Predictive Analysis of Occurrence Factors of Alveolar Osteitis Post- Dental Extraction in Kinshasa Hospital Using Bayesian Model

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ABSTRACT

Context: Alveolar osteitis (AO) is a clinical complication post-dental extraction from inflammatory or infectious origin. Poorly designed studies with different statistical biases and the poorly conducted analysis make the identification of risk factors contradictory. Present study was conducted to identify the risk factors of the occurrence of alveolar osteitis (AO).

Settings and Design: Descriptive and Prospective study done in Kinshasa University, Faculty of Medicine.

Methods and Materials: The Bayesian model, using a qualitative method, had invited eight experts to reflect on the alveolar osteitis (AO).A subjective Bayesian model (SBM) was constructed by the selection, interview of the experts and training by Delphi method. Brainstorming technical has helped an elaboration of 48 factors selected by experts from the literature.The nominal group technical, allowed to the experts to regroup a list of seven independent factors from 48 factors selected.

Results: The Pre-existent infections factor (F3) was most occurrence with 614 cases of AO (98%), followed by the bad oral and dental hygiene factor (F1) with 572 cases of AO (84%), Inexperienced practitioner factor (F6) with 485 cases of AO (78%. Preoperative infection factor (F4=454; 73%) and followed by the post-operative infection factor (F7=370 cases

of AO; 59%). The lack of asepsis factor (F5) was the most less implicated in the occurrence of AO with 57 cases (9%).

Conclusions: The identification of risk factors by the Bayesian model can help practitioners to take primary preventive measures in order to reduce the morbidity of alveolar osteitis in our context.

Keywords: Alveolar Osteitis (AO.) Risk Factors, Occurrence, Bayesian Model.

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INTRODUCTION

Alveolar osteitis (AO) is a complication post-dental extractions which is from inflammatory origin.[1-6] This complication is more common, unforeseeable and occurring in healthy subjects or handicap and its clinical management is accompanied by very unfavorable economic situations for practitioners and patients.[7-10] The aetiology of AO is not accurately determined; many risks factors are evoked but the pathogenesis of those risk factors is not clearly proved yet and it can manifest as dry or alveolitis suppurative, marginal and a slowness alveolitis.[11-14]

The brainstorming and nominal group session of experts was done in the literature for to use an elaboration of Subjective Bayesian Mathematic Model[15-16] and the regrouped independent and mutually factors have been discussed for their implication or not in the pathogenesis of AO by others studies.[11,12] Poorly designed studies with different statistical biases, different treatment methods, different conditions of patients and the poorly conducted predictive of analytics make the identification of risk factors contradictory.[11-12,17]

From those few studies found in the literature, no one have been conducted in the poor economic milieu in general and Republic Democratic of Congo in particular. Thus justify our study aims to identify the risk factors of the occurrence of AO using SBM in Kinshasa hospital/DR.Congo in order to improve the management of Dental extraction and also the management of alveolar osteitis (AO).

MATERIALS AND METHODS

This study used a qualitative method under form as a nominal group, which is based on Bayesian statistics and adapted from work of Gustafson.[18] The choice of this method is justified by the fact that these statistics are help using the opinions, the subjective elements provided by experts and generate the statistics on the basis evidence.[18,19] The qualitative method was carried out under form of integration group with eight experts. It has helped to identify the factor can establish the occurrence of AO in patients post dental extractions from 8 dental clinics hospital at Kinshasa (D. R. Congo.). It was conducted in six steps such as Selection of experts by using Delphi method;[20,21]

Interview of experts; Training of experts; Establishment list of predictive factors; Regrouping of independent factors and Elaboration model. The selection criteria of experts were to be a professor at the faculty of Dental medicine, a master's degree in oral surgery, dentistry, periodontology, prosthesis and to be dental doctor with more than 20 years of occupation. All of them have the skills and knowledge of AO, and be available during the period of our study. Interview of experts by Brainstorming followed by technique of nominal group, have been help to list 48 factors of AO; used in an elaboration of the Subjective Bayesian model (SBM)

Elaboration of SBM was carried out by three steps such as determination of a prior probability of quotient (APRIQ), determination of the likelihood ratio (LHR) and Determination of a posteriori probability quotient (APPQ) like detailed in our first work.[22]

Statistical Analysis

The data related to qualitative variables were treated during the interviews of experts for to generate an independent and mutually exclusive list factors.

