Indonesian Journal of Medicine (2022), 07(02): 122-130
Masters Program in Public Health, Universitas Sebelas Maret

Meta-analysis

Meta Analysis: Correlation between Diabetes Mellitus and Surgical Wound Infection

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ABSTRACT

Background: Surgical wound infections complicate 10-20% of operations with a considerable burden of increasing morbidity, mortality, and health care costs. One third of postoperative deaths are associated with surgical wound infections. The risk of surgical site infection is associated with the presence of risk factors for diabetes mellitus. This causes patients undergoing surgery with diabetes mellitus to have a higher risk of developing surgical site infections. This study aims to examine the effect of diabetes mellitus on the incidence of surgical wound infection.
Subjects and Method: This research was conducted using a systematic review design and meta-analysis using PRISMA flow diagrams. The article search was conducted by selecting articles published between the years 2000-2022 which were obtained from several databases of PubMed, Google Scholar, Science Direct, and Springer Link. The keywords used to search for articles were "Diabetes Mellitus", "Surgical Site Infection", "cohort", "Diabetes Mellitus" AND "Surgical Site Infection", "Diabetes Mellitus" AND "Surgical Site Infection" AND "adjusted odd ratio" . The analysis was carried out using RevMan 5.3 software.
Results: Meta-analysis of 9 articles of diabetes mellitus (aOR= 2.54; 95% CI= 1.93 to 3.34; p<0.001) affected the incidence of surgical wound infection.
Conclusion: Diabetes mellitus increases the incidence of surgical wound infections.

Keywords: diabetes mellitus, surgical wound infection

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Cite this as:
Fahrezi C, Murti B, Tamtomo D (2022). Meta Analysis: Correlation between Diabetes Mellitus and Surgical Wound Infection. Indones J Med. 07(02): 122-130. https://doi.org/10.26911/theijmed.2022.07.02.01.

BACKGROUND

The prevalence study showed that 11.2% of 1,047 hospitalized patients had nosocomial infections where the most common surgical wound infection was 36 patients out of 124 patients (Ella et al, 2013). Globally, surgical site infections increased from 2.5% (Singh et al., 2014) to 41.9% (Mawalla et al., 2011). Surgical wound infections account for 14%-16% of all nosocomial infections in hospitalized patients and are considered the most common infections among surgical patients (Mangram in Junker, 2012). Increases morbidity, mortality, and health care costs (Pull et al., 2009).

Surgical wound infections complicate up to 10-20% of operations with a considerable burden on health care workers (Turtiainen et al, 2010). A total of 1.07% of the annual incidence with 8,000 deaths is directly related to surgical site infection in the United States (Scott, 2009). The cumu-

lative incidence of surgical site infections in Africa ranges from 2.5% to 30.9% (Nejad et al., 2011). Then in Ethiopia, the incidence of surgical site infection ranged from 10.9% (Mulu et al., 2013) to 75% (Mengesha et al., 2014).

The risk of surgical site infection is associated with a number of factors, one of which is diabetes mellitus (Shoaib et al, 2008). Patients with diabetes mellitus are more susceptible to surgical site infections and other nosocomial infections (Shilling et al, 2008). In the study of Cheadle (2006) stated that diabetes mellitus is associated with surgical wound infections. Multivariate risk factor analysis from the study of Harrington et al. (2004) showed that diabetes was the main predictor of surgical site infection (OR: 1.6; 95% CI: 1.2 to 2.1). Other studies have also studied the effect of diabetes mellitus with the incidence of surgical site infections. The results showed that surgical patients with diabetes mellitus had a 2.5 times greater risk of developing surgical site infections (OR: 2.5; 95% CI: 1.27 to 4.91) (Vilar et al., 2000).

Based on research conducted by Latham et al. (2001) also stated that diabetes mellitus was independently associated with surgical site infection with an odds ratio of 2.76. The study stated that forty-two (6%) of the 700 patients without a previous history of diabetes had evidence of undiagnosed diabetes and their infection rates were comparable to those of those with diagnosed diabetes. Then the overall rate of surgical wound infection in one study was 3.5%, significantly more in individuals with diabetes than in those without (Dane et al., 2011).

