GENERAL REVIEW

Smoking and plastic surgery, part I. Pathophysiologica aspects: Update and proposed recommendations

Tabac et chirurgie plastique, partie I. Aspects physiopathologiques : mise au point et proposition de recommandations

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Received 28 April 2014; accepted 24 June 2014

KEYWORDS
Smoking; Plastic surgery; Wound healing; Physiopathology; Preoperative nicotine withdrawal; Nicotine replacement therapy

Summary
Objectives. — Smoking patients undergoing a plastic surgery intervention are exposed to increased risk of perioperative and postoperative complications. It seemed useful to us to establish an update about the negative impact of smoking, especially on wound healing, and also about the indisputable benefits of quitting. We wish to propose a minimum time lapse of withdrawal in the preoperative and postoperative period in order to reduce the risks and maximize the results of the intervention.

Methods. — A literature review of documents from 1972 to 2014 was carried out by searching five different databases (Medline, PubMed Central, Cochrane library, Pascal and Web of Science).

Results. — Cigarette smoke has a diffuse and multifactorial impact in the body. Hypoxia, tissue ischemia and immune disorders induced by tobacco consumption cause alterations of the healing process. Some of these effects are reversible by quitting. Data from the literature recommend a preoperative smoking cessation period lasting between 3 and 8 weeks and up until 4 weeks postoperatively. Use of nicotine replacement therapies doubles the abstinence rate in the short...
Introduction

Smoking is the first cause of preventable death in France, where in 2012 it was directly responsible for 73,000 deaths [1]. Tobacco consumption leads to increases in cardiovascular [2] and pulmonary [3,4] diseases, as well as high levels of mortality connected with the elevated incidence of different types of cancer.

Rapidly addictive, tobacco smoke has a diffused and multifactorial impact in the body. Its privileged targets are the cardiovascular apparatus and the central nervous system, in which nicotinic acetylcholine receptors have the property of being ubiquitous. The receptors are likewise present in the neuromuscular system as well as in leukocytes, lymphocytes, macrophages and the vascular endothelium [5,6]. In the long term, tobacco consumption has an inexorable impact on healing and tissue repair or regeneration. In surgical settings, these effects on the skin are a source of perioperative and postoperative complications. The problem is particularly preoccupying in plastic surgery, a specialty involving scar tissue in which esthetic and functional results are the foundation for success. In order to minimize risk, smoking cessation is clearly a necessary condition preceding intervention.

The objective of our first part is to comprehensively summarize the many different ways in which tobacco consumption affects the healing process. The indisputable benefits of quitting are spelled out in detail, and we propose a synthesis of the currently available methods of achieving that goal. Do they indeed have a positive impact on healing? What could be the role of the electronic cigarette? Lastly, we wish to inform the reader about our recommendations on the most suitable time lapses for perioperative smoking cessation.

Materials and methods

A computerized literature review of documents dating from 1972 to 2014 was carried out on by searching five different data bases: Medline, PubMed central, Pascal, Cochrane library and Web of Science. Consultations continued through March 2014. The key words were “wound healing”, “physiopathology”, “smoking cessation”, “nicotine replacement therapy”, “smoking”, “tobacco” and “nicotine”.

Initial reading was carried out starting from titles and abstracts, after which the full text of articles of interest was obtained. Randomized controlled and observational studies were retained for further examination. English and French-language publications were included in our research.

Results

As regards the physiopathology of smoking, 1670 references were found. Following elimination of overlap and initial reading of the titles and abstracts, the complete texts of
82 articles were analyzed. All in all, 39 references of interest were selected.

The different systematic reviews found in the literature were analyzed. Complementary research was dedicated to publications issued from government organs.

Discussion

The harmful effects of tobacco on wound healing

Cigarette smoke is composed of a mixture of approximately 4000 toxic substances [7,8]. Harmful effects on wound healing are caused mainly by four of these substances: nicotine, carbon monoxide (CO), hydrocyanic acid (HCN) and nitrogen oxide (NO) [9]. They systemically act at the level of the cutaneous envelope. Each time a cigarette is consumed, approximately 2 to 3 mg of nicotine and 20 to 30 mL of CO are inhaled [10]. The other substances have a secondary but undeniable role; for example, tar is implicated in pulmonary carcinogenesis.

