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Bleeding assessment in oral surgery: A cohort study comparing individuals on anticoagulant therapy and a non-anticoagulated group

Amanda Leal Rocha [a], Sicilia Rezende Oliveira [a], Alessandra Figueiredo Souza [a], Denise Vieira Travassos [b], Lucas Guimarães Abreu [c], Daniel Dias Ribeiro [d], Tarcília Aparecida Silva [a,*]

[a] *Department of Oral Surgery and Pathology, Faculty of Dentistry, Universidade Federal de Minas Gerais, Minas Gerais, Brazil*
[b] *Department of Community and Preventive Dentistry, Faculty of Dentistry, Universidade Federal de Minas Gerais, Minas Gerais, Brazil*
[c] *Department of Pediatric Dentistry and Orthodontics, Faculty of Dentistry, Universidade Federal de Minas Gerais, Minas Gerais, Brazil*
[d] *Department of Hematology, Faculty of Medicine, Universidade Federal de Minas Gerais, Minas Gerais, Brazil*

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ABSTRACT

Some prospective studies have been designed specifically to investigate perioperative bleeding in dental surgery. The quantitative assessment of intraoperative blood loss can be useful for indicating the real risk of bleeding complications, especially in medically compromised individuals. The aim of this study was to evaluate the pattern of bleeding in individuals under vitamin K antagonist (VKA) therapy and non-anticoagulated individuals submitted to dental extractions. Perioperative bleeding was evaluated by using a total collected bleeding corrected by absorbance reading (dental bleeding score). 138 procedures were performed. When the perioperative dental bleeding score was correlated with the number of extracted teeth, the quantity of bleeding was found to be directly proportional to the procedure. Extractions of two or more teeth presented higher scores than single extractions ($p = 0.003$). In a comparative analysis between the VKA and non-anticoagulated groups, no significant difference in the scores was found. The previous history of complications in dental procedures ($p = 0.001$) and the use of additional hemostatic measures were higher in the VKA group ($p = 0.017$). VKA therapy did not impact significantly the volume of blood lost during dental extractions. Perioperative bleeding assessment might be a useful parameter for evaluating patients under antithrombotic treatment.

1. Introduction

A number of studies evaluating the influence of anticoagulant therapy on dental treatment outcomes have been published in the literature in recent years. In a search in PubMed using the MeSH terms “*anticoagulants and tooth extraction*”, more than 300 studies were retrieved. Although thoroughly studied, dental management of individuals undergoing oral anticoagulant therapy (OAT) is still unclear for many clinicians, particularly as regards the need for interruption of medication before dental treatment, international normalized ratio (INR) reference values of for warfarin users, and the risk of bleeding events (Van Diermen et al., 2013; Ringel and Maas, 2016; Chinnaswami et al., 2017).

Warfarin, a vitamin K antagonist (VKA), is the most commonly prescribed anticoagulant drug for prevention and treatment of thromboembolic disorders (Wahl, 1998). Earlier recommendation for individuals using warfarin was the interruption and/or replacement of anticoagulant therapy before dental surgery (Roser and Rosenbloom, 1975; Lockhart et al., 2003; Bajkin et al., 2009). However, a large body of evidence has demonstrated that the incidence of bleeding associated with dental procedures in individuals undergoing anticoagulant therapy is low, and even if any complications occur, management using localized measures is easily applied (Morimoto et al., 2011; Bajkin et al., 2012; Hong et al., 2012; Wahl et al., 2015; Febbo et al., 2016; Dudek et al., 2016, Rocha et al., 2018). Therefore, anticoagulant therapy maintenance during dental treatment has currently been indicated in the most

* Corresponding author. Department of Oral Surgery and Pathology, Faculty of Dentistry, Universidade Federal de Minas Gerais, Av. Presidente Antônio Carlos, 6627 — Pampulha, Belo Horizonte, MG, 31270-901, Brazil. Fax: +55 31 34092430.
E-mail address: silva.tarcilia@gmail.com (T.A. Silva).

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important guidelines (Douketis et al., 2012; Nishimura et al., 2014; ADA, 2018).

