Risk factors for ala nasi pressure sores after general anesthesia with nasotracheal intubation

Thunshuda Sumphaongern*

Department of Oral and Maxillofacial Surgery, Faculty of Dentistry, Chulalongkorn University, Bangkok, Thailand

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ABSTRACT

Purpose: To prospectively investigate the risk factors that associate to ala nasi pressure sores after general anesthesia with nasotracheal intubation.

Material and method: All Patients underwent oral and maxillofacial surgeries during May 2018 to December 2018 were enrolled in this prospective study. Alae nasi were evaluated after finishing of the operation under general anesthesia with nasotracheal intubation for having pressure sore or not. The seven suspected risk factors were investigated for evaluation of the significant association with ala nasi pressure sores. Descriptive, univariate, and multivariate statistics were computed, and the P value was set at .05.

Results: One hundred and fifty-five patients were enrolled. The incident of ala nasi pressure sore after general anesthesia with nasotracheal intubation was 21.45% in duration of six months. Risk factors associated with ala nasi pressure sore with univariate analysis were long duration of surgery, and lack of hydrocolloid dressing. After multivariate analysis, the significant risk factors for ala nasi pressure sores after general anesthesia with nasotracheal intubation were long duration of surgery (OR 1.005, 95%CI 1.002 to 1.009, p = 0.004), and lack of hydrocolloid dressing (OR 9.934, 95%CI 3.347 to 29.489, p < 0.001). While the significant protective factor was higher body mass index (OR 0.864, 95% CI 0.749 to 0.997, p = 0.045).

Conclusion: Long duration of surgery and lack of hydrocolloid dressing are significant risk factors for ala nasi pressure sores after general anesthesia with nasotracheal intubation. While high body mass index is significant protective factor. Shortening the duration of surgery and using of hydrocolloid dressing between ala nasi and the nasotracheal tube or catheters that inserted via nose, such as nasogastric tube, are strongly recommended.

1. Introduction

General anesthesia with nasotracheal intubation is commonly used in oral and maxillofacial surgery, providing more access and widening the surgical field as compare to orotracheal intubation. To perform nasotracheal intubation, experiences, skills, knowledges of anatomy and its complications are required. The complications from nasotracheal intubation include epistaxis from trauma to nasal cavity, especially Little's area (the anterior part of the nasal septum), bacteremia from trauma to nasal mucosa or bacterial transfer via the tube, damage of turbinates and retropharynx, and pressure sore of ala nasi [1, 2].

A prevalence of ala nasi pressure sores are unclear. Some literatures reported a prevalence range from 0.59% to 24.48% [3, 4, 5]. The risk factors that may be associated to ala nasi pressure sores are gender, prolonged duration of surgery time, type and material of endotracheal tubes, bare contact surface and sharp angle between the tube and nose [5, 6].

The effects of ala nasi pressure sores are usually minor and self-limiting, but sometimes there are serious necrosis resulting in functional and cosmetic problems. Additionally, this complication effects patients’ health and satisfaction.

There are many developing methods try to prevent the nasal alar pressure sores such as use of hydrocolloid dressing (Duo Active® CGF), polyvinyl alcohol foam (Merocel®), Dynaplast™ or combined use of Soft Liner and DuoDERM® CGF to attach between the nasal alar and nasotracheal tube. Other methods are application of modified endotracheal tube or strong fixation of the nasotracheal tube [5, 7, 8, 9, 10, 11].

There is very little data about the risk factors of ala nasi pressure sore and the result of it is rather serious. Therefore, the purpose of this study was to find out the risk factors that associated to ala nasi pressure after general anesthesia with nasotracheal intubation.
2. Materials and methods

The prospective study protocol was settled and was approved by the human research ethics committee of the Faculty of Dentistry, Chulalongkorn University (HREC-DCU 2018–017). And the Helsinki Declaration guidelines had been followed in this investigation. The figure used in this manuscript had already obtained permission and had explicit written consent from the patient.

Patients aged more than 18 years old that underwent oral and maxillofacial surgery at Faculty of Dentistry, Chulalongkorn University during May 2018 to December 2018 were enrolled. All enrolled patients underwent the surgery under general anesthesia with nasotracheal intubation. In every case, we paid attention to the alignment of the nasotracheal tubes to lie directly toward the nasal cavities and did not lean toward any sides of the nares. All nasotracheal tubes were highly secured and anchored with medical tape and flexible silicone putty to ensure that the angle between ala nasi and the reflection of nasotracheal tube are about 35°.