Table 1: Distribution of occurrence of AO according to the Gender

Dental Extraction Number		Total of AO	%
8.997		625	7 (Prevalence)
Gender	Male	304	48.6
	Female	321	51.3

Table 2: Independent7 Factors and exclusive obtained by Nominal Group Technique

Factors (F)	Regroupment
F1: Bad oral and dental hygiene	- Poor or bad oral hygiene state
	- Smoker
	- Environmental factors, economic and socio-geographical
F2: Systemic diseases leading to the deficiency of immunity	- Immune deficiency (anemia, diabetes, AIDS, Avitaminosis)
F3:Pre-existent infections	- Apical periodontitis acute with abscess
	- Apical periodontitis chronic with granuloma
	- Periodontal infection of vicinity
	- Hot tooth extraction
	- The aero-anaerobic microorganisms
	- Multifactorial
	- Healthy factors
F4: Preoperative Infection	- Alveolar curettage
	- Alveolar infection
	- Pre-operative infection by bacteria
F5: Lack of asepsis	- No asepsis (operator-materials)
F6: Unexperienced practitioner	- Traumatic extraction
	- Mandible localization of extraction
	- Extraction Difficulty
	- Residuals fragments (bone, dental, tartars
	- Third mandibular molars or impacted teeth
	- Bad used xylocaine anesthesia with vasoconstrictor
	- Singular extraction than numerous
	- Vascular trauma
	- Bad design of mucoperiosteal flap
	- Bad suture post-operative
F7: Post-operative infection	- Intensive rinsing the wound
	- Move out the alveolar clot
	- Postoperative Mouth wash by Nacl solution
	- Infection of postoperative wound by bacteria ,biofilm

RESULTS

Out of 8.997 number of dental extraction, the prevalence of occurrence of AO was 7% (625 cases) and gender shows no significant difference found (table 1). The unmodifiable factors such as gender and age (10 to 80 years) wasn't been taken account in our study by using SBM. 48 risks factors grouped in seven independent modified factors was obtained by the technique of Nominal groups such as shown in table 2. As well in table 3, the F3 was most occurrence with 614 cases of AO (98%), followed by F1 and followed by F6 and F4. The F5 factor was the mostly less implicated in the occurrence of AO with 57 cases (9%). (Table 3)

ELABORATION OF SBM

a. Determination of the a priori probability quotient (APRIQ)

From clinical experience of experts, an average number of patients treated in 8 dental hospitals and those developed an AO were established. The mean number of patients did not developed an AO was deduced. The occurrence probability of AO in patient P (AO) was estimated at 0.175 and its complementary probability

P (OA¯) was deduced at 0.825.The APRIQ was 0.21< to1, thus prediction of experts showed that a patient has less chance to develop an AO. (Table 4)

b. Determination of the likelihood ratio (LHR)

Different likelihoods ration of 7 factors were differently generated by the experts. Different LHR values in table 5 are greater than 1; this means that all identified independent factors had a positive impact on the occurrence of AO. By decreasing order and according to LHR, the risks factors were grouped in LHR = 4 (F3), LHR = 3 (F1, F7), LHR = 1, 5 (F2, F4, F6) and LHR = 1, 3 (F5).

c. Determination of a posteriori probability quotient (APPQ)

The APPQ allows calculation of probability of the occurrence of AO. Thus taking account of all these 7 factors, the APPQ = LHR x APRIQ = 157, 9 x 0, 21 = 33,159

d. Determination of the probabilities to make alveolar osteitis or not.

The probability (P) of to develop an alveolar osteitis with 7 factors was 0.97 and the probability of 6 independent factors for to make an AO was 0.90, for 5 factors (P= 0.75), 4 factors (P=0.64), 3 factors (p=0.51), 2 factors (p=0.48) and P= 0.38 for one factor.

Table 3: Distribution of Risks factor from different hospital according to the AO s

	Hospitals (H)								Total (%)		
Number of hospital	H1	H2	H3	H4	H5	H6	H7	H8	8		
Extraction number	850	650	780	920	540	615	20	4622	8997		
Number of AO	100	74	75	60	59	32	4	221	625		7% (prevalence of 8 Hospitals)
Factors										∑F	%
F1	93	64	75	60	59	32	4	140		527	84%
F2	32	15	16	10	8	12	2	84		179	29%
F3	99	72	75	60	59	32	4	213		614	98%
F4	52	36	56	58	46	21	3	182		454	73%
F5	7	6	20	7	8	0	2	7		57	9%
F6	74	71	42	60	53	25	2	158		485	78%
F7	72	42	37	55	42	14	3	105		370	59%

Legend: H1= Referential General Hospitalof Kinshasa; H2= Affiliated Hospital ofKinshasa University;
H3= Armée du salut; H4=NgaliemaHospital; H5=Sino Congolese Hospital; H6=Saint Joseph Hospital;
H7= Hospital of Kimbanseke; H8= Referential Hospital of soldier of Kinshasa;
∑F= sum of factors and F1…….F7= factor 1 to factor 7.

