applications in bodybulding dates back to the 60 decade, when in Italy the commercially product known as Esiclene (Formebolona) started to be manufactured for therapeutic purposes. In the 80 decade from the last century, its use by the European and American bodybuilders was already common. Esiclene was used by bodybuilders to increase volume of some muscular group immediately before any competition. It is a steroid of low anabolic action; however, with inflammatory properties responsible for this apparent and sudden increase [14,15]. Its production was discontinued and right after Synthol came out, which was created by a bodybuilder in the 90 decade of the XX century. Synthol is 85% middle-chain oils, 7.5% lidocaine analgesic and 7.5% alcohol. It is intramuscularly injected, and is similar to a temporary implant and of immediate action. Among the known adverse effects of Synthol are nerve injury and pulmonary embolism, occlusion of the pulmonary artery, myocardial infarct, infection complications and cerebral vascular accident [16].

It cannot be precisely stated when the use of ADE started in Brazil; however, anecdotal evidence has shown the end of the 80 decade and beginning of the 90 decade of the XX century, especially among competitive bodybuilders, who expect with this practice cosmetic improvement of muscles which would not respond to training. The first case reported in the scientific literature in Brazil dates from the end of the 80 decade[17]. At that time, the bodybuilders tried to harmonize the volume of calves with the volume of the remaining muscles with small applications. Eventually, they started to use ADE in biceps and triceps, but moderately, Just the sufficient to slightly increase the volume of arms and equal it with the remaining muscle groups. The bodybuilders users of ADE tried to not exaggerate, since two of the main characteristics considered by the judges are symmetry and proportions between muscles, besides muscle size, separation and definition [18]. Both ADE use in Brazil and Synthol use in the USA are badly-seen even among steroid users, since the use of such substances is seen as cheating greater than the use of hormonal agents, since the muscle increase is not a result of muscle hypertrophy.

During the 90 decade of the XX century, the use of ADE would have significantly and recurrently started. However, in the last years the use of ADE seems to have become a public health case, since novice bodybuilders started to use ADE as the first resource to locally increase the muscle tissue, with reports of complications derived from this use increasing in the lay media.

Case reports among bodybuilders

Darsow et al.[19] report the case of subcutaneous nodules in a bodybuilder caused by injection of sesame oil with the aim to increase muscle volume of the injected site. The patient states that such procedure is common among American bodybuilders. Koopman et al.[20] also report a case of use of sesame oil injections. The individual injected sesame oil in the biceps, shoulder and lower limbs, developing vasculitis and presenting big skin eruptions on the site of the applications, with edema and necrosis of the injected muscles. Georgieva et al.[13] reported the case of a bodybuilder who injected during two years, sesame oil, presenting painful subcutaneous nodules. Histological analysis revealed what is called "Swiss cheese pattern" of oleoma, since the histological image presented fat lobules with giant cells and surrounding foamy macrophages, with adjacent fibrous tissue.

Iversen et al.[21] describe the case of a bodybuilder who developed muscle and skin necrosis forming multiples ulcers after paraffin oil injections in the biceps, triceps and anterior and posterior deltoids. During about a year, he injected almost one liter of oil in each arm. The neck lymphatic nodules were increased and painless, having presented laboratory confirmation of increased leucocytes and neutrophils, compatible with an infection. Ultrasound exam showed eco-empty structure of different sizes compatible with oil. After two months, ulcers of many sizes could be observed on the arms, reaching up to 7 x 15cm.

Restrepo et al.[12] present a case of two bodybuilders and six transsexuals who presented severe respiratory complications after fluid silicone injections, and two of these individuals died. The bodybuilders had injected silicone in the pectoralis and arms muscles. Munch and

Hvolris[22] report a case of a Dannish bodybuilder who intramuscularly injected during some months walnut oil and stated that such practice is apparently normal among bodybuilders of that country.

The first and only case published in the Brazilian literature dates back 1986[17], when na individual was admitted after the weekly practice of Monovin and Arovit application (vitamin A and oily vehicle) in the pectoralis, arms and penis, during two years.

How to identify ADE applications

Naked eye verification can be sufficient to determine ADE use in the case of extreme users. In these cases, the disproportion between limbs is clearly visible. It is possible to evidence arm circumferences with up to the double of leg circumferences and it is not rare to find in these users arms with 40 or 50cm of circumference, measures only found in elite bodybuilders. Da Silva et al.[23] found as mean circumference among Brazilian bodybuilding athletes 41cm and 50 cm as maximum circumference in this competition. However, arms thicker than 50cm, as 60, 70, 80 and even 90cm are occasionally found among ADE and other oils users.