The action mechanisms of these substances have yet to be completely elucidated. We nevertheless know that hypoxia and tissue ischemia are central to the process (Fig. 1) [11,12].

Nicotine

Nicotine is a toxic alkaloid present in tobacco leaves in sizable concentrations. As the main addictive agent in cigarette smoke, it is the agonist of the nicotinic cholinergic receptors. It induces peripheral vasoconstriction by stimulating the release of catecholamines from the adrenal medulla [13], by increasing the production of the powerful vasoconstrictor thromboxane A2 [14], and by diminishing the production of prostaglandine I2, which has a role in vasodilatation and in inhibition of platelet aggregation [9]. Nicotine provokes microvascular lesions by damaging the endothelial cells, leading to platelet hyperaggregability. All of these factors favor hypoxia and intravascular microthrombosis [15,16].

Moreover, the proliferation and cell migration of macrophages and fibroblasts are altered [10]. In smokers, lessened intensity of inflammatory cell response consequently characterizes an early phase of wound healing [17]. Since macrophages help to immunize wounds, the risk of infection of surgical site infection is heightened [17]. As for fibroblasts, they are indispensable to healing because of their capacity to synthesize components of the extracellular matrix such as collagen and some of the inflammatory mediators necessary to granulation tissue proliferation [18]. They are differentiated into myofibroblasts, the star-shaped cells that are responsible for cicatrization. In addition, it has been proven that nicotine slows the epithelialization of wounds [19]. Decreased production of collagen lessened quantity of collagen (particularly types I and III) at the level of the wound leads initially to delayed healing and subsequently to a widened fibrous scar with altered texture [20–23]. And since collagen serves as the support for new blood vessel formation, its rarefaction at the level of the wound leads to diminished angiogenesis [24,25].

Carbon monoxide (CO)

CO binds itself to the heme group at the level of the pulmonary capillaries with an affinity 200 times greater than oxygen (O2) and thereby forms carboxyhemoglobin (HbCO). It diminishes hemoglobin-based oxygen delivery capacities and O2 tissular distribution (it moves the dissociation curve.
of O₂/heme towards the left, increasing the affinity of the O₂ carried by the heme group) [26]. The resultant state of hypoxia stimulates erythropoiesis and the production of fibrinogen, increasing viscosity and blood thrombogenicity [27].

**Hydrocyanic acid**

Hydrocyanic acid is an extremely toxic compound currently used as a pesticide (and previously used in gas chambers). When inhaled, it inhibits mitochondrial oxidative cell metabolism, leading to hypoxia and diminishing cell repair potential [15,28]. It also inhibits the leukocyte function necessary to the inflammatory phase of healing [29].

**Nitrogen oxide (NO)**

Nitrogen oxide is the one gaseous neurotransmitter in the organism. Having been produced at the level of the vascular endothelium, it acts as a vasodilator. Unfortunately, chronic smoking diminishes the biological action of endogenous NO and increases its degradation by inducing production of free radicals, which are inducers of oxidative stress. As it is highly concentrated in cigarette smoke, it induces vasodilatation in the pulmonary capillaries [30].

The overall antioxidant level is diminished, particularly with regard to vitamin C, which is a cofactor required in collagen synthesis [31].

The early effects connected with hypoxia and vasoconstriction are to be distinguished from the late effects, which appear in the immune and the microvascular endothelial systems.

The composition of cigarette smoke varies between the primary current, which is directly inhaled through the filter, and the secondary current, which is present in second-hand smoking. The preponderant factors are combustion temperature (complete combustion in the distal part of the cigarette, incomplete combustion in the proximal part that generates CO), pH, and the way a smoker takes his puffs [32]. Schick and Glantz have shown that the secondary current contains more toxic substances than the primary current, with twice as much nicotine [33].

Cannabis smokers are exposed to the same risks as tobacco smokers. From a qualitative standpoint, the smoke resulting from the combustion of marijuana contains most of the toxic substances found in the primary current of tobacco. From a quantitative standpoint, it contains 3 to 5 times as much NO and hydrocyanic acid, and 20 times as much ammonia [34,35].