Diabetes mellitus was consistently found to be associated with the incidence of surgical site infection in 13 adjusted analyses, and 85% of them reported a statistically significant association. In another study, diabetes mellitus was the main factor related to surgical wound infection with an odds ratio of 2.04 (Fei, Junming, and Xianzhong, 2015).

The results of research conducted by Temming et al (2017) differ from the results of previous studies which stated that diabetes mellitus was not significant for the occurrence of surgical wound infections. This is supported by research conducted by Fahmi (2016) regarding diabetes mellitus on the incidence of surgical wound infections, the results show that there is no relationship with the incidence of surgical wound infections.

Several studies have been conducted to see the effect of diabetes mellitus on the incidence of surgical wound infections, but there are still different research results. Therefore, researchers are interested in conducting further research on diabetes mellitus on the incidence of surgical wound infections. So that more in-depth and clear results can be obtained by conducting a meta-analysis.

SUBJECTS AND METHOD

1. Study Design

This research was conducted using a systematic review and meta-analysis with PRISMA flow diagram guidelines. Search articles using databases: PubMed, Google Scholar, Science Direct, and Springer Link. Some of the keywords used: “Diabetes Mellitus”, “Surgical Site Infection”, “cohort”, “Diabetes Mellitus” AND “Sur-gical Site Infection”, “Diabetes Mellitus” AND “Surgical Site Infection” AND “adjusted odd ratio”.

2. Inclusion Criteria

The inclusion criteria for this research article were full-text cohort articles, multivariate analysis with AOR, using diabetes mellitus intervention, and patients aged 14 years and over.

3. Exclusion Criteria

The exclusion criteria for this research

article were articles not using English, published before 2000, the outcome was not surgical wound infection.

4. Operational Definition of Variables

Diabetes Mellitus is a pancreas that does not produce enough insulin or the body does not effectively use insulin with blood sugar limits when fasting plasma glucose values 7.0 mmol/L (blood sugar <126 mg/ dl), and plasma glucose ≥ 11.1 mmol/L (blood sugar). when <200 mg/dl).

Surgical wound infection is an infection that occurs in the operating area or room or organ within 30 days after surgery or within 1 year.

5. Study Instrument

The study was carried out using the PRISMA flow diagram and assessing the quality of research articles using the Critical Appraisal Checklist for Cohort Study tools (CEBM, 2014).

6. Data Analysis

The data in this study were analyzed using the RevMan 5.3 application, to calculate the effect size and heterogeneity of the study. The results of data processing are presented in the form of forest plots and funnel plots.

RESULTS

The article review process was carried out using the PRISMA flow chart, which can be seen in Figure 1. The total articles obtained were 9 articles. The distribution of the article is on 3 continents with details 3 from Asia, 1 from North America, and 5 from Europe.