It is possible to identify a recent ADE application when the application target is with a local deformity, a small unnatural peak on the musculature, which can be swollen and red. The ADE user also loses muscle definition (apparent muscle fibers on the skin) typical of practitioners with large muscle mass and low fat percentage. The application site, such as the gastrocnemius, arms and shoulders, lose muscle definition and apparently get more swollen when compared to the remaining muscles (figure 1).

Palpation of the muscles as a way of recognizing the ADE user and localization of the injected material can also be performed. When touching the muscle group in which the application was made, a cist within the muscle surface can be noticed, even if it is relaxed and not contracted; it can also be sore to palpation [19]. When the biceps is contracted, for instance, a peak on the surface will be seen, as it is visible on experienced trained biceps; however, when it is extended, this portion with the visible peak does not subside. Thus, the biceps peak still remains, even with the muscle extended.

More detailed methods can be used in medical practice to visualize the application site. Some possible methods are: magnetic resonance imaging (MRI), ultrasound or computed tomography (CT) to observe more accurately the confluent and cystic areas due to the injections of oils [11,20,21,24].

Action mechanism and adverse effects

There are no studies in the literature which can demonstrate which action mechanisms in fact act so that ADE application volumetrically increases the muscles as well as the cause for the morphological pattern these muscles take. However, there are studies and reports in the literature with other analog substances used for intramuscular injection, such as Synthol, vegetable, animal and mineral oils (such as the paraffin and vaseline oils). Nevertheless, it ca n be stated that such reactions, both of oil and ADE applications, are partly due to the lipophilic properties of these substances. The possible adverse effects of this use are listed in table 1.

Little information is available in the literature; experimental studies on this issue are even scarcer. However, the use of ADE can be similar to the self-transplant of fat intramuscularly injected. Aygit et al.[25] injected in muscle tissue of rabbits their own body fat. Fibrous tissue in the muscle tissue was observed in the site to stabilize the fat graft. Such episode must also occur with ADE users and it is demonstrated in users of other kinds of oils reported as follows.

Figura 1. Atleta de culturismo com diversas aplicações de substâncias oleosas. Fotografia gentilmente cedida pela IFBB (*International Federation of Bodybuilding*).

The clinical characteristics of paraffin injection and other oils, subcutaneous and acutely, are presented as: 1) an initial inflammatory phase, 2) a latency phase, and 3) a final chronic and late phase.

The initial inflammatory phase comes out and lasts until the first six months after the injection. Its intensity depends on the injected amount. Large amounts lead to acute inflammatory reactions, but they decrease as time passes by [2]. Allergic reaction may also occur, which can lead to vasculitis[20].

A latency phase follows, during which the substance can be well tolerated by the organism. This phase can take months, years or decades. There are cases in the literature of adverse effects which manifest after 24 years from the injections of mineral oils or liquid silicone [4,11].

Subsequently, we have the chronic reaction, when the macrophage response increases in a trial to metabolize the foreign bodies through fragmentation [2,19], which may lead to formation of paraffinoma[6,26]. The paraffin oil and other mineral oils are resistent to the action of lysosomal enzymes, which leads to chronic granulomatous inflammation (which agrees with other reactions to foreign bodies)[21]. The behavior of the lysosomal enzymes when facing the substances contained in the ADE is not known; however, it is speculated that ADE is not as inert as mineral oils, which would explain the reason why ADE can disappear with its nodules, despite the delay, and depending on the injected amount, what would suggest that the substance is metabolized.

Fatty acids can combine with calcium, causing calcification of the

Table 1. Possible complications of AdE or other oils injections.

Complication	Due to
Hypervitaminosis	Non-formation of the fibrous capsule
Occlusion of pulmonary artery, pulmonary embolism, alveolar hemorrhage	Accidental intravenous application or mobilization of the fat buildups
Inflammation, redness, stiffness, skin rupture, oil extrusion	Bad application, lack of sanitation, Subcutaneous application or excess of injected material
Impossibility of muscle contraction, movement loss	Harmed nerve, excessive applied volume.
Paraffinoma (tumor)	Chronic use, chronic inflammation, or subcutaneous application
Deformities, subcutaneous nodules which can be painful	Excessive and chronic use (can be the result of results expected by the users)
Necrosis	Chronic use.
Ulcerations	Subcutaneous application.
Infections, increased lymphatic nodes	Subcutaneous application, excessive use, lack of sanitation.
Calcification and hyaline sclerosis	Subcutaneous application reaching adipose tissue.
Vasculitis	Allergic reaction
Deformities; muscle tissue loss	Surgery to remove the material