**Reversibility through smoking cessation: To what degree?**

**Nicotine: pharmacokinetics, pharmacodynamics...**

The nicotine present in cigarette smoke is absorbed by inhaling at the level of the pulmonary capillaries. This is the most efficient route of administration, as plasma nicotine reaches its highest level at the end of the cigarette and can consequently act rapidly in the organism (Fig. 2) [36]. The oral, nasal (chewed tobacco, gum, pipe, cigar), digestive or transdermal routes of absorption yield more gradual and delayed nicotinemia growth [5]. The half-life of nicotine is variable, ranging from 1 to 4 h and averaging about 2 h [37,38]. In addition, there exists inter-individual variability. Metabolism takes place essentially at the level of the liver, and elimination comes about through urine in the form of its derivatives, namely cotinine and nicotine 1'-N-oxide.

It has been shown that nicotine’s acute vasoconstrictor effect is maintained for 45 to 90 min [11,39].

**Co**

CO/heme binding is stable but reversible. The half-life of CO ranges from roughly 2 to 4 hours. It is eliminated at the level of the pulmonary capillaries on the same basis as CO₂. However, the physiological level of HbCO appears to be reestablished following 12 hours of abstinence [40].

The plasma half-life of hydrocyanic is estimated at 4 min [28].

In theory the vasoconstrictor and hypoxic effects of nicotine and carbon monoxide disappear 24 to 48 h after cessation of intoxication [11,41]. This may lead us to think that some of the immediate effects of tobacco smoke are rapidly reversible after quitting.

As for the later effects, they are gradually attenuated [42,43] (Fig. 3). The inflammatory function essential to wound healing is apparently reestablished quite rapidly, in some cases after just four weeks of abstinence [44]. A diminution in the number of surgical site infections has been observed after smoking cessation [45]. On the other hand,
recovery of the fibroblast proliferation and remodeling functions involves a longer time span, usually lasting several months \[17,44,46\].

**Perioperative smoking cessation: choosing the moment most likely to optimize surgical outcomes and results: “proposal and recommendations”**

A future surgical intervention can be the occasion for the smoker to change his habits by beginning to quit, with or without assistance (concept of the "teachable moment") \[47\]. During consultation, physicians have a duty to test for smoking, to estimate the quantity, and possibly to ask the patient if he has ever considered quitting \[48\].

Smoking cessation theoretically diminishes perioperative risks and improves long-term outcome \[16\]. Given the short half-life of nicotine and carbon monoxide, it is allowable to assume that even a short time period of smoking cessation can be beneficial, at least from a cardiovascular standpoint \[49\]. Optimal duration of this period nonetheless varies according to the criteria studied (anesthesia complications, mortality, postoperative complications).

The required preoperative smoking cessation period must be reasonably short so as to ensure the patients’ commitment and maintain their motivation, and has got to be easy to implement. Associated risks, particularly with respect to anesthesia, should not be ignored.

The preponderant criteria in plastic surgery involves postoperative complications, most of which entail difficulties in wound healing. Unsatisfactory or delayed healing negatively influences the esthetic result. And even when it occurs within an acceptable time frame, healing in a smoking patient is often of poor quality.

Numerous studies with clinical or experimental series have proposed a nicotine withdrawal period conducive to reduced risk of complications \[50–59\]. However, the outcome criteria diverge, as does the nature of the interventions having taken place. We have deemed it useful to synthesize the different data in order to determine the minimal length of a phase of tobacco withdrawal propitious to avoidance, for surgeon and patient alike, of the complications connected with continued smoking. The data are reported in Table 1. The point in time most conducive to diminution of perioperative risks appears to be 4 weeks before the scheduled intervention, and no additional anesthetic risk would be incurred. Moreover, smoking cessation should continue until primary wound healing of the surgical state has been achieved, which in most cases means two postoperative weeks.

The recommendations issued by the supervisory authorities are somewhat divergent, and the differences underscore the difficulties encountered when an ideal time for preoperative tobacco withdrawal is suggested. The French National Authority for Health recommends six weeks \[48\], while the French Society of Anesthesia and Intensive Care advises as many as eight weeks \[60\].

