New oral hygiene care regimen reduces postoperative oral bacteria count and number of days with elevated fever in ICU patients with esophageal cancer

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Introduction:

1. **What is the author's central purpose? Is it clearly stated?**

   The author's central purpose is to decrease the risk of postoperative complications associated with the surgical treatment of esophageal cancer by using benzethonium chloride, interdental brushes, and hydrogen peroxide. Complications include: "Pulmonary complications, including pneumonia, and ventilator-associated pneumonia in ICU patients.

2. **Write a 150- 200 word summary of the article that accurately conveys the content of the article.**

   This article involves a study done in Japan on a total of 44 esophageal cancer patients recovering in the ICU using a controlled pre/post study design. A common post-op complication of esophageal surgery is a fever in combination with ventilator-related pneumonia. The purpose of this study was to see the effects of using benzethonium chloride solution and hydrogen peroxide on the number of oral bacteria and post-op complications. The main goal was to reduce the risk of post-op complications by using benzethonium chloride solution during intensive interdental cleaning and hydrogen peroxide to clean the patient's tongue. This intensive cleaning reduced the number of oral bacteria which in return lowered the number of days patients experienced elevated fever associated with pneumonia. A schedule of the same three times a day for three days was maintained for performing the cleanings post-op. Putting aside any possible influences on the study, the results showed that the hypothesis was correct. The number of oral bacteria and the risk of post-op complications was reduced.

3. **Does the work meet the standards to be considered an appropriate/academic/scholarly source? Justify your choice.**

I think this article meets the appropriate standards because it is/contains the following:

- Is blind peer-reviewed
- Editorial Board Reviewed
- Expert peer-reviewed
- Contains an abstract
- Contains materials and methods
- Starts with an introduction
- States a hypothesis
- Shows data and provides criteria to follow in order to replicate the study
- A discussion that consists of explanations and recommendations
- An explanation of the control group and Intervention group
- The article is less than 5 years old
- States that it is a controlled pre/post study
- Ethical Consideration
- Lists who this study was financially supported by
- Publication Type is Journal Article

4. **Are the qualifications of the author(s) appropriate for an academic article? Briefly describe the authors' qualifications**

There are many authors of this article, many who have written up to and over 10 articles and some who have written only this article. Yasuhiro Shirakawa and Chie Omori have only

written two articles. This is the first publication for Ayano Tabata-Taniguchi and Aya Yokoi. Shinsuke Mizutani along with most of the rest of the authors have written up to ten plus articles. What's good is that there is a diversity in the authors. Those who are experienced as well as those with new knowledge and ideas to bring to the study. As stated in the article, some of the authors were involved in the study itself by performing the oral examination (measurement of oral bacteria and oral hygiene status) on the morning before the surgery and on post-op days 1-3. Those "trained and calibrated dentists" are Shinsuke Mizutani, Ayano Tabata-Taniguchi, Takayuki Maruyama, Aya Yokoi, and either Hirofumi Mizuno or Hiroshi Morimatsu (Initials were used in the article, not specifying which of the two H.M. was being named).

5. **When was the work published?**

   The work was published less than five years ago on August 30, 2018.

Methods:

1. **Is the experimental design clearly described? Describe the design in your own words.**

   Yes, the experimental design is clearly described. The design states that the study was a controlled pre/post study that consists of a control group of 23 patients and an intervention group of 21 patients. The patients were recruited at different times and separately in 2015. First, the control group was recruited followed by the intervention group. All 44 patients received "professional mechanical tooth cleaning and scaling as preoperative care" before being split into the two groups. After esophageal surgery, nurses gave the control group normal oral hygiene care when they were in the ICU for 3

days. On the other hand, dentists used a more involved process of oral hygiene care for the same amount of time. Both groups had their cleaning 3 times a day for three days. "(6:00, 14:00, and 21:00)" The article provides a schedule of the design process.

2. **Have the possible influences on the findings been identified and controls instituted? Describe and evaluate the use of controls and possible influences**

There have been possible influences listed but I don't believe all of the possible influences were taken into account. In the discussion section, the article states, " This study has several limitations. First, it enrolled a small number of participants at a single center. Second, the relationship between elevated fever and the number of oral bacteria remains unclear. Therefore, further large-scale studies are needed in order to confirm our findings. Third, the intervention was performed by dentists and routine oral hygiene care was provided by nurses. The differences in the skills of dentists and nurses in performing oral hygiene care should be considered. However, the new oral hygiene regimen does not require specialized skills and thus the effects of differences in clinical skill are likely to be small.". I agree with all the listed above although there are still a couple of things they mentioned but didn't state as possible limitations. First, although the sample size is small with a number of 44 total patients, a power analysis was used. "A statistical software package... [was used]. A sample size of 19 per group was required for detection of a significant difference (90% power, two-sided significance level of 1.7%). One specific possible influence in regards to the sample size is the number of patients in the group is not equal to the number of patients in the intervention group. Control= 23 Intervention=21. These numbers also don't allow for a margin of error associated with unexpected factors, mortality of the patients throughout the whole process pre/post-op,

and/or patients dropping out of the study unexpectedly. If 19 patients are required to see a significant difference that means they only have room to lose 4 from control and 2 from intervention. With this in mind, Table 1 in the article states data for predicted mortality of 13.4 in the control group and 15.2 in the intervention group. In that case, the results will no longer be viable if 13.4/15.2 patients pass away. Statements that support this data were stated in the article as:

"Esophageal cancer is a common cause of cancer death…"; "...patients who develop postoperative complications have a high risk of postoperative death…"; " Pulmonary complications, including pneumonia, frequently develop after esophagectomy and are the most common reason for morbidity and mortality."; " Oral bacteria increase the risk of postoperative pneumonia in patients with esophageal cancer."; "...preoperative reduction of oral bacteria is critical for this patient group."

It's clear that the authors know the risks but with such high risks and possibility of complications, the number of patients is way too small to make up for the margin of error associated with the possibility of things going wrong or not as hypothesized. Other things that should be taken into account or distinguished is the type of esophageal cancer and which stages of cancer the patients have. According to Web MD, "There are two main types of esophageal cancer. One type is squamous cell carcinoma. Squamous cells line the inner esophagus, and cancer developing from squamous cells can occur along the entire esophagus. The other type is called adenocarcinoma. This is cancer that develops from gland cells. To develop adenocarcinoma of the esophagus, squamous cells that normally line the esophagus are replaced by gland cells. This typically occurs in the lower esophagus near the stomach and is believed to be largely related to acid exposure to the lower esophagus." What if chemicals from stomach

acid, hormones from glands, or if the patient has the H-pylori bacteria or has had it in the past play a role in post-op recovery? Just like how oral bacteria can travel down the esophagus, the inferior end of the esophagus can be exposed to bacteria in the stomach. In Table 1 we see that there is a mix of different types of esophageal cancer patients as well as stages of cancer. Even though this data was collected, there's still the possibility that results could be different if they did separate studies for each category of cancer. For example,

- A study on oral bacteria and esophageal cancer in the neck further separated into other sub-studies for their respective stage.
- A study on oral bacteria and esophageal cancer in the chest further separated into other sub-studies for their respective stage.
- A study on oral bacteria and esophageal cancer in the abdomen further separated into other sub-studies for their respective stage.

Another possible factor is the state of oral health of the patients. Did any of them have gingivitis, periodontal disease, periodontal surgery, or any other history of gum disease? Or did they all have healthy mouths before being chosen as candidates? "Data on systemic and oral health were collected from medical and dental records." The state of oral health determines the number of oral bacteria in patient's mouths regardless of the professional mechanical tooth cleaning and scaling that was done as preoperative care on all 44 patients. One cleaning may have reduced the number of oral bacteria and biofilm but one cleaning alone doesn't cure gingivitis or gum disease. As we've been taught in Dental Hygiene Seminar, a professional cleaning and proper home care are required for at least 7 days in order for a difference to be made whether it be reversing gingivitis or arresting periodontal disease. Although the patients received "routine oral hygiene care for the control group [and] intensive oral hygiene care for the intervention group",

they didn't all start off with the same gingival health, or at least it wasn't noted in the article. The only thing stated was the "mean PPD (mm) [, which was,] 2.3 [control group] and 2.6 [intervention group]" there's no state of inflammation noted. A patient can have healthy PPDs and still have inflammation of the gums. The dentists did, however, record the "measurement of oral bacteria and oral hygiene status" the morning before the surgery and on post-op days 1-3, the same days that patients had the cleanings. Results of the number of oral bacteria on tongue and plaque index are noted in Table 2. "Volunteers recorded P1I and oral bacteria count and to assess intra- and inter-examiner agreement repeated the procedures within 1 week." How long were these volunteers trained for? What did the training consist of? Was there a competency to see the level of understanding of these volunteers? All these factors could play a role in whether or not the data was collected and assessed correctly.

As I read through the discussion section of the article, I found a couple more things that could have a significant influence on the study. There was a "significant difference in the rate of postoperative infection between [the two groups]...,[they] reanalyzed the data after excluding cases of postoperative infection (n=4). The result was unchanged. (data not shown)" The data should have been provided because we don't know for a fact that the results were unchanged, not to mention also that the number of patients in the study has now decreased to under 19 depending on whether or not all the patients with infection were from one group or not. That is another fact that wasn't stated.

The next item I found in the discussion section is, "All patients received antibiotics and steroid therapy during the perioperative period, and the type of drug used did not differ between groups...the use of antibiotics and steroids is governed by a standardized protocol." The article doesn't state if the patients were taking any medications previous to the study or while they

underwent the study. What if there are contradictions between their medication and the antibiotics and steroids? Did any of the patients experience xerostomia as a result of medication? These are factors that should be taken into consideration.