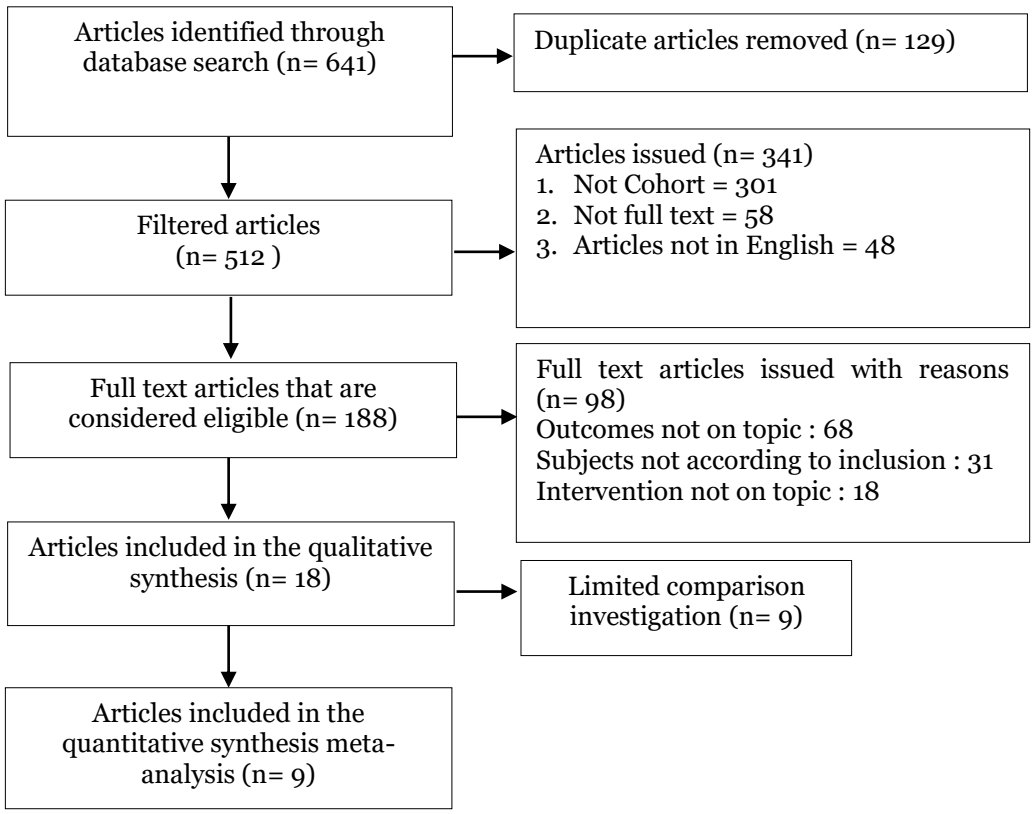

Figure 1. PRISMA flow diagram

Table 1. Assessment of the quality of research on diabetes mellitus articles on the incidence of surgical wound infections

No	Checklist of questions	Publications (Author and Year)								
		Olsen *et al* (2017)	Alkaaki*et al* (2019)	Figuerola*et al* (2016)	Paramo*et al* (2021)	Kokudo*et al* (2015)	Dubory*et al* (2015)	Liang*et al* (2019)	Emil *et al* (2020)	Latham *et al* (2020)
1	Does this research group have a clear research focus?	1	1	1	1	1	1	1	1	1
2	Did the author use an appropriate method to answer the question?	1	1	1	1	1	1	1	1	1
3	Is the cohort method applicable?	1	1	1	1	1	1	1	1	1
4	Is exposure accurately measured to minimize bias?	1	1	1	1	0	1	1	1	1
5	Are research results measured accurately to minimize bias?	1	1	1	1	1	1	1	1	0
6	Did the author identify all confounding factors? Have the authors taken into account confounding factors in the design and/or analysis?	1	1	1	1	1	1	1	1	1
7	Was the follow-up of the subjects of this study complete?	1	1	1	1	1	1	1	1	1
8	What are the results of this study?	1	1	1	1	1	1	1	1	1
9	Are the research results reliable?	1	1	1	1	1	1	1	1	1
10	Can the research results be applied to the local population?	1	1	1	1	1	1	1	1	0
11	Are the results of this study consistent with other studies?	0	1	1	0	1	1	0	1	1
	Total	11	11	11	10	11	11	10	11	9

Note: Yes= 1 No= 0

Table 2. Table of studies

Author (year)	Country	Design Studies	P (Population)	I (Intervention)	C (Comparison)	O (Outcome)	aOR (CI 95%)
Olsen et al. (2017)	Denmark	Cohort	Ankle fracture surgery patient	Diabetes mellitus	No Diabetes Mellitus	Surgical Wound Infection	2.72 (1.16 to 6.36)
Alkaaki et al. (2019)	Canada	Cohort	Abdominal surgery patient	Diabetes mellitus	No Diabetes Mellitus	Surgical Wound Infection	1.52 (0.52 to 4.50)
Figuerola et al. (2016)	Spanish	Cohort	Heart surgery patient	Diabetes mellitus	No Diabetes Mellitus	Surgical Wound Infection	2.80 (1.50 to 5.40)
Paramo et al(2021)	Spanish	Cohort	Colorectal surgery patients	Diabetes mellitus	No Diabetes Mellitus	Surgical Wound Infection	2.99 (0.91 to 9.87
Kokudo et al(2015)	Switer land	Cohort	surgery patient liver	Diabetes mellitus	No Diabetes Mellitus	Surgical Wound Infection	1.25 (0.42 to 3.78)
Dubory et al(2015)	French	Cohort	Spine injury surgery patient	Diabetes mellitus	No Diabetes Mellitus	Surgical Wound Infection	3.42 (1.01 to 11.57)
Burrow et al. (2019)	China	Cohort	Orthopedic (geriatric) surgery patients	Diabetes mellitus	No Diabetes Mellitus	Surgical Wound Infection	3.70 (1.70 to 5.60)
Emil et al. (2020)	Israel	Cohort	Abdominal surgery patient	Diabetes mellitus	No Diabetes Mellitus	Surgical Wound Infection	1.48 (0.55 to 3.97)
Latham et al. (2020)	United States of America	Cohort	surgery patient	Diabetes mellitus	No Diabetes Mellitus	Surgical Wound Infection	2.76 (1.64 to 4.66)