A number of authors have attempted to determine a minimal preoperative tobacco withdrawal time lapse. In their 1998 review, Knobloch et al. came to the conclusion that the duration should be set at 4 weeks \[61\]. In 2006, a review by de Theaom et al. \[62\] analyzed the data extracted from 12 studies. While no precise time lapse was clearly determined, it appeared that even a short period of preoperative smoking cessation is highly likely to diminish the risk of postoperative complications. In 2009, Thomsen et al. analyzed 11 studies and recommended 4 weeks of preoperative withdrawal \[63\]. In their 2011 analysis of some 21 studies, Mills et al. showed that quitting 4 weeks before surgery led to the best results \[64\]. In their 2012 review, Khullar et al. \[16\] estimated that a period ranging from 4 to 8 weeks contributed to reduction of perioperative complications and frequency of revision surgery. However, in their 2011 meta-analysis involving 9 studies, Myers et al. \[65\], observed that 8 weeks of preoperative smoking cessation had no impact on the increase or decrease of complication occurrence, but also stated that preoperative quitting should be advised at the earliest possible time.

Anesthetists are likewise concerned by perioperative and postoperative complications. Cardiovascular events related to tobacco are largely due to the action of nicotine on the sympathetic nervous system \[66\]. The period of early tobacco withdrawal is said to involve a risk of pulmonary complications that are associated with a increase in mucus secretion and bronchial hyperreactivity (Fig. 3), but the affirmation remains controversial \[41,67\]. For most of the authors, 6 to 8 weeks of withdrawal suffice to significantly improve pulmonary function \[68,69\]. According to Møller et al., that is the duration needed to diminish both surgical and anesthetic perioperative risks \[70\]. However, some authors suggest a period as long as 12 weeks \[71\]. Kotani et al. have shown that 6 months of abstinence restore antimicrobial and inflammatory alveolar function \[72\]. As regards the risk of inhalation, no difference in volume and gastric pH has been observed between a non-smoker and a smoker having suspended his intoxication the day before an intervention \[41\].

It indeed seems desirable that smoking cessation occurs as long as possible before an intervention. The longer the preoperative withdrawal period, the more the risk of complications appears to diminish, totally disappearing once more than 6 weeks have elapsed. Summarized in Table 1, our review of the literature suggests a preoperative withdrawal period lasting at least 4 weeks \[15,73,74\]. In addition, smoking cessation must continue during the postoperative period until the surgical wound has healed, that is to say from fifteen days to three weeks \[60\]; complications related to the early effects of smoking (hypoxia, ischemia) are thereby avoided.