Although some limitations of VKA therapy have encouraged the development of new drugs, such as direct oral anticoagulants (DOACs), many individuals in need of anticoagulant therapy might be ineligible for treatment with DOACs (Little, 2012; Djulbegovic and Lee, 2018). Moreover, there are clinical situations in which DOACs are not suitable because of insufficient data on their efficacy and safety (Schulman et al., 2009; Einstein Investigators et al., 2010; Liu et al., 2015; Nakamura et al., 2015; Lee, 2016; Moustafa et al., 2018). In addition, DOACs are costly, and affordability and accessibility are an issue for health services in many countries with different healthcare systems, in particular, emerging countries from Asia, Africa, and South America (Lee, 2016; Fortier et al., 2018). Therefore, VKA therapy remains a highly effective strategy for thromboembolism prevention, and the most widely prescribed drug for OAT (Van Gorp and Schurgers, 2015).

Studies using quantitative methods to investigate perioperative bleeding patterns in anticoagulated individuals submitted to dental extractions are scarce in the literature (Karsli et al., 2011; Erden et al., 2015). Furthermore, with robust evidence for the low risk of postoperative bleeding, other questions have arisen: Does OAT significantly impact the bleeding pattern during oral surgery? Do individuals on OAT bleed more than non-OAT individuals when submitted to dental extractions? In addition, increased perioperative bleeding has been shown to be associated with a significant risk of postoperative bleeding in anticoagulated patients (Rocha et al., 2018). Therefore, the assessment of perioperative bleeding might provide additional evidence for predicting and minimizing postoperative outcomes in patients under antithrombotic medication.

In this study, we evaluated the impact of OAT on bleeding, during and after dental extractions, by means of a quantitative method, as well as hemorrhagic outcomes.

2. Methods

2.1. Ethical issues

This was a prospective study, following the STROBE statement guidelines (von Elm et al., 2007). The study was approved by the Department of Education and Research of the Hospital das Clínicas of the Universidade Federal de Minas Gerais (HC/UFMG). Approval from the Institutional Ethics Committee of UFMG (protocol 48122215.4.0000.5149) was also obtained, and the guidelines established in the Declaration of Helsinki (revised version/2002), for research involving humans, were followed. Each participant signed a statement of informed consent to take part in the study. Anonymity was guaranteed to all participants.

2.2. Participants, eligibility criteria, setting, and recruitment period

The sample consisted of all individuals undergoing VKA therapy who met the eligibility criteria, were referred by hematologists and cardiologists, and were admitted for treatment by the HC/UFMG Dental Service between January 2016 and January 2018. Inclusion criteria were as follows: individuals who needed dental extraction of at least one erupted tooth, and had INR values ≤ 3.5. The study also had a control group of non-anticoagulated individuals (non-OAT group), consisting of all those seeking dental treatment at the service, without coagulation disorders or not using antithrombotic drugs, and who needed dental extraction of at least one erupted tooth.

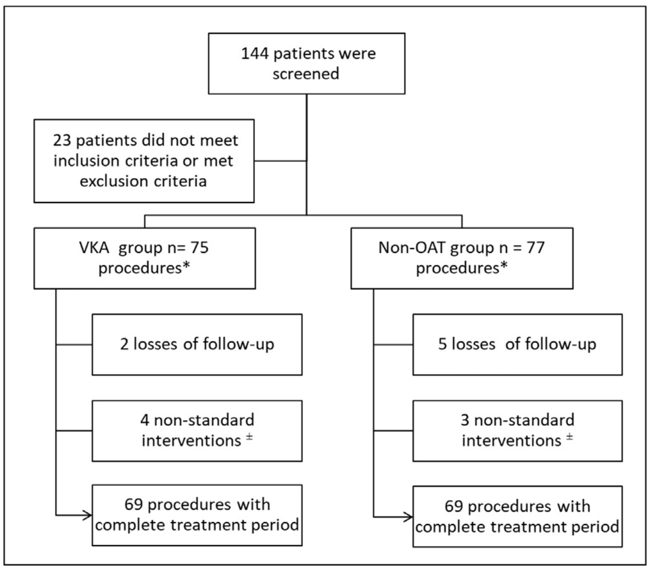
Individuals with INR >3.5, or with any coagulation disorders not related to anticoagulant use (i.e. hepatic diseases, thrombocytopenia); elderly individuals aged >80 years old, and individuals presenting teeth with acute inflammatory conditions (i.e. periodontal or periapical abscess with suppurative process) were excluded from the study. Individuals who underwent non-standard interventions and cases with incomplete follow-up were also excluded (Fig. 1).