After the surgeries ended, the patients were observed if they had ala nasi pressure sore or not. The seven risk factors that may be associated with ala nasi pressure sore, as follows: 1) duration of surgery; 2) type and material of endotracheal tube (three types of endotracheal tube; naso clear polyvinyl chloride Ring-Adair-Elywn (RAE) tube or preformed nasotracheal ivory silicone tube or flexometallic reinforced endotracheal tube); 3) lack of hydrocoild dressing, such as DuoDERM® CGF, attached between the tube and nose; 4) age; 5) gender; 6) body mass index; 7) underlying conditions that causes poor skin elasticity, such as post-radiation therapy for head and neck cancer, poor-controlled diabetes mellitus, scleroderma, etc., were recorded. The exclusion criteria were patients aged under 18 years old or patients refused to participate the study.

When ala nasi pressure sore occurred, prednisolone cream was applied to the affected area and the patients were followed up until the pressure sores healed. The pressure sore grading, using International NPUAP/EPUAP pressure ulcer classification system; stage I: Non-blanchable erythema, stage II: Partial thickness skin loss, stage III: Full thickness skin loss, stage IV: Full thickness tissue loss [12]. The number of follow-up days until the pressure sore healed, and level of patient concern were also recorded.

The sample size was calculated using formula for cross sectional study, qualitative variable [13] with the precision of 5% and at type 1 error of 5%.

3. Statistical analysis

Statistical analyses were performed using IBM SPSS Statistics version 22 (IBM Corporation, Armonk, NY, USA) unless stated otherwise. Subjects were categorized into two groups: case with pressure sore, and control without pressure sore. Independent variables known to affect occurring of pressure sore were included as follows; age, gender, body mass index, duration of surgery, having underlying conditions that affect tissue elasticity, type of endotracheal tube (nasal clear polyvinyl chloride RAE tube or preformed nasotracheal ivory silicone tube or flexometallic reinforced endotracheal tube), and lack of DuoDERM® CGF dressing. Categorical independent variables were presented in frequencies and percentages. Continuous independent variables were presented in medians and interquartile ranges. Associations between occurring of pressure sore and each categorical independent variable were analyzed using the chi-square test or Fisher exact test as appropriate. For continuous independent variable, the associations were performed using Mann-Whitney U test. P < 0.05 was considered statistically significant. To further investigate the degree of association with pressure sore, univariate and multivariate logistic regression were used. Crude and adjusted odds ratios and their 95% confidence intervals were calculated for each independent variable.

4. Results

A total number of 155 cases were enrolled in this study. There were 69 (44.5%) males and 86 (55.5%) females. The age of the participants in this study ranged from 18 to 88 years, with the median ± interquartile range (IQR) = 26.0 ± 10.0 years. Basic characteristics of the study participants according to occurring of pressure sore are shown in Table 1. There were 33 cases with ala nasi pressure sores and 122 cases with no pressure sores, in which the incident was 21.45% in duration of six months. Low body mass index, long duration of surgery, and lack of DuoDERM® CGF dressing tended to have higher incidence in the ala nasi pressure sore group. Unfortunately, there was no difference in age, gender, having underlying conditions that effect tissue elasticity, types and materials of endotracheal tube between both groups.

Univariate and multivariate logistic regression analysis results were shown in Table 2. From univariate analysis, risk factors that had significantly association to ala nasi pressure were: duration of surgery (OR 1.003, 95% CI 1.000 to 1.006, p = 0.040), and lack of DuoDERM® CGF dressing (OR 6.704, 95%CI 2.578 to 17.436, p < 0.001). From multi-variate analysis risk factors that had significantly association to ala nasi pressure were: duration of surgery (OR 1.005, 95% CI 1.002 to 1.009, p = 0.049), and lack of DuoDERM® CGF dressing (OR 9.934, 95%CI 3.347 to 29.489, p < 0.001). While the protective factor that had significantly association to ala nasi pressure was body mass index (OR 0.864, 95% CI 0.749 to 0.997, p = 0.045).

All of ala nasi pressure sore cases were stage I pressure sore and every case was prescribed prednisolone cream to apply to the wounds. The wound was inspected at least twice a day until the pressure sore healed. Most of them (85%) healed within 24 h, but there were 3 cases (9%) which the pressure sores healed in 48 h and 2 cases (6%) which the pressure sores healed in 72 h. No permanent scars were seen in all patients. About the level of patients’ concern, all of the ala nasi pressure sore patients had minimal (36.4%) to moderate (63.6%) concern about their wounds as shown in Table 3.

