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The Effect of Caffeine Administration and Consumption on Anesthetic Efficacy: A Systematic Review

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Abstract

Introduction: Caffeine is considered one of the most common stimulants that improve alertness and prevents sleepiness in many people. It is one of the most common consumed psychoactive substances in the world. Sometimes patients report failing of feeling numbness after local anesthesia administration due to excessive consumption of coffee, thus, they request a higher dose of local anesthesia during treatment. To this day, no previous study reported a direct association between caffeine intake and local anesthesia failure. ***Aim:*** This study aims to review published articles that discussed the effect of caffeine administration and consumption on anesthetic efficacy. ***Materials and Methods:*** A literature search was performed from multiple databases including PubMed, Web of Science, Cochrane, and Google Scholar. The most eligible articles were included using specific keywords. The literature search was limited to full-text English articles, which were screened for eligibility by two reviewers. ***Results and Discussion:*** Four studies were included in our study, these studies demonstrated that caffeine administration following general anesthesia can significantly accelerate recovery. However, the effect of caffeine consumption on local anesthesia efficacy was not yet completely proven. ***Conclusion:*** Caffeine consumption can speed up post-general anesthesia recovery. However, the effect of caffeine consumption on local anesthesia efficacy is still controversial and further investigation and clinical trials are required.

Keywords: Caffeine, Coffee, Local anesthesia, General anesthesia, Efficacy.

INTRODUCTION

Caffeine is one of the active substances of coffee. Caffeine is the chief alkaloid in tea and coffee. It is one of the most common consumed psychoactive substances in the world. Sometimes patients report failing of feeling numbness after local anesthesia administration because of the excessive consumption of caffeine, thus, they request a higher dose of local anesthesia during treatment. A lot of studies were aimed to investigate whether coffee has beneficial or harmful effects on health, these studies had a lot of mixed conclusions. Caffeine affects different parts of the central nervous system and influences cognitive performance, increases alertness, and changes the state of mind. Moreover, caffeine has a negative effect on sleep. Excessive caffeine consumption is associated with nausea, anxiety, restlessness, and headaches. Several factors have been linked to the failure of local anesthesia. These factors include operator-dependent factors, such as the amount of solution and technique used, and patient-related factors, including psychological factors, pathological, and anatomical factors. To this day, no previous study reported a direct association between caffeine intake and local anesthesia failure [1]. This study aims to review published articles that discussed the effect of caffeine administration and consumption on anesthetic efficacy.

MATERIAL AND METHODS

Elaboration

This systematic review followed the guidelines of the Preferred Reporting Items for Systematic Review and Meta Analyzes Protocols (PRISMA 2020) [2]. The acronym PICOS was used according to the research question "What is the effect of caffeine administration and consumption on anesthetic efficacy?" P = Patients pre and post anesthetic administration; I = caffeine administration and consumption; C = Control group; O = Interference with anesthetic effect. The search strategy was applied to PubMed, Cochrane, Google Scholar, and Web of science on July 29, 2022, without the restriction of time and is demonstrated in (Fig 1).

Eligibility Criteria

For the selection process of the articles to be included in this systematic review, all articles that evaluated the effect of caffeine administration and consumption on anesthetic efficacy were defined as inclusion criteria. Exclusion criteria are as follows: (1) Did not evaluate the effect of caffeine administration and consumption, (2) Did not evaluate anesthetic efficacy; (3) Non-English language articles, (4) Articles with no full text available.

Selection Process

The articles were selected in two stages. In the first step, reviewers B.F and R.K evaluated the title and abstract of the articles found after applying the search strategy according to the eligibility criteria, to select the articles to be read in full. In the second step, B.F and R.K independently assessed the articles selected for full reading according to the eligibility criteria.

Data Extraction

Data arrangement was performed in an Excel spreadsheet according to the criteria (a) Author, (b) Aims and objectives; (c) Total number of samples; (d) Year of publications; (e) Type of anesthetic used; (f) Results and is illustrated in (Table 1).

Risk of bias

The risk of bias classification was performed in the RevMan 5.3 software (The Nordic Cochrane Center) according to the criteria (1) Low risk of bias (high methodological quality), (2) Moderate risk of bias (moderate methodological quality), (3) High risk of bias (low methodological quality). All included studies demonstrated low-risk bias (high methodological quality). No insufficiency concerning the data outcome was observed for all articles. General analysis of the risk of bias of the studies is demonstrated in (Fig 2).