A blood count test was ordered for all participants. An INR test was run for all individuals taking VKA. The tests needed to be accomplished 3 days before dental surgery.

2.3. Dental extraction

All procedures were carried out under local anesthesia in the hospital outpatient clinic, early in the morning, by qualified oral surgeons who were trained and supervised by the principal investigator. Dental extractions were performed without interrupting or modifying the OAT regimen. Blood pressure was measured prior to and shortly after the surgical interventions. Local anesthesia was standardized for all patients and consisted of a regional block complemented with local infiltration, using lidocaine hydrochloride 2% with epinephrine (Alphacaine 1:100,000; DFL Indústria e Comércio SA, Rio de Janeiro, Brasil).

The surgical technique followed strictly pre-established parameters, observed by the principal investigator, including the use of forceps and elevator, and was carried out as atraumatically as possible. Hemostatic measures included wound closure with 3.0 nylon 14502 T sutures (Mononylon, Ethicon, Somerville, New Jersey) and a piece of sterile gauze bitten by the participant for 20 min to compress the operated site. Some 20 min later, the participants were examined to ensure that hemostasis was achieved, and the immediate postoperative bleeding outcome was evaluated. When increased levels of immediate postoperative or perioperative bleeding were observed, additional measures of hemostasis were performed, applying a $10 \times 10 \times 10$-mm absorbable gelatin sponge (Hemospon, Technew, Rio de Janeiro Brazil), tranexamic acid (Transamin, Nikkho, Rio de Janeiro, Brazil), and/or new sutures. Tranexamic acid paste (one 250 mg pill macerated and mixed with saline) was used to soak the gelatin sponge filling the alveolar socket. An additional layer of the paste was applied on the wound



* The analysis was conducted considering the number of procedures
± Exceeded the standardized volume of 100 mL of saline solution

Fig. 1. Flowchart for patients recruited to the study groups: screening, inclusion criteria, and follow-up.

after sutures and covered with gauze under compression. For these individuals, local use of tranexamic acid mouthwash (one pill mixed in 100 ml of cold saline solution), four times a day, was recommended during the following 7 postoperative days. The individuals received written postoperative instructions. Procedure time was measured, with a stopwatch, from the first incision for the detachment of the gingiva until the complete suture.

Postoperative pain was managed with 500 mg of metamizole or 500 mg of acetaminophen every 6 h for 3 days. Antibiotic prophylaxis was only used in individuals at risk of infective endocarditis, as defined by the American Heart Association (Nishimura et al., 2014).

2.4. Data collection

2.4.1. Independent variables

The following variables were collected: participants' age and sex; history of bleeding in previous medical or dental procedures, and history of bleeding in family members (parents and/or siblings). Information on medical diagnosis, indication for OAT, concomitant medications affecting hemostasis (e.g. antiplatelet agents, nonsteroidal anti-inflammatory drugs, antibiotics), INR (for the VKA group), hematocrit level, and platelet count were also collected.

The number and indication of surgical procedures (periodontal disease, dental caries, or third molar), as well as a number of teeth extracted, were recorded. The number of tooth extractions (one tooth, two teeth, or three teeth) and type of teeth (single-rooted or multi-rooted) were also recorded. Additional parameters collected were surgical procedure time, pain, and number of gauzes used for hemostasis.

2.4.2. Outcome variables

These variables included: the need for additional hemostatic measures; immediate postoperative bleeding; postoperative bleeding; dental bleeding score; and wound healing (satisfactory, swelling/erythema, or bone exposure). Postoperative bleeding events were recorded, as well as the management of the bleeding (local hemostatic measures in outpatient care or hospital admission).