Table 1. Basic characteristics of the study participants according to occurring of pressure sore.

| Characteristics                  | Ala nasi pressure sores (N = 33) | No pressure sores (N = 122) | P-value |
|----------------------------------|----------------------------------|-----------------------------|---------|
| Age (year), median ± IQR         | 25.0 ± 10.0                      | 26.0 ± 11.0                 | 0.398   |
| Gender, n (%)                    | 17 (51.5)                        | 52 (42.6)                   | 0.362   |
| Male                             | 16 (48.5)                        | 70 (57.4)                   |         |
| Female                           | 9 (27.3)                         | 22 (17.6)                   |         |
| Body mass index, median ± IQR    | 19.7 ± 4.8                       | 21.8 ± 4.3                  | 0.039   |
| Duration of surgery (min), median ± IQR | 235.0 ± 170.0                  | 195.0 ± 121.0               | 0.019   |
| Having underlying conditions     |                                 |                             |         |
| that affect tissue elasticity, n % |                                  |                             | 0.111   |
| Type of endotracheal tube, n (%)  |                                  |                             | 0.739   |
| Clear PVC nasal RAE              | 10 (30.3)                        | 45 (36.9)                   |         |
| Silicone ivory performed tube     | 15 (45.5)                        | 53 (43.4)                   |         |
| Flexometallic reinforced tube     | 8 (24.2)                         | 24 (19.7)                   |         |
| DuoDERM® CGF, n (%)              | <0.001                           |                             |         |
| Used                             | 6 (18.2)                         | 73 (59.8)                   |         |
| Not used                         | 27 (81.8)                        | 49 (40.2)                   |         |

A significant association (P < 0.05) is indicated in bold.

** Differences between groups were tested using Mann-Whitney U test.

*** Associations between occurring of pressure sore and each categorical independent variable were analyzed using chi-square test.

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T. Sumphaongern

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Lack of DuoDERM

Having underlying

Duration of surgery

1.003 (1.000–1.006), 0.040*

Possible method to anchor nasotracheal tube with

oral and maxillofacial surgeons sometimes

silicone putty to avoid shifting of the tube and make ulceration of nasal

skin. In addition, the oral and maxillofacial surgeons sometimes

between the nasal alar and the tube, for example; polyvinyl alcohol foam,

combined use of hydrocolloid dressing with soft denture lining-material,

increase the incident of ala

formed nasotracheal ivory silicone RAE tube and comparing the type of

the material between nasal clear polyvinyl chloride RAE tube and pre-

cesses, decrease sterilization, and may also aggravated high pressure on the ala nasi.

Another significant risk factor associated with the ala nasi pressure sore was

were increased 4.8% for every 10 min of anesthesia time. Similarly,

Masanori et al [3], a retrospective study, they found that ala nasi pressure

increase 5% for every 10 min of operation time increased. Similarly,

When there is pressure on ala nasi, the pressure sore occurred due to
decrease of the capillary blood supply. The long duration of surgery under
general anesthesia with nasotracheal tube was one of the significant
facors. From our study, the incidence of ala nasi pressure sore incident
were increased 4.8% for every 10 min of anesthesia time. Another significant risk factor associated with the ala nasi pressure sore was the use of trimmed DuoDERM® CGF to attach between nasal alar and the nasotracheal tube (as shown in Figure 1). From our study, patients with lack of DuoDERM® CGF dressing had ala nasi pressure sore 9.934-fold greater than patients who use DuoDERM® CGF dressing. Other litera
tures also emphasized the effectiveness of the use of barrier to attach
between the nasal alar and the tube, for example; polyvinyl alcohol foam,
combined use of hydrocolloid dressing with soft denture lining-material,
and the use of modified endotracheal tube to avoid the bare contact
surface between nasal alar and nasotracheal tube [7, 8, 9, 10]. Sharp
angulation between nose and tube might also increase the incident of ala
nasi pressure sore, therefore it should be avoided. Ogawa et al [11]
described stronger method to anchor nasotracheal tube with flexible
silicone putty to avoid shifting of the tube and make ulceration of nasal
alar skin. In addition, the oral and maxillofacial surgeons sometimes

Figure 1. Use of trimmed DuoDERM® CGF (arrow sign) to attach between nasal alar and the nasotracheal tube.

aggressively pressed the nasotracheal tube tightly under the drapes and
aggravated the pressure sore from the sharp angulation.

There was significant lower incident of ala nasi pressure sore in pa-
tients who had higher body mass index. For every increased 1 kg/m² of
body mass index, risk of pressure sore was decrease to 0.864-fold. The
reason may be that the obese patients had more subcutaneous fat and
thicker soft tissue drape over the cartilaginous skeleton of the nose.

There was no significant difference of incidence in patients who were
different in age, gender, and patients who had any underlying conditions
that caused poor skin elasticity, such as post-radiation therapy for head
and neck cancer, poor-controlled diabetes mellitus, scleroderma, etc. We
also compared the type and material of the nasotracheal tube. Comparing
the material between nasal clear polyvinyl chloride RAE tube and pre-
formed nasotracheal ivory silicone RAE tube and comparing the type of
endotracheal tube between nasal RAE tube and flexometallic reinforced
endotracheal tube, there was no difference of pressure sore incident.
Sonal et al [4] reported the retrospective study of nasal alar pressure sore
in head and neck reconstructive surgery. They found that there was no
association between the pressure sore and the type of endotracheal tube.