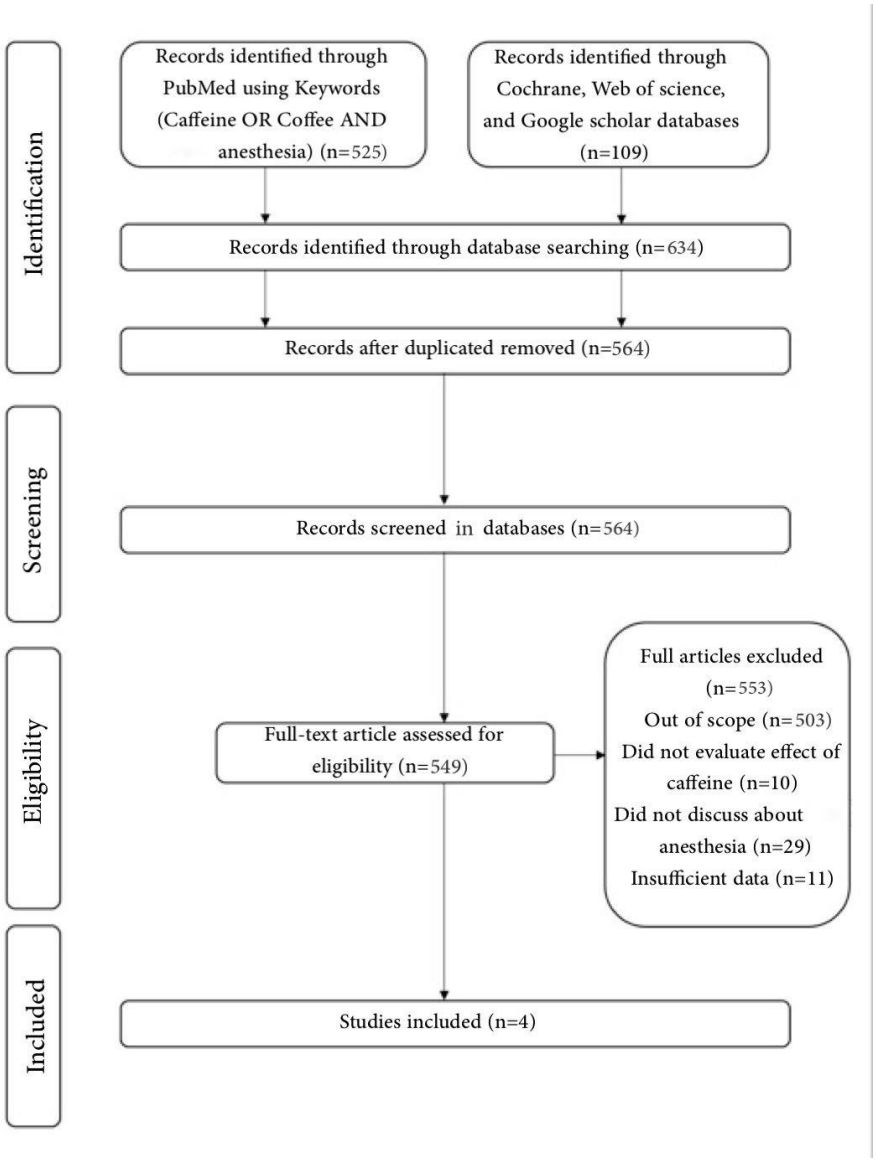

Fig 1: Study flow chart

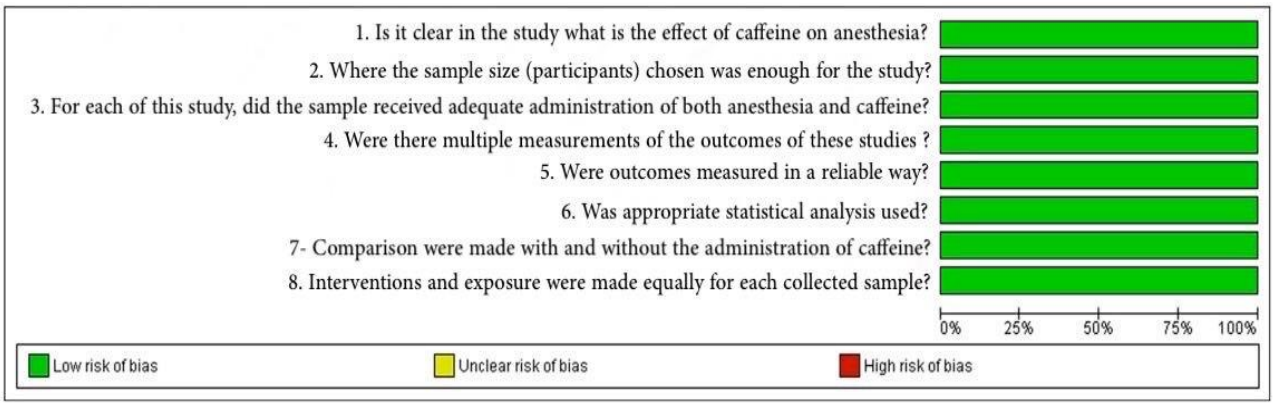

Fig 2: General analysis of the risk of bias of the studies

RESULTS

All four studies discussed the effect of caffeine on anesthesia, between these four studies, two illustrated the effect of caffeine on local anesthesia efficacy [3, 4]. However, the other to investigate the effect of caffeine on general anesthesia [6, 7]. (Table 1) summarizes the objective and results of the four eligible studies on the effect of caffeine consumption on anesthetic efficacy. Alfaraj, R *et al*., investigated the effect of habitual caffeine intake on lidocaine action and explored the potential involvement of voltage-gated sodium channels in the interaction effect. The findings indicated that chronic caffeine consumption enhances the local effects of lidocaine [3]. Alobaid, A. S *et al*., Investigated the effect of caffeine on the onset, duration, and efficacy of local anesthesia. However, the caffeine effect on local anesthesia was not proven [4]. Warner, N et al reviewed intravenous caffeine administration to 151 heavily sedated patients in the post-anesthesia recovery area, to assess the association between caffeine and changes in sedation score. Warner, N *et al*., suggested that IV administration of caffeine can improve the speed of recovery after general anesthesia. However, Warner, N *et al*., recommended future prospective trials