2.5. Quantitative assessment of perioperative bleeding — dental bleeding score

2.5.1. Bleeding amount

Perioperative bleeding was quantified through the storage of the fluids aspirated during the surgical procedure using a portable vacuum pump (5005 BRS, Nevoni, São Paulo, Brazil). A standardized volume of 100 ml of saline solution was used for wound irrigation in all procedures. To avoid clot formation during aspiration, 2 ml of heparin sodium 5000 IU/ml (Hepamax-S, Blausiegel, São Paulo, Brazil) were added to the final aspirated solution. Subsequently, this fluid was measured with a graduated cylinder. For each five ml of fluid, the sample was categorized from 1 to 10 as follows: samples up to 5 ml were scored 1; samples with 6–10 ml were scored 2; samples with 11–15 mlL were scored 3, and so on.

2.5.2. Absorbance of aspirated fluid

A sample was collected from total aspirated fluids and used to assess optical density (an indirect measurement of red blood concentration) using a spectrophotometer at 537 nm (RA 50 clinical, Bayer, São Paulo, Brazil). With this analysis, control of the bias caused by salivary fluid, which might have had an influence on the total volume of aspirated fluid, was feasible. The values for absorbance were also scored, as follows: absorbance up to 1.0 was scored 1; absorbance of 1.1–2.0 was scored 2; 2.1–3.0 was scored 3, and 3.1 or more was given the maximum score of 4.

2.5.3. Bleeding score assessment

The scores for total aspirated fluid and absorbance were summed to achieve a final score for bleeding. The values varied from 2 to 14, with lower scores indicating less perioperative bleeding.

2.5.4. Postoperative bleeding

A clinical outcome characterized by a postoperative hemorrhagic event was defined as oozing or marked hemorrhage, and required one or more of the following outcomes: (1) telephone call to the dental service or to the principal investigator reporting concern about postoperative bleeding; (2) return to our or other outpatient facility because of postoperative bleeding; (3) need for hospitalization. With the aim of monitoring bleeding episodes from the day of surgery until 1 week after the dental extractions, the participants were instructed to use gauzes for local compression in case of bleeding, and to register the number of gauzes used.

On the seventh postoperative day, participants returned for an appointment to remove the sutures and to evaluate wound healing. Parameters such as the presence of local erythema/edema, bone exposure, and suppuration were also analyzed. During the appointment, the patients were asked to report bleeding complications during the postoperative period and pain, which was measured using a numeric rating scale (NRS) (Downie et al., 1978), ranging from 0 to 10. A score of 0 indicated no pain and a score of 10 indicated the highest perception of pain. Individuals who did not return for a follow-up visit were excluded from the analysis.

2.6. Statistical analysis

The analysis was carried out considering the number of procedures. Comparative analysis was performed between the VKA group ($n = 69$) and the non-anticoagulated group ($n = 69$).

Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS for Windows, version 23.0, Chicago, IL, USA). Intergroup comparisons regarding independent variables and dependent variables (outcome) were carried out by means of bivariate analysis. For qualitative variables, Pearson's chi-squared and Fisher's exact test were used. The Kolmogorov–Smirnov test demonstrated that the continuous variables presented a non-normal distribution. Thus, a non-parametric test (Mann–Whitney test) was used. The level of significance was set at $p < 0.05$.

3. Results

Some 152 dental extractions were performed. Following the application of the remaining inclusion and exclusion criteria, 69 procedures in the VKA group and 69 procedures in the non-anticoagulated group were included for analysis (Fig. 1). As shown in Table 1, the individuals in the VKA group were between 30 and 77 years of age, with a mean age of 51 (±10) years. Most participants in the VKA group were female individuals (63.8%), and all participants were taking warfarin (5 mg). Fifty-six procedures were carried out in individuals under monotherapy and 13 in individuals undergoing dual therapy — anticoagulant plus antiplatelet therapy with acetylsalicylic acid (ASA). A summary of indications for anticoagulation therapy is also provided in Table 1.