For some highly dependent patients, however, the notion of total cessation preceding the intervention constitutes a seemingly insurmountable obstacle. In such cases, the relationship between the surgeon and the patient may be marked by misunderstanding and, more precisely, a fruitless exchange of demands; neither one of them is disposed to make a concession. That said, the concept of "programmed pause" has at times represented a way out of difficult situations. One may explain to the patient that he is not being asked to permanently stop smoking, but rather to take a break lasting a few weeks so as to enhance the chances for a successful intervention. The patient is reassured to know that tobacco-related risks in surgery have been limited and the wound has healed, he can resume smoking.
<table>
<thead>
<tr>
<th>Author Year</th>
<th>Number</th>
<th>Lost of follow-up?</th>
<th>Type of surgery</th>
<th>Preoperative time lapse</th>
<th>Postoperative time lapse</th>
<th>Authors’ conclusions/Relative risk active smoker (AS)/former smoker (FS)/non-smoker (NS)</th>
<th>Lenght of follow-up?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chang 2000</td>
<td>718</td>
<td>—</td>
<td>Breast reconstruction Free TRAM flap</td>
<td>4 weeks</td>
<td>—</td>
<td>Necrosis of mastectomy flap 18.9% (AS) vs. 10% (FS) and 9% (NS)* Overall donor site complications 25.9% (AS) vs. 10% (FS)* and 14.2% (NS)* Necrosis of abdominal flap 4.4% (AS) vs. 0.8% (NS)* Parietal hernia 6.7% (AS) vs. 2.1% (NS)* No significant difference in flap or donor site complications between FS and NS</td>
<td>No</td>
</tr>
<tr>
<td>Nakagawa 2001</td>
<td>288</td>
<td>—</td>
<td>Pulmonary surgery</td>
<td>4 weeks</td>
<td>—</td>
<td>Risk of postoperative pulmonary complications similar in FS and MS (RR 1.03) Overall complication rate 39.4% (AS) vs. 25% (FS)* and 25.9% (NS)* Necrosis of mastectomy flap 7.7% (AS) vs. 2.6% (FS)* and 1.5% (NS)* No significant difference between FS and NS in overall complication rate and necrosis of mastectomy flap rate</td>
<td>No</td>
</tr>
<tr>
<td>Padubidri 2001</td>
<td>748</td>
<td>—</td>
<td>Breast reconstruction TRAM flap (pedicled and free) Tissue exposure</td>
<td>3 weeks</td>
<td>—</td>
<td>Overall complications 52% (AS) vs. 18% (FS)* Wound healing difficulties 31% (AS) vs. 5% (FS)* Impaired wound healing 12% (AS) vs. 0% (NS)<em>. No significant difference between AS and FS Surgical site infection 12% (AS) vs. 1% (FS)</em> 2% (NS)*</td>
<td>15 months</td>
</tr>
<tr>
<td>Kuri 2005</td>
<td>188</td>
<td>—</td>
<td>Head and neck</td>
<td>3 weeks</td>
<td>—</td>
<td>RR delayed wound healing 0.17 AS/FS and 0.11 AS/NS Revision surgery for wound healing complications 85.7% (AS) vs. 55% (FS)* and 47.5% (NS)*</td>
<td>No</td>
</tr>
<tr>
<td>Møller 2002</td>
<td>120</td>
<td>12</td>
<td>Hip and knee orthopedics</td>
<td>6 weeks</td>
<td>—</td>
<td>Overall complications 52% (AS) vs. 18% (FS)* Wound healing difficulties 31% (AS) vs. 5% (FS)* Impaired wound healing 12% (AS) vs. 0% (NS)<em>. No significant difference between AS and FS Surgical site infection 12% (AS) vs. 1% (FS)</em> 2% (NS)*</td>
<td>No</td>
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<tr>
<td>Sørensen 2003</td>
<td>78</td>
<td>4</td>
<td>Skin incisions</td>
<td>4 weeks</td>
<td>—</td>
<td>Overall complications 52% (AS) vs. 18% (FS)* Wound healing difficulties 31% (AS) vs. 5% (FS)* Impaired wound healing 12% (AS) vs. 0% (NS)<em>. No significant difference between AS and FS Surgical site infection 12% (AS) vs. 1% (FS)</em> 2% (NS)*</td>
<td>15 months</td>
</tr>
<tr>
<td>Author Year</td>
<td>Number</td>
<td>Lost of follow-up?</td>
<td>Type of surgery</td>
<td>Preoperative time lapse</td>
<td>Postoperative time lapse</td>
<td>Authors' conclusions/Relative risk active smoker (AS)/former smoker (FS)/non-smoker (NS)</td>
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<tr>
<td>Sørensen 2003</td>
<td>81</td>
<td>21</td>
<td>Colorectal surgery</td>
<td>2 weeks</td>
<td>—</td>
<td>No significant difference in overall or wound healing complication rate between the 3 groups</td>
<td></td>
</tr>
<tr>
<td>Lindstrom 2008</td>
<td>117</td>
<td>15</td>
<td>General and orthopedic surgery</td>
<td>4 weeks</td>
<td>4 weeks</td>
<td>Overall complication rate 41% (AS) vs. 21% (FS) *</td>
<td></td>
</tr>
<tr>
<td>Experimental studies Campos 2008</td>
<td>66 rats</td>
<td>0</td>
<td>McFarlane-type random flap</td>
<td>5 days</td>
<td>—</td>
<td>No significant difference between FS and NS involving skin necrosis area Skin necrosis area 14.84cm² (AS) vs. 8.85cm² (NS) *</td>
<td></td>
</tr>
<tr>
<td>Manchio 2009</td>
<td>40 rats</td>
<td>5</td>
<td>McFarlane-type random or axial flap</td>
<td>8 weeks (at random)</td>
<td>4 weeks (axial)</td>
<td>Percentage of random flap necrosis 30.3% (AS) vs. 29.7% (FS) and 16.6% (NS) Percentage of axial flap necrosis 31.1% (AS) vs. 21.7% (FS) and 11.1% (NS) *</td>
<td></td>
</tr>
</tbody>
</table>