Table 4: Determination of the a priori probability quotient on the occurrence of AO (APRIQ) by 8 experts

Experts	E	E1	E2	E3	E4	E5	E6	E7	E8	Total	Arithmetic means	Means/10
Probability to do AO	P(AO)	2	1	1	1	2	3	2	2	14	14/8 = 1,75	0,175
Non-probability to do $\overline{AO}$	P($\overline{AO}$)	8	9	9	9	8	7	8	8	66	66/8 = 8,25	0,825

Legend: E=experts, E1……E8= expert one to experts 8

DISCUSSION

Medicine is a science of highly open to other disciplines, such as medical anthropology, medical psychology, mathematics, statistics, biophysics and medical informatics. Mathematics with its various models has an important place in the quantification of morbid phenomena encountered in medical practice. Our mathematical model was developed based on the subjective Bayesian approach, which is much used in general practice.

The SBM statistics compared to conventional statistics use an intelligence of experts from which a mathematical model can be developed.[23-26] Predictive analysis of the factors of the occurrence of alveolar osteitis, by the SBM must be operated by all dentists and other health professional depending of the frequent category of complication dental extraction; with the prevalence ranging from 0.5% to 75% throughout the world.[1-3,12,27]

Table 5: Construction of ABAQUE: likelihood ratios (LHR)

F_i	Likelihood Ratio F/OA	Likelihood Ratio F/$\overline{OA}$	Likelihood Ratio LHR	Impact
F1	$P(F1/AO)= a_1 = 3/10 = 0,3$	$P(F1/\overline{AO})= b_1 = 1/10 = 0,1$	$a_1/ b_1 = 0,3/0,1 = 3$	Positive
F2	$P(F2/AO)= a_2 = 3/10 = 0,3$	$P(F2/\overline{AO})= b2 = 2/10 = 0,2$	$a_2/ b_2 = 0,3/0,2 = 1,5$	Positive
F3	$P(F3/AO)= a_3 = 4/10 = 0,4$	$P(F3/\overline{AO})= b_3 = 1/10 = 0,1$	$a_3/ b_3 = 0,4/0,1 = 4$	Positive
F4	$P(F4/AO)= a_4 = 3/10 = 0,3$	$P(F4/\overline{AO})= b_4 = 2/10 = 0,2$	$a_4/ b_4 = 0,3/0,2 = 1,5$	Positive
F5	$P(F5/AO)= a_5 = 4/10 = 0,4$	$P(F5/\overline{AO})= b_5 = 3/10 = 0,3$	$a_5/ b_5 = 0,4/0,3 = 1,3$	Positive
F6	$P(F6/AO)= a_6 = 3/10 = 0,3$	$P(F6/\overline{AO})= b_6 = 2/10 = 0,2$	$a_6/ b_6 = 0,3/0,2 = 1,5$	Positive
F7	$P(F7/AO)= a_7 = 3/10 = 0,3$	$P(F7/\overline{AO})= b_7 = 1/10 = 0,1$	$a_7/ b_7 = 0,3/0,1 = 3$	Positive
$\overline{F1}$	$P(\overline{F1}/AO)= c_1 = 3/10 = 0,3$	$P(\overline{F1}/\overline{AO})= d_1 = 7/10 = 0,7$	$c_1/ d_1 = 0,3/0,7 = 0,28$	Negative
$\overline{F2}$	$P(\overline{F2}/AO)= c_2 = 2/10 = 0,2$	$P(\overline{F2}/\overline{AO})= d_2 = 8/10 = 0,8$	$c_2/ d_2 = 0,2/0,8 = 0,25$	Negative
$\overline{F3}$	$P(\overline{F3}/AO)= c_3 = 1/10 = 0,1$	$P(\overline{F3}/\overline{AO})= d_3 = 6/10 = 0,6$	$c_3/ d_3 = 0,2/0,6 = 0,16$	Negative
$\overline{F4}$	$P(\overline{F4}/AO)= c_4 = 2/10 = 0,2$	$P(\overline{F4}/\overline{AO})= d_4 = 5/10 = 0,5$	$c_4/ d_4 = 0,2/0,5 = 0,4$	Negative
$\overline{F5}$	$P(\overline{F5}/AO)= c_5 = 3/10 = 0,3$	$P(\overline{F5}/\overline{AO})= d_5 = 4/10 = 0,4$	$c_5/ d_5 = 0,3/0,4 = 0,75$	Negative
$\overline{F6}$	$P(\overline{F6}/AO)= c_6 = 2/10 = 0,2$	$P(\overline{F6}/\overline{AO})= d_6 = 6/10 = 0,6$	$c_6/ d_6 = 0,2/0,6 = 0,33$	Negative
$\overline{F7}$	$P(\overline{F7}/AO)= c_7 = 1/10 = 0,1$	$P(\overline{F7}/\overline{AO})= d_7 = 7/10 = 0,7$	$c_7/ d_7 = 0,1/0,7 = 0,14$	Negative

Legend: F1…….F7: factor 1 to 7

Currently in the medical world, artificial intelligence associated with mathematics, statistics and computer gives a good performance of medical practice.[23] A predictive model factors in the occurrence of alveolar osteitis by seven factors, presents a high internal validity as test.