In the non-anticoagulated group, the mean age of individuals was 48 (±13) years (range 19–77 years). Most of the participants in this group were female individuals (59.4%). Thirty-seven procedures were performed in individuals without any systemic disease, 20 procedures in individuals with controlled hypertension, seven in

Table 1
Clinical and demographic characteristics for the VKA and non-OAT groups ($n = 138$).

	VKA group (n = 69)	
	n	%
Age (yrs)		
Mean (±SEM)	51.1 (±10.1)	–
Range	30–77	–
Sex		
Male	25	36.2%
Female	44	63.8%
Indication for OAT[a]		
DVT	23	26.1%
AF	20	22.7%
MHV	15	17.1%
PE	15	17.1%
BHV	8	9.1%
CIA	3	3.3%
VD	2	2.3%
PH	2	2.3%
OAT prescribed		
Warfarin	56	81.2%
Warfarin + ASA	13	18.8%
	Non-OAT group (n = 69)	
	n	%
Age (yrs)		
Mean (±SEM)	48.4 (±13.7)	–
Range	19–77	–
Sex		
Male	28	40.6%
Female	41	59.4%

Abbreviations: VKA, vitamin K antagonist; non-OAT, non-anticoagulated; yrs, years; DVT, deep vein thrombosis; AF, atrial fibrillation; MHV, mechanical heart valve; PE, pulmonary embolus; BHV, biological heart valve; CIA, cerebrovascular ischemic accident; VD, valvular disorders; PH, pulmonary hypertension; ASA, acetylsalicylic acid.
[a] The same patient may have more than one diagnosis.

individuals with mental disorders, and five in individuals with thyroid dysfunction.

A comparative analysis of clinical and demographic characteristics (independent variables), taking into account the number of procedures carried out during the study, is presented in Table 2. The continuous variables age and INR value were categorized by median value, and platelet count was grouped according to the minimum reference value of the blood count test. There was no significant difference between groups in relation to participants' age, sex, platelet count, hematocrit level, previous history of bleeding in medical procedures, previous history of bleeding in family members, indication for dental extraction, number and type of teeth extracted, surgical procedure time, or pain ($p > 0.05$). In the VKA group, the previous history of bleeding in dental procedures occurred more often ($p = 0.001$) and more gauzes were used for hemostasis ($p < 0.001$).

Regarding dependent variables (presented in Table 3), in the VKA group, the need for additional hemostatic measures was more frequent than in the non-anticoagulated group ($p = 0.017$). In addition, the amount of wound healing was lower in the non-anticoagulated group ($p = 0.048$). For the outcome of immediate postoperative bleeding and postoperative hemorrhage, no difference between groups was observed ($p > 0.05$). Three episodes of immediate postoperative bleeding were observed in procedures carried out in individuals in the VKA group, and none in individuals in the non-anticoagulated group. Postoperative hemorrhage occurred after three procedures carried out in individuals in the VKA group (4.6%) and after two procedures in individuals in the non-anticoagulated group (3.0%). No bleeding episode in this study required hospitalization or medical/systemic intervention. All individuals returned to the dental service, but those who returned after the 7th day of follow-up were considered follow-up losses (Fig. 1).

Table 2
Comparative analysis of the clinical characteristics of surgical procedures for the VKA versus non-anticoagulated study groups ($n = 138$).