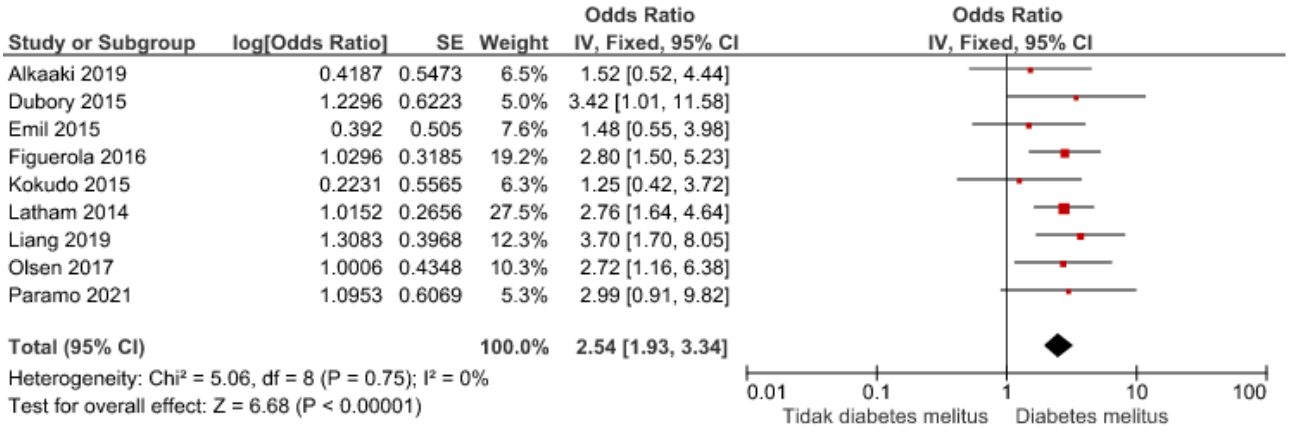

Figure 2. Forest plot of the effect of diabetes mellitus on surgical wound infection

The forest plot in Figure 2 shows the effect of diabetes mellitus on the incidence of surgical wound infection. Patients with diabetes mellitus had a risk of developing surgical wound infection 2.54 times compared to those without diabetes mellitus, and the effect was statistically significant (aOR= 2.54; 95% CI= 1.93 to 3.34; p<0.001). This meta-analysis showed the homogeneity of the estimated effect between studies with I^2= 0%. Thus, the calculation of the average effect estimate is carried out using a fixed effect model approach.