adipose tissue and hyaline sclerosis during the final phase of the reaction to the subcutaneous application [2,21]. However, calcification can also occur when there is intramuscular application of oils [19]. The time of onset of this chronic reaction as well as damage intensity are related to the injected amount and on the tissue which received the injection [2,21]. Large amounts of the material are surrounded by polynucleate giant cells, which can either appear at the final stages or initial stages of the reaction. Stromal fibroblasts are stimulated to produce collagen fibers[2]. The formation of fibrous tissue, which surrounds the oil and divides it in small globules, may lead to skin hardening, necrosis and disfigurating subcutaneous nodules [19]. In case the application is subcutaneous, the oleoma Will be on the facial compartments, since there is not fat in the muscle fascia [2,21]. Nevertheless, if it is injected by intramuscular way, mineral oils and ADE may remain encapsulated, both by the inflammatory and fibriotic reaction triggered by the external agent and by the lypophilic barrier of the muscle fascia. Such encapsulation is increased when the used oil is of vegetable origin[19], such as the ADE oily vehicle.

Clinically, the injury appears as a hard and brown nodule, isolate or with others, making big spots on the skin, dermis and subcutaneous adipose tissue. The nodules may be big and palpable, or may be scattered in small nodules, invisible to the naked eye and can be painful to palpation in both its forms. Methods such as ultrasound can be used to intramuscularly visualize the nodes in the subcutis. Darsow et al.[19] used ultrasound the visualize the nodules. Many subcutaneous cists surrounded by fibrous tissue can be seen, full of whitish oily material, easily exudated from the cavity. Necrosis was present in other areas, with spaces optically empty, many of these surrounded by membranes containing inflammatory cells and macrophages. In some of these membranes calcifications of an amorphous material could be seen. Some times, fistulas with purulent secretion or ulcers secreting oily materials can be present. The oil spreads and infiltrates the soft tissues, causing that an area wider than the injected area is affected.

Microscopically, paraffinoma is a chronic granulomatosis inflammation, with giant cells and cistic spaces containing the oil and the calcification giving it the histological appearance of "Swiss cheese". Usually, a surgery is performed to remove as most quantity of the material or affected area as possible [2,19,21]. However, in cases of extensive area of oil dominance, it may not be possible to perform the surgery [21].

In case ADE and oils accidentally become intravenously, there are higher chances that a lethalevent occurs to the user, since the substance can reach the lungs and cause embolism and alveolar hemorrhage [8,22] similar to the fatty embolism [12]. However, even if there is not intravenous application, there are still risks of embolism due to the mobilization of the fat buildups [17]. Experimentally, Svendsen and Aaes-Jørgensen[27] injected 0.45 and 1ml/kg of sesame oil in dogs via intramuscular once a week during six months. Although the dosings and frequencies of ADE use greatly vary, and many times do not present any pattern, this study is similar to what occurs with many ADE users. At the end of the period, all animals presented pulmonary microembolism, besides increased lymphatic nodules containing sesame oil cists. When rabbits and rats were injected with higher frequency (three time per week), but for less time of duration (two to five weeks), pulmonary embolism was still observed. Thus, high doses and/or chronic use of oil applications may also reach the lungs and cause microembolisms, even if injected via intramuscular and with no damage to the arteries.

Comparing ADE with other materials usually injected, we can observe by the qualitative characteristic of this medication, that this is less inert than other injected oils, such as paraffin, vaseline, and silicone. Perhaps this is an advantage compared to these oils, which can be absorbed and the cist reverted. However, it can also be a disadvantage, in case the administered dose is not encapsulated by the local biological alterations, which would lead to embolism or hypervitaminosis.

CASES IN BRAZIL

Our research team published a paper on the use of hormonal agents by health clubs goers [28], having found low prevalence of ADEuse. This has been so far the only investigation to quantify the ADE use in a sample of health club goers. We have no information on any other investigation in Brazil which has quantified ADE use. However, this sample is composed of health club goers from only one urban Center, which does not reflect the prevalence of ADE use in the entire country. There are many cases in the lay media, reported as follows, of self-injections or group application sessions in some Brazilian capitals, as well as in many cities in the countryside of Brazil, where could be easier to buy ADE by the lack of surveillance, easy access to veterinary pharmacies as well as low cost fro the good, which, added to the lack of information of these users, aggravates the problem. We mentioned the lack of information of these users since some brand names of ADE sell, associated to the polyvitamin, a anthelmintic, such as Ivermec AD3E, which two under-aged subjects in Caiapônia, Goiás, injected in 2009. Altogether, they injected 230ml of the product, which led them to seizures and coma, but they survived [29]. One year before that, another youngster also from the countryside in Goiás, specifically in Catalão, injected ADE in the arms and died [30]. In São Luís (October, 2006), a 18-year old individual died from a heart attack after having injected ADE and in September of the same year, another 16-year old individual also died by the use of the same medication [31]. In 2005, in the countryside of Minas Gerais, a 19-year old subject who had never practiced bodybuilding was in a coma due to systematic use for three months of ADE, with other users [32], and died 15 days after hospital admission [33]. In a suburban city of Brasília, in 2004, another 18-year old

