Archives of Cardiovascular Disease (2015) 108, 75—83

Available online at ScienceDirect www.sciencedirect.com

Elsevier Masson France EM|consulte www.em-consulte.com/en

REVIEW

Smokeless tobacco, sport and the heart

Tabac non fumé, sport et cœur

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Received 5 September 2014; received in revised form 29 October 2014; accepted 30 October 2014
Available online 12 November 2014

KEYWORDS
Nicotine;
Smokeless tobacco;
Sports;
Doping;
Cardiovascular effects

Summary Smokeless tobacco (snuff) is a finely ground or shredded tobacco that is sniffed through the nose or placed between the cheek and gum. Chewing tobacco is used by putting a wad of tobacco inside the cheek. Smokeless tobacco is widely used by young athletes to enhance performance because nicotine improves some aspects of physiology. However, smokeless tobacco has harmful health effects, including cardiovascular disorders, linked to nicotine physiological effects, mainly through catecholamine release. Nicotine decreases heart rate variability and the ventricular fibrillation threshold, and promotes the occurrence of various arrhythmias; it also impairs endothelial-dependent vasodilation and could therefore promote premature atherogenesis. At rest, heart rate, blood pressure, inotropism, cardiac output and myocardial oxygen consumption are increased by nicotine, leading to an imbalance between myocardial oxygen demand and supply. The same occurs at submaximal levels of exercise. These increases are accompanied by a rise in systemic resistances. At maximal exercise, heart rate, cardiac output and maximal oxygen uptake ($\dot{V}O_{2\,max}$) are unaffected by nicotine. Because endothelial dysfunction is promoted by nicotine, paradoxical coronary vasoconstriction may occur during exercise and recovery. Nicotine induces a decrease in muscular strength and impairs anaerobic performance. However, nicotine is used in sports as it diminishes anxiety, enhances concentration and agility, improves aerobic performance and favours weight control.

Abbreviations: SLT, smokeless tobacco; VO_{2max}, maximal oxygen uptake; WADA, World Anti-Doping Agency.

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http://dx.doi.org/10.1016/j.acvd.2014.10.003

Importantly, smokeless tobacco, similar to cigarette smoking, leads to nicotine dependence through dopaminergic pathways. Smokeless tobacco has harmful cardiovascular effects and is addictive: it fulfils all the criteria for inclusion in the World Anti-Doping Agency prohibited list as a doping product. Smokeless tobacco use in sporting activities must be discouraged.

MOTS CLÉS
Nicotine ;
Tabac non fumé ;
Sport ;
Dopage ;
Effets cardiovasculaires

Résumé Le tabac non fumé (TNF) est un tabac finement moulu ou broyé qui peut être placé soit dans le nez (*dry snuff*, tabac à priser) ou entre la joue et la gencive (*moist snuff*, *snus*, tabac à chiquer). Le TNF est utilisé couramment par les jeunes athlètes qui pensent ainsi pouvoir augmenter leur performance sportive, la nicotine améliorant certains paramètres physiologiques. Cependant, le TNF a des effets nocifs sur la santé, entraînant notamment des troubles cardiovasculaires, liés aux effets physiologiques de la nicotine, principalement via une libération de catécholamines. La nicotine diminue la variabilité de la fréquence cardiaque (FC), le seuil de fibrillation ventriculaire et favorise la survenue d'arythmies. Elle altère la vasodilatation dépendante de l'endothélium et pourrait donc favoriser le développement prématuré d'athérome. Au repos, la FC et la pression artérielle (PA), ainsi que l'inotropisme, le débit cardiaque et la consommation myocardique d'oxygène sont augmentées par la nicotine, conduisant à un déséquilibre entre la demande et l'apport en oxygène au niveau myocardique. Ceci est également constaté à des niveaux d'effort sous-maximal. Ces modifications sont accompagnées d'une élévation des résistances périphériques. À l'exercice maximal cependant, la FC, le débit cardiaque et à le $\dot{V}O_{2\,max}$ sont inchangés par la nicotine. Puisqu'un dysfonctionnement endothélial est favorisé par la nicotine, une vasoconstriction coronaire paradoxale peut survenir aussi bien pendant l'exercice que pendant la phase de récupération. La nicotine diminue la force musculaire et altère la capacité d'exercice anaérobie. Cependant, elle est consommée dans certains sports car elle diminue l'anxiété, renforce la concentration, améliore la performance aérobie et favorise le contrôle de la prise de poids. Il est important de savoir que le TNF, à l'instar du tabac fumé, entraîne une dépendance à la nicotine, relevant de mécanismes dopaminergiques. L'usage du TNF possède des effets cardiovasculaires nocifs, et induit une dépendance à la nicotine : le TNF remplit donc les critères pour être incorporé à la liste des produits dopants de l'Agence mondiale antidopage. L'utilisation du TNF doit donc être déconseillée dans le cadre de la pratique sportive.

Background

Over the past two decades, the use of alternative kinds of tobacco consumption, such as smokeless tobacco (SLT) in the form of 'snuff', chewing tobacco, snus or 'tabac à chiquer' in France, has increased in young athletes. SLT is chewed or sniffed but not smoked. Although the negative health effects of cigarette smoking have been largely documented, those of SLT remain controversial. SLT has been shown to be associated with an increased risk of oral or oropharyngeal cancer and cardiovascular diseases [1,2], leading to the strong discouragement of its use [3]. Although no firm association was found between SLT use and the risk of myocardial infarction in a pooled analysis of prospective observational studies [4], quitting snus, a humid form of powdered tobacco placed under the lip, after myocardial infarction has recently been associated with a better prognosis [5].

Current guidelines recommend that tobacco, including SLT, must be avoided for 2 hours before and after a sports session or practice [6]. However, given that SLT is mostly used by athletes and that intense physical exercise can induce acute cardiovascular events [7], it is important to determine whether the cardiovascular effects of nicotine can increase the risk of cardiovascular outcomes, especially during sports activities. Nicotine is currently under evaluation as a doping product by the World Anti-Doping Agency [8]. As nicotine contributes substantially to the cardiovascular effects of tobacco [9], the debate could be extended to e-cigarettes.

We aim to review current knowledge regarding SLT as a cardiovascular risk factor, considering patterns of consumption of SLT around the world, the pharmacological properties of SLT, the context of SLT use by athletes and SLT safety data. Finally, we review the main findings on the cardiovascular impact of SLT and discuss whether SLT can be classified as a doping agent.

Worldwide consumption patterns

Few data are available on the real use of SLT across the world. In the USA, SLT use is frequent among athletes, especially baseball players [1,10]. In Scandinavia, SLT use is common both in the community and among athletes [1,11], and often starts early in life; more than 15% of