Lenght of follow-up:

- 1 month
- 1 week
- 15 days

*: data not specified.
Means of assisting for tobacco withdrawal

The majority of smokers wish to quit, but they fail or fall back [5]. The notion of tobacco withdrawal implies dependency and addiction. Nicotine remains the main addictive agent in cigarette smoke. It disrupts the dopamine circuit [75], inducing large-scale disorganization of the nicotinic acetylcholine receptors, which are numerous in the brain. Pharmacological dependency is largely due to the increased number of these receptors (up-regulation) and to their desensitization.

There are numerous available ways and means of furthering tobacco withdrawal, and they necessitate both human assistance and medicinal agents. As smoking may be considered as an independent risk factor, disease treatment is multidisciplinary. Non-medical interventions are generally distinguished from replacement, nicotine-based therapies [5].

Non-medical interventions include the human means needed to accompany tobacco withdrawal. Some studies have shown that even minimal counsel can increase the rate of preoperative smoking cessation. [16]. Tobacconists have a key role, and practitioners should not hesitate to apply their advice. Numerous withdrawal assistance structures exist in France, and many of them are state-sponsored. Telephone or Internet “hot lines” are placed at the disposal of patients. Cognitive-behavioral therapy allows for action on psychological dependency.

These structures may be complemented by nicotine replacement therapy (NRT), which is available in several galenic forms (Table 2) [76]. It involves administration of the nicotine dose accounting for the withdrawal effect without the aerosolized toxic substances contained in a cigarette. Their use doubles the rate of abstinence [48,77,78]. When the same dosage is applied, all the galenic forms of NRT show similar efficacy [5]. They may be associated in cases of pronounced dependency [48,78]. As complements to NRTs, two other molecules have been awarded marketing authorization: bupropion (Zyban®) and varenicline (Champix®). They are used as a second-line treatment [48]. In a recent meta-analysis, NRT and bupropion were found to have comparable efficacy, while varenicline was more efficient than either bupropion or NRTs. However, when TSNs are associated with one another, their effects are equivalent to those of varenicline, and with limited risks of adverse effects [79].

Given the proven negative effects of nicotine, NRTs initially raised questions concerning their possible dangerous nature. In practice, however, nicotine does not kill the smoker, and the secondary pathologies linked to smoking are due to the other toxic substances [80]. NRTs have been found innocuous in patients suffering from stable heart disease [81–83]. Moreover, it has been demonstrated that even with patches, the benefits of tobacco withdrawal are greater than the risks entailed by continued smoking [84], since use of a patch allows for some diminution of tobacco-related intoxication. Few studies have reported on the effects of NRTs with regard to wound healing. Experimental studies on animals have employed nicotine doses markedly higher than those caused by in vivo NRTs in humans. A study on humans carried out in 1998 by Fulcher et al. [85] did not detect any negative effect of NRTs on peripheral microcirculation. Moreover, Sorensen et al. did not bring to light any negative effects of transdermal patches on infection rates or wound healing [46,54].

These findings may be explained by the fact that the arterial plasma nicotine concentrations induced by NRTs are lower than the peaks resulting from smoking a cigarette [5,37,71,86,87] (Table 2 and Fig. 4). The patch stabilizes plasma nicotine concentration above the pharmacological withdrawal threshold of severity.

Numerous authors have recommended preoperative use of NRTs in the tobacco withdrawal process; means of application are to be adjusted in accordance with the Fagerstrom Test for Nicotine Dependence [88] and associated with offers of assistance to the smoker in withdrawal (telephone “hot line”, regularly scheduled compliance monitoring) [48,89–92].