Variables	Non-OAT	VKA	*p*
Age (years)			
≤50	36 (52.2)	37 (53.6)	0.999[a]
>50	33 (47.8)	32 (46.4)	
Sex			
Male	28 (40.6)	25 (36.2)	0.726[a]
Female	41 (59.4)	44 (63.8)	
Previous history of bleeding in a medical procedure			
No	64 (92.8)	63 (91.3)	0.999[a]
Yes	5 (7.2)	6 (8.7)	
Previous history of bleeding in a dental procedure			
No	66 (95.7)	52 (75.4)	**0.001**[a]
Yes	3 (4.3)	17 (24.6)	
Previous history of bleeding in family			
No	68 (98.6)	66 (95.7)	0.619[a]
Yes	1 (1.4)	3 (4.3)	
Platelet count (10^3/μl)			
≤150	4 (5.8)	7 (10.1)	0.532[a]
>150	65 (94.2)	62 (89.9)	
Hematocrit (%)			
Mean (median)	40.6 (40.8)	40.1 (40.3)	.879[c]
Min–max	30.0–51.4	25.5–51.4	
INR			
≤2.30	–	32 (50.0)	–
>2.30		32 (50.0)	
Tooth extraction			
One tooth	24 (34.8)	34 (49.3)	0.145[b]
Two teeth	24 (33.8)	19 (27.5)	
Three teeth	21 (30.4)	16 (23.2)	
Teeth			
One root	13 (18.8)	14 (20.3)	0.999[a]
Two or more roots	56 (81.2)	55 (79.7)	
Indication			
Periodontal disease	19 (27.5)	22 (31.9)	0.455[b]
Decay	45 (65.2)	44 (63.8)	
Third molar	5 (7.2)	3 (4.3)	
Procedure time			
Mean (median)	38.3 (35.0)	41.1 (40.0)	0.560[c]
Min–max	15–90	10–100	
Pain			
Mean (median)	2.5 (1.0)	2.2 (0.0)	0.276[c]
Min–max	0–10	0–10	
Gauzes			
Mean (median)	0.7 (0.0)	1.9 (1.0)	**0.000**[c]
Min–max	0–10	0–5	

Bold values are those with a *p*-value < 0.05.
Abbreviations: VKA, vitamin K antagonist; non-OAT, non-anticoagulated; INR, international normalized ratio; min, minimum; max, maximum.
[a] Chi-squared test and Fisher exact test.
[b] Linear by linear.
[c] Mann-Whitney U-test.

For the bleeding score outcome, while no difference between the groups was observed ($p > 0.05$). As expected, higher scores (8–14) were more commonly observed in procedures in which more than one tooth had been extracted ($p = 0.003$) (Fig. 2). On the other hand lower scores (2–7) were more observed in procedures with reduced bleeding, as in single extractions. Thus, it was suggested that the method presents sensitivity distinguishing procedures, with increased and reduced bleeding.

4. Discussion

This prospective cohort study was designed to analyze bleeding outcomes after tooth extractions in individuals under OAT. A total of 138 dental procedures were performed in individuals under VKA therapy and in individuals without anticoagulant treatment.

Table 3
Clinical and quantitative assessment of bleeding and outcomes in the VKA versus non-anticoagulated study groups ($n = 138$).

Variables	Non-OAT	VKA	*p*
Additional hemostatic measures			
No	68 (98.6)	61 (88.4)	**0.033**[a]
Yes	1 (1.4)	8 (11.6)	
Immediate postoperative bleeding			
No	69 (100)	66 (95.7)	0.245[a]
Yes	0 (0.0)	3 (4.3)	
Postoperative bleeding			
No	67 (97.1)	66 (95.7)	0.999[a]
Yes	2 (2.9)	3 (4.3)	
Bleeding score			
Mean (median)	7.7 (7.0)	6.9 (7.0)	0.195[b]
Min–max	3–14	2–14	
Score 2–7	38	46	0.222[a]
Score 8–14	31	23	
Wound healing			
Satisfactory	55 (79.7)	43 (62.3)	**0.045**[c]
Swelling/erythema	13 (18.8)	25 (36.2)	
Bone exposure	1 (1.3)	1 (1.5)	

Bold values are those with a p-value < 0.05.
Abbreviations: VKA, vitamin K antagonist; DOAC, direct oral anticoagulant; non-OAT, non-anticoagulated; min, minimum; max, maximum.
[a] Fisher exact test.
[b] Mann-Whitney U-test.
[c] Linear by linear.

Despite the similar levels of bleeding and postoperative outcomes observed in the controls and anticoagulated patients, the need for hemostatic measures was higher in the VKA group.