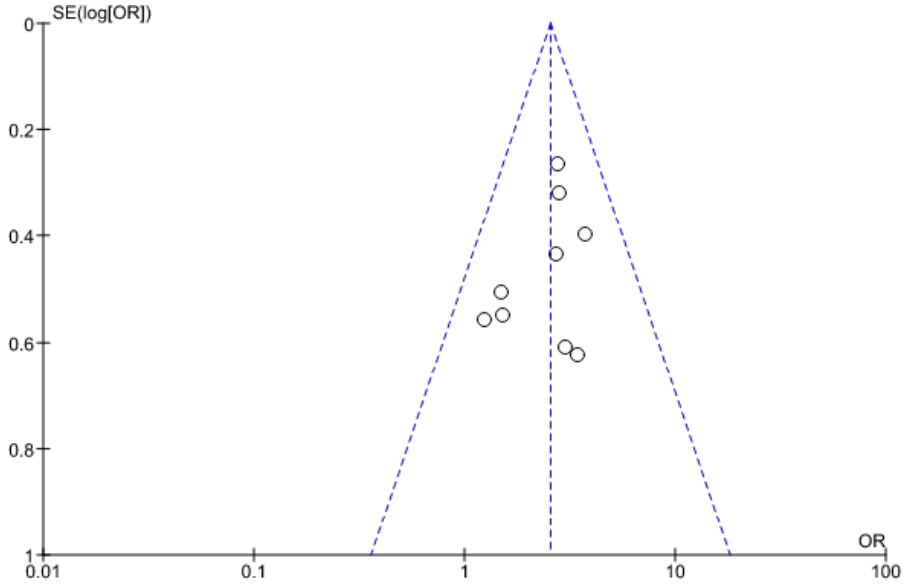

Figure 3. Funnel plot of the effect of diabetes mellitus on the occurrence of surgical wound infections

The funnel plot in Figure 3 is on the left, which indicates publication bias. Because in the funnel plot image, the distribution of the estimated effects is located to the right of the average vertical line which is also in the same direction as the diamond (average effect estimate) in the forest plot, the publication bias overestimates the actual effect.

DISCUSSION

In this meta-analysis, there were 9 articles on the effect of diabetes mellitus on the incidence of surgical wound infections. After being processed using RevMan 5.3, the results of the analysis showed that there was homogeneity between studies (=0%) so that the analysis used the Fixed Effect Model. Patients with diabetes mellitus had a risk of developing surgical wound infection 2.54 times compared to those without diabetes mellitus, and the effect was statistically significant (aOR= 2.54; 95% CI= 1.93 to 3.34; p<0.001).

The results of this study are supported by Olsen et al (2017) where patients who underwent surgery with diabetes mellitus could increase the occurrence of surgical wound infections 2.72 times compared to patients who did not have diabetes mellitus (aOR= 2.72; 95% CI= 1.16 to 6.36). The study was a cohort study that reviewed patients who underwent surgery for ankle fractures between 2008 and 2013.

In accordance with the study of Figuerola et al. (2016) that diabetes mellitus significantly 2.80 times can increase the occurrence of surgical wound infections (aOR= 2.8; 95% CI= 1.50 to 5.40). The study used a cohort study and the subjects used were patients who underwent coronary surgery for a period of 6 years.

Paramo et al (2021) also stated that one of the risk factors for the occurrence of surgical wound infection is the presence of diabetes mellitus in patients undergoing surgery. The results of the study stated that diabetes mellitus increased the incidence of surgical site infection 2.99 times compared to patients who did not have diabetes mellitus (aOR= 2.99; 95% CI= 0.91 to 9.87). The study included a total of 130 patients who underwent colorectal surgery between January 2017 and December 2018 and used a cohort study design.

Another study from Dubory et al. (2015), which stated that diabetes mellitus increased the occurrence of surgical wound infections 3.42 times compared to patients who did not have diabetes mellitus (aOR = 3.42; 95% CI = 1.01 to 11.57). The study used a cohort study design with 518 patients who underwent spinal cord injury surgery between February 2011 and July 2011.

Diabetes mellitus or hyperglycemia can affect the wound healing process. Diabetes mellitus will prolong the wound healing process because diabetes causes levels of fatty substances in the blood to increase thereby accelerating the occurrence of atherosclerosis (accumulation of fatty plaques in blood vessels) so that poor blood circulation through large blood vessels can injure the brain, heart, and leg blood vessels (macroangiopathy), whereas small blood vessels can injure the eyes, nerves, and skin and slow wound healing.

AUTHOR CONTRIBUTION

Chattrin Fahrezi is the main researcher who selects the topic, searches and collects research data. Bhisma Murti and Didik Tamtomo analyzed data and reviewed research documents.

FINANCIAL DAN SPONSORSHIP

This study is self-funded.

ACKNOWLEDGMENT

The researcher would like to thank all those who supported the preparation of this article and also thank the database providers PubMed, Google Scholar, Science Direct, and Springer Link.

CONFLICT OF INTEREST

There is no conflict of interest in this study.

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