The model is valid using an algorithm to many factors that used separately in the literature,[28] it should be noted that more authors have listed several factors that produce AO dental post-extraction,[1,28] but the SBM actually use have only retained seven factors. Despite of many factors identified in the literature, but for ease to use this model, a limited number of factors were kept in the final model.

Analyses of different modifiable variable and no modifiable variable in 625 sampling of occurrence AO collected from 8 hospital of Kinshasa city and after an elaboration of 7 independent risks factors has helps us to do Somme these comment:

According to gender and age; were not considered to be a determinant factor in our study. No significant difference was found between sex and occurrence of AO. But out of 625 cases of AO, the women were 321 and 394 for the men with sex ration of 1, 05. Similar to others authors.[28,29]

The factors F3, F1, F4 and the factor F6 were mostly implicated in the increasing occurrence of AO with 614 cases of AO (98%) for F3, 572 cases of AO (84%) for F1, 485 cases of AO (78%) for F4 and 454 cases of AO (73%) for F6 respectively. Our results were similar to many of authors.[1,6,30-36] The pre-existent infections factor (F3) play an important role that can modify the environment or oral ecology and favorite the development of pathogen flora in post dental extraction and the implication of the preoperative infection in increasing the occurrence of AO is probably due to the incident and accident during the operation processes. For that the patient should be quite to belief for to avoid the stress, emotional, the fear that is the source of the discharge of endogen adrenalin.

The factor F1 is consequently due to association of lacking of dental surgeon in DR.Congo and on particular in Kinshasa capital with 1 dental surgeon per 4865 resident lower from the recommendation of WHO. Also is caroler with the poor economic condition of patients, excessive usage of alcohol, lacking of use dentifrice of Fluor and the no recall monitoring of each 4 months to dentist. Thus justify an increasing factor F1, likewise to others reports.[37-38] Inexperience of dentist practitioner factor (F6) is characterize of some operative difficulty that are considered such as a determinant factor in the pathogenesis of AO. The post-operative infection factor (F7), was also important to increase the occurrence of AO with 370 cases (59%). It is due to no antibiotic and anti-inflammatory drugs taken postoperatively and the no cleaning of alveolar cavity after operation. Our result was corroborate from these of literature study.[16,39]

On the contrary, the lack of asepsis factor (F5) was less implicated in the occurrence of AO with 57 cases (9%) followed by systemic diseases leading to the deficiency of immunity factor (F2) with 179 cases of AO (29%) and was similar to others reports.[1,15,40-41] We can conclude that, the asepsis conditions done in 8 hospital were good and thus justify the decreasing occurrence of AO.

From this study, the mathematical model used has an advantaged in the groupmate of many independent risks factions in 7 clinical factors, simple to use and helpful in preoperative, per and post-operative study in order to stop or to decrease the occurrence of AO by a primary prevention of each modifiable factor. That way, is important in our poorly milieu of lower country that, the poorly of patients and gap of dental surgeon in a population of 73.000.000/resident in DR. Congo and 10.000.000 resident of Kinshasa Capital which as a problem of dental health likewise to other country.[42,43]

The SBM statistics has also help the medical practionner with the knowledge of LHR of each modifiable risks factors or no in order to determine the pathogenesis of AO according to the value of LHR. Depending of the LHR value found, with or without modifiable risks factors, the clinicians can make decision to modify or not the management of AO and a possible elaboration of outcome treatment protocol.

LIMITATIONS

- The first is related to the specification of the a priori probability; it is found that various experts will also produce the different a priori probabilities.
- The second limit is related to the Bayesian approach to estimate the probability of the occurrence or non-AO, estimated by the opinions of experts and not the objective or quantitative method.

CONCLUSION

The identification of risks factors by SBM using an opinion of expert with qualitative method, allow to determine the positive or negative impact factor of occurrence of AO or no with knows the likelihood ration(LHR). The final consideration of this Bayesian model, on the occurrence of AO factors elaborated in our study should be later presented in the National or international symposium for to get a large adhesion of Scientifics Investigator that can establish the performance or not in order to the research the positive or negative impact of the risks factors of occurrence of AO in dental medicine and also to standardizes its considerations and treatment protocol.

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