VKA therapy — represented by warfarin in this study — is used worldwide, and has been shown to be highly effective for primary and secondary prevention of venous and arterial thromboembolic events (Ageno et al., 2012). Despite the disadvantages associated with the VKAs, such as the need for frequent coagulation blood tests, dose adjustments, and perceived dietary restrictions, warfarin still remains the first choice due to its widespread availability, convenience of administration, and cost-effectiveness (Douketis et al., 2012; Febbo et al., 2016). DOACs have been introduced as a potental replacement for VKAs, however, pivotal trials applying strict exclusion criteria have excluded individuals with a presumed high risk of bleeding (Schulman et al., 2009; Einstein Investigators et al., 2010; Liu et al., 2015; Nakamura et al., 2015).

The occurrence of postoperative bleeding complications in the VKA group compared with the non-OAT group was not statistically different. Only two (2.8%) episodes in procedures performed in individuals in the non-anticoagulated group and three (4.3%) in procedures in the VKA group were observed. Febbo et al. (2016) found nine complications (2.1%) in individuals under anticoagulant therapy and no cases of bleeding in the control group. Moreover, the authors found that all postoperative complications occurred in individuals with an INR ≥2.2 (Febbo et al., 2016). In our study, for analysis purposes, the sample was categorized using an INR median threshold of 2.3, with episodes of postoperative bleeding occurring in procedures carried out in individuals with an INR higher than 2.3 (data not shown). The choice of the INR limit value was based on the fact that the therapeutic ratio for preventing the development of serious thromboembolic events ranges from 2.0 to 3.5, with individuals with an INR value higher than 4.0 having an increased bleeding risk and no medical benefit (Thean and Alberghini, 2016).

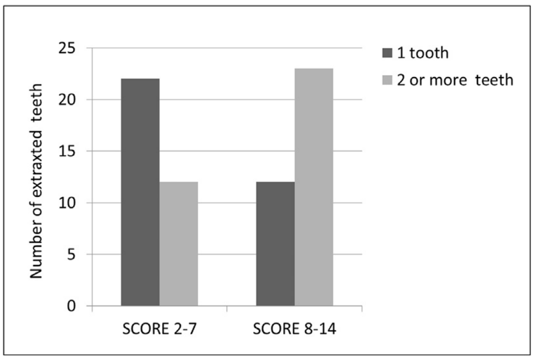


Fig. 2. Distribution of categorized dental bleeding score (set at median = 7). The score bars for 2 to 7 indicate the lower values and those for 8 to 14 the higher values for bleeding score in relation to the number of teeth extracted in the VKA group ($n = 69$).

Previous studies have demonstrated different values for bleeding events following dental surgery, with percentages of incidence from 2.8% to 6.8% (Morimoto et al., 2011; Bajkin et al., 2012; Hong et al., 2012; Wahl et al., 2015; Febbo et al., 2016; Dudek et al., 2016, Rocha et al., 2018). In our study, the percentage of postoperative bleeding complications seems to be within the range of those previously described in the literature, with the occurrence of this outcome in individuals of the VKA group almost equal to that observed in the non-anticoagulated group. It is important to note that, due to the matching strategy, and for a reliable comparative analysis, it was expected that confounding variables would not present significant differences between groups. This assumption was confirmed because groups were equal with regard to the type and indication of dental extraction, and the demographic characteristics of participants. Other confounding variables that may have influenced the outcome, such as non-diagnosed coagulation disorders, measured by platelet count, and duration of dental procedure, were also evaluated, and no differences were observed.

Additional hemostatic measures were used in eight procedures carried out in anticoagulated individuals and one procedure performed in a non-anticoagulated individual. This difference was statistically significant. These data suggest that localized hemostatic measures used after dental extractions could explain the low incidence of postoperative bleeding outcomes. In contrast to our study, in which additional measures were performed only in persistent bleeding situations, other authors have reported the use of hemostatic measures as a reliable strategy for preventing postoperative bleeding after all dental extractions in anticoagulated individuals (Miclotte et al., 2017). The localized hemostatic protocol used in our study was gauze soaked in tranexamic acid, gelatin sponge, successive sutures, and compression of the postextraction site with dry gauze. These were effective in preventing postoperative bleeding (Soares et al., 2015), and may have influenced our results on reducing bleeding outcomes in the VKA group. The clinician should be attentive regarding increased bleeding during surgical procedures, and localized measures should be employed if necessary (Rocha et al., 2018) In addition to localized hemostatic measures, the need for local gauze compression in the postoperative period and previous history of bleeding episodes after dental procedures were also more frequent among individuals in the VKA group. These findings may be related to the concerns of the individuals with respect to bleeding complications, however rare.