young subject was admitted due to pain in the arm and thorax due to ADE complications which they had injected for over eight months [33,34] and, in September of the same year, in Brasília, a 21-year old man died by the same abuse [33]. He made ADE applications with other four friends, all of them presenting some severe complication [35]. In November, 2009, a health club owner in Rio de Janeiro state had been convicted for having applied a mixture of ADE and nandrolone in goers of his health club [36].

The ADE or oils use problematics has reached the extreme of users injecting kitchen oil in their muscles [37,38]. In the city of Fortaleza, in 2004, a user of several anabolic steroids as well as AD applied 300ml of kitchen oil via intramuscular. After many months, ligaments and bones were able to be seen in his leg. This user reports that the due of kitchen oil is recurrent ad has spread to many neighborhoods in Fortaleza[37]. In Natal, many adolescents have made use for years of kitchen oil, when one of them died after supposedly having applied 200ml of kitchen oil in the coronary vein [38].

The practice of local applications among elite and recreational bodybuilders in Brazil was restricted to ADE and vegetable oils use. Nonetheless, in 2010, silicone use was reported in health clubs of Pernambuco[39], which may increase the concern with new cases with mineral oils.

All case reports presented in the lay media were only presented due to complications which these users had, which made them search for emergency medical help. These case reports are only a small amount of the number of cases of ADE self-applications in Brazil, since many users do not search for medical help, since it is common routine among these individuals the practice so-called 'pus draining' when they understand it is necessary to remove the purulent content after repeated applications of the medication. Videos demonstrating this homemade aspiration with syringes and with no sanitation are easily found in the internet in videos sites. Internet is a tool which can be sued to search for images, texts and videos, in video, images and discussion forums sharing sites. Information from which medication to buy, where to buy, instructions on how to apply, to even the illegal commercialization itself of ADEand reports in texts and videos of the complications which many users had can be easily found. You just need to use the terms: ADE, Synthol, localized, draining and/or collateral effects.

CONCLUSION AND PERSPECTIVES

Injection of oily material is an obsolete procedure, revived by bodybuilders as an alternative way or even combined with anabolic steroids. The consequences of these injections are destructive and many times lethal [40]. It is of great relevance to raise the discussion in the academic field on the deleterious practice of injecting ADE and other oils to the health of many Brazilian young subjects, both from urban centers and small towns from the Brazilian countryside.

As the reactions to injected oils may appear after years of latency [21], the few cases which have been seen so far in the media do not reflect the real frequency of ADE intramuscular injection in Brazil. The health problems derived from such practice will tend to increase its incidence and recurrence in hospital emergencies from all around the country, becoming a public health problem. Damage can be acute, when it presents higher probabilities of being lethal, or chronic, when the mutilation and deformities cannot be easily avoided. Thus, it is important to call out the medical field, so that they publish case studies when facing such patients in emergency hospitals, since there is only one case report which dates back from 1989, so that this topic is discussed and ADE and other oils intramuscular application is discouraged. Additionally, it is necessary to study what factors lead these patients to use such medication, to study the possible relation of this abuse and bigorexia, since psychological counseling may be appropriate in many cases [7,40].

In addition to the medical professionals and its importance in the surgical and prognostic treatment of these patients, the physical educators are also important in the prevention as educators. These professionals are the ones who in the majority of times will verify in loco the ADE users in bodybuilding centers. Thus, it is relevant that these professionals are able to identify the ADE users and also the complications of this practice in order to discourage the present and future users.

The aim of this work was to discourage individuals who wish to apply ADE or even any other mineral or vegetable oil in their muscles, to raise the debate on such practice and to make an alert to the scientific community as well as health professionals who still do not know about it, and also to suggest new studies on the topic, such as case reports and epidemiological studies.

Finally, we suggest that the ADE an remaining oils use (vegetable, animals or mineral) are considered cosmetic doping, since such practice meets the definition of doping by the WADA for being it harmful to health, being against the game ethics and being an artificial means to increase muscle circumference, not a result from training.

We suggest here that the term cosmetic doping is sued, since we understand that ADE applications are similar to faking the muscle tissue volume, differently from other ergogenic devices such as anabolic steroids, which, by their action their systemic action could be considered aesthetic doping.

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