The rights of the patient require that he be fully informed and aware of the risks and the consequences of continued

<table>
<thead>
<tr>
<th>Route of administration</th>
<th>C max (ng/ml)</th>
<th>T max (min)</th>
<th>Bio-availability (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cigarettes (2 mg/5 min)</td>
<td>15–30 (20–60/artery)</td>
<td>5–8 min (3–5/artery)</td>
<td>80–90</td>
</tr>
<tr>
<td>Nasal spray 1 mg</td>
<td>5–8 (10–50/artery)</td>
<td>11–18 min (4–6 artery)</td>
<td>60–80</td>
</tr>
<tr>
<td>Chewing gums (30 min)</td>
<td>2 mg</td>
<td>6–9</td>
<td>30 min</td>
</tr>
<tr>
<td></td>
<td>4 mg</td>
<td>10–17</td>
<td>30 min</td>
</tr>
<tr>
<td>Inhaler (4 mg)</td>
<td>8.1</td>
<td>30 min</td>
<td>51–56</td>
</tr>
<tr>
<td>Sucked tablets (20 to 30 min)</td>
<td>2 mg</td>
<td>4.4</td>
<td>60 min</td>
</tr>
<tr>
<td></td>
<td>4 mg</td>
<td>10.8</td>
<td>66 min</td>
</tr>
<tr>
<td>Sublingual tablets 2 mg (20 to 30 min)</td>
<td>3.8</td>
<td>60 min</td>
<td>65</td>
</tr>
<tr>
<td>Transdermal devices</td>
<td>15 mg/16 h</td>
<td>11–14</td>
<td>6–9 h</td>
</tr>
<tr>
<td></td>
<td>14 mg/24 h</td>
<td>11–16</td>
<td>4–7 h</td>
</tr>
<tr>
<td></td>
<td>21 mg/24 h</td>
<td>12–23</td>
<td>3–12 h</td>
</tr>
</tbody>
</table>

Adapted from “Traité d’addictologie”. Berlin et al. [76].

The absorption kinetics of Nicotine Replacement Therapies are characterized by a plasma peak of lower intensity and occurring later than with a cigarette.
tobacco intoxication in the perspective of a surgical intervention. He must also be informed as to how these risks can be prevented.

The role of the electronic cigarette

The electronic cigarette is a device assuring the delivery of vapor without the other combustion-related toxic products contained in a conventional cigarette. Nicotine and its propylene glycol solution are inhaled. While the electronic cigarette results in nicotine concentrations lower than those on a classic cigarette, the plasma peak is reached just as quickly, and constitutes a factor of dependence [93].

Its advantages render it quite tempting. It replaces the cigarette with a less noxious source of nicotine and facilitates prolonged withdrawal. Pharmacological and psychological dependence on the cigarette are managed simultaneously.

As to its relative innocuousness, however, several unknowns remain, particularly as regards the additives contained in the nicotine reload and with respect to the aromas accompanying the inhaled solution. Given a lack of reliable and relevant current data, the French National Authority for Health and the French agency for drug and health product safety do not recommend its use [48]. While recent studies have underscored an increasingly pronounced public interest in this type of device, they do not allow for conclusions on the benefits that could be entailed [94,95].

Conclusion

Smoking remains a problem of public health, particularly in case of a surgical intervention. It should be a source of concern to surgeons and anesthetists alike, and they need to work conjointly so as to steer the patient towards efficient withdrawal management. Nicotine replacement therapies are henceforth of proven innocuousness and should be associated with human support throughout the withdrawal process.

We recommend total cessation of preoperative smoking at least 4 weeks before the intervention. Cessation should continue until the surgical wound is completely healed, which means at least 2 weeks. Lengthening of these time periods can only be beneficial. At times it would appear that negotiation with the patient of a “programmed pause” of 4 preoperative and 2 postoperative weeks is easier to accept than definitive withdrawal involving no short-term perspective of smoking resumption.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

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Less variability in nicotine.

1969;166:1424

Tobacco smoking attenuates wound inflammation and proliferation while smoking cessation restores inflammation but not proliferation. Wound Repair Regen 2010;18:186–92.