The observation of bleeding during the dental procedure is a relevant factor. It has been previously demonstrated that the risk of postoperative complications in procedures with increased perioperative bleeding is 8.8 times higher than those without perioperative bleeding (Rocha et al., 2018). However, the evaluation of this variable is mostly achieved by subjective analysis, with few previous studies providing quantitative data on bleeding amount (Karsli et al., 2011; Erden et al., 2015). Currently, there is no standardized methodology for the quantitative measurement of bleeding in dental practice, so for this study, a dental bleeding score protocol was proposed to measure the amount of bleeding during tooth extractions. This method was developed to allow for salivary interference in measuring oral perioperative bleeding. The combination of the optical density of the sample with the total amount of aspirated fluid made an estimation attainable.

Results for bleeding score analysis performed in VKA and non-anticoagulated individuals confirmed the clinical outcome of postoperative bleeding, for which no significant difference between the groups was found. Although there was no difference between perioperative bleeding scores for individuals in the VKA group and non-anticoagulated group, the use of additional hemostatic measures was higher in the VKA group. This finding may indicate that, in most individuals undergoing OAT, the alteration in the coagulation process may not significantly influence the amount of bleeding during tooth extraction. However, OAT can prolong the final hemostatic process and, for this reason, additional measures were deemed necessary. Despite this increased time for coagulation, the volume of blood loss in this period did not appear to be significant. In addition, impaired wound healing was more frequent in individuals in the VKA group, which might be associated with the alteration in hemostasis and, consequently, with the formation and stabilization of the clot in the dental socket.

In contrast with our study, Karsli et al. (2011) found that values for bleeding amount in individuals under warfarin therapy were significantly higher than in individuals undergoing bridging therapy and in non-medicated individuals. The authors measured the amount of immediate postoperative bleeding using the weights of gauze swabs placed over the extraction socket, over the course of 20 min, on completion of the extraction (Karsli et al., 2011). The same protocol was applied in the study by Erden et al. (2015), comparing dental extractions under warfarin and bridging therapy. In contrast to Karsli et al. (2011), these authors found that bleeding amount was higher in individuals under bridging therapy than in their peers under warfarin therapy; no control group was enrolled (Erden et al., 2015).

The methods suggested in previous studies differ from that used in our study in two ways. First, our method allows the measurement of bleeding throughout the procedure, not only after removal of the tooth. Second, it takes into account salivary flow during oral surgery, which can increase bias in the measurement of bleeding amount. In addition, the score was correlated with the number of extracted teeth, implying that the method presents sensitivity distinguishing procedures with increased and reduced bleeding. Thus, our study proposes a new method of quantitative measurement of bleeding, by using total collected bleeding corrected using absorbance reading, that could be useful for further studies aiming to analyze amounts of perioperative bleeding.

The study has strengths and limitations. Blinding of the study's personnel and assessors was deemed unfeasible, which might have influenced how the surgeon conducted perioperative procedures. Several analyses were not possible due to the non-occurrence or rarity of the event. The methodology adopted was new, so further studies, with different and larger samples, should be developed in this field to validate it. Nevertheless, this study presents novel information on bleeding outcomes with chronic OAT, and our findings provide an additional and objective parameter for evaluating blood loss in dental surgery.

5. Conclusion

The results of the bleeding score method demonstrated that the amount of blood lost in dental extraction was similar in anticoagulated and non-anticoagulated individuals, in spite of the need for localized hemostatic measures being higher in patients under VKA therapy. Additional measures for hemostasis were effective, and could be used in cases of persistent bleeding. Bleeding tendencies, identified by previous history of hemorrhage and by perioperative bleeding pattern, suggest the need for careful monitoring, and these parameters can be useful for predicting and minimizing postoperative complications.

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