Although analyzing of the ala nasi pressure or the blood flow volume
of ala nasi during the operations are the reliable and objective methods,
but the measuring probes may interfere the surgery fields, decrease
sterilization, and may also aggravated high pressure on the ala nasi.
Furthermore, these probes are not routinely use and rarely find in our
country, therefore we use International NPUAP/EPUAP pressure ulcer
classification system to grade the pressure sore.

The outcomes of ala nasi pressure sores in this study were all stage I
pressure sore and self-limiting. These might be from the early detection
and prompt treatment with application of the corticosteroid cream. But
this complication effected greater on patients’ concern, depending on the
degree of pressure sore, functional, and cosmetic problem. Therefore,
prevention and early treatment were the most effective solution.

5. Discussion

When there is pressure on ala nasi, the pressure sore occurred due to
decrease of the capillary blood supply. The long duration of surgery under
general anesthesia with nasotracheal tube was one of the significant
facors. From our study, the incidence of ala nasi pressure sore increased 5% for every 10 min of operation time increased. Similarly,
Masanori et al [3], a retrospective study, they found that ala nasi pressure
sore incident were increased 4.8% for every 10 min of anesthesia time. Another significant risk factor associated with the ala nasi pressure sore was the use of trimmed DuoDERM® CGF to attach between nasal alar and the nasotracheal tube (as shown in Figure 1). From our study, patients with lack of DuoDERM® CGF dressing had ala nasi pressure sore 9.934-fold greater than patients who use DuoDERM® CGF dressing. Other litera
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silicone putty to avoid shifting of the tube and make ulceration of nasal
alar skin. In addition, the oral and maxillofacial surgeons sometimes

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Table 2. Correlation between occurring of pressure sore and each categorical independent variable.

| Characteristics          | Crude odds ratio (95% CI), p-value | Adjusted odds ratio (95% CI), p-value |
|--------------------------|------------------------------------|--------------------------------------|
| Age                      | 0.985 (0.951–1.020), 0.389         | 1.004 (0.967–1.042), 0.842           |
| Male                     | 1.430 (0.661–3.093), 0.363         | 1.282 (0.474–3.464), 0.625           |
| Body mass index          | 0.902 (0.800–1.016), 0.090         | 0.864 (0.749–0.997), 0.045           |
| Duration of surgery      | 1.003 (1.000–1.006), 0.040*        | 1.005 (1.002–1.009), 0.004           |
| Having underlying conditions | 3.967 (0.762–20.647), 0.102       | 7.070 (0.853–58.576), 0.070          |
| Lack of DuoDERM® CGF dressing | 6.704 (2.578–17.436), <0.001*   | 9.934 (3.347–29.489), <0.001**       |

A significant association (P < 0.05) is indicated in bold.

Table 3. Outcomes of ala nasi pressure sore.

| Characteristics          | Details* | n (%) (n = 33 cases) |
|--------------------------|----------|----------------------|
| Pressure sore severity   | Stage I  | 33 (100)             |
|                          | Stage II | 0 (0)                |
|                          | Stage III | 0 (0)               |
|                          | Stage IV | 0 (0)                |
| Time to healed           | 24 h     | 28 (85)              |
|                          | 48 h     | 3 (9)                |
|                          | 72 h     | 2 (6)                |
| Patients’ concern        | Not concern | 0 (0)             |
|                          | Minimal  | 12 (36.4)            |
|                          | Moderate | 21 (63.6)            |
|                          | Very much | 0 (0)              |

* Using International NPUAP/EPUAP pressure ulcer classification system [12]; stage I: Nonblanchable erythema; stage II: Partial thickness skin loss; stage III: Full thickness skin loss; stage IV: Full thickness tissue loss.

6. Conclusion

The significant risk factors for ala nasi pressure sores after general anesthesia with nasotracheal intubation are long duration of surgery and lack of hydrocolloid dressing. While the significant protective factor was high body mass index. We recommend shortening the duration of surgery
and using hydrocolloid dressing between ala nasi and the nasotracheal tube or catheters that inserted via nose, such as nasogastric tube, to decrease ala nasi pressure sore occurrence.

Declarations

Author contribution statement

Thunshuda Sumphaongern: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

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Competing interest statement

The authors declare no conflict of interest.

Additional information

Supplementary content related to this article has been published online at https://www.epuap.org/wp-content/uploads/2016/10/quick-reference-guide-digital-npuap-epuap-pppia-jan2016.pdf.

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