The final item that I believe could be a possible limitation is related to the fact that nurses did the cleanings for the control group and dentists worked on the intervention group. The article stated that the dentists were "trained and calibrated", but there was no statement about the level of expertise of the nurses in this matter. It's stated in the article that in normal circumstances nurses perform oral cleanings, but were they trained in specifics for this study? Were all the nurses calibrated as to make sure no patient gets a different level of cleaning?

3. **Has the sample been appropriately selected (if applicable)? Describe the sample used in the study, and evaluate its appropriateness.**

   No. Although a power analysis program was used with the result of 19 patients per group needed in order to get significant results, it's still not enough to take into account factors such as infection and mortality. There was a total of 44 patients chosen out of the initial 50, the mortality rate and the 4 patients excluded because of infection would make the study results no longer viable. If the 13.4 and 15.2 patients predicted in the mortality rate passed away, that would mean 58% of the control group and 66% of the intervention group is excluded from the study. Therefore, bringing us under the 19 required patients in each group to see a significant result.

4. **Is the experimental therapy compared appropriately to control therapy? Describe and evaluate the use of the control group.**

   Yes. Looking at the baseline information of the study, both the control group and the intervention group received equal scaling and cleaning pre-op. Therefore, all the patients started at the same level of oral status in regards to oral bacteria. Post-op, the control group received standard oral care in relation to esophageal cancer while the intervention group received intensive oral care in order to observe its effect on post-op complications.

5. **Is the investigation of sufficient duration? Evaluate, and explain your reasoning.**

   No. Even though there was a difference noted between both groups, it wasn't enough data long-term. Often with illness, there's a point of improvement before complications show up. In other words, sometimes patients get better before they get worse. The only way to eliminate that possible influence is if a longer study was held in order to monitor the duration of the patients' healing. The authors stated, " ...the number of oral bacteria remains unclear. Therefore, further large-scale studies are needed in order to confirm our findings."

Results and Discussion:

1. **Have the research questions or hypothesis been answered? Restate the research questions and/or hypotheses in your own words, and describe if or how they are answered.**

   In summary, the hypothesis states that using benzethonium chloride, interdental brushes, and hydrogen peroxide during intensive oral hygiene care post-op in patients with

esophageal cancer will reduce the number of oral bacteria and post-op complications such as fever and pneumonia.

I believe the hypothesis was answered. Although the relationship between the bacteria and fever still isn't clear, results prove that the number of oral bacteria was decreased in patients who received the intensive cleaning.

2. **Review the results in light of the stated objectives. Does the study reveal what the researcher intended?**

   After reviewing the results, there were only partial answers to the entire objective. We know that intensive oral care decreases the number of oral bacteria, as hypothesized. On the other hand, there isn't enough data to support its effect on fever, a risked post-op complication, in post-op patients.

3. **Do you agree or disagree with the article and findings? Explain why?**

   I agree with the hypothesis and the results that were documented, but I can only judge based on the information I was provided with. I agree that there should be a longer study with many more patients in order to find more significant results. I also believe that it should be more organized in regards to splitting into multiple studies by separating patients by gingival assessment, medications, type of treatment received pre-study, cancer type, and stage. The more specific the subgroups the more accurate the data will be in regards to all the possible influencing factors.

4. **What would you change in the article? Why? Think outside of the box. What would you add or delete?**

As I stated in previous answers, in regards to the article itself, I would add data about any pre-study medication/procedures, and gingival assessment not just PPD. In regards to content, there were things mentioned in the discussion that wasn't mentioned previously in the article such as:

- The fact that antibiotics and steroids would be given to the patients post-op.
- "Recurrent pharyngeal nerve paralysis is a major postoperative complication in esophageal cancer patients and can cause silent aspiration, which contributes to elevated fever." This should have been stated in the introduction when post-op complications were discussed.
- I would define or explain what the "floor effect" is, especially since it had an impact on the unlikely ability to "detect a significant difference between the groups."
- I would have mentioned previous oral hygiene studies in the ICU before the discussion section.
- In the discussion, they mention minor changes that were made. That should have been stated and elaborated under materials and methods since it's considered part of the "recipe".

To conclude my article critique; although there was a significant number of changes I would have made and unanswered questions I still have, I believe that this is an interesting study that could yield promising results if taken a step further.

Refrences:

"Esophageal Cancer (Cancer of the Esophagus)." WebMD, WebMD, 2018, www.webmd.com/cancer/esophageal-cancer.

Mizuno, Hirofumi, et al. "New Oral Hygiene Care Regimen Reduces Postoperative Oral Bacteria Count and Number of Days with Elevated Fever in ICU Patients with Esophageal Cancer." Journal of Oral Science, Nihon University School of Dentistry, 27 Dec. 2018, www.jstage.jst.go.jp/article/josnusd/60/4/60_17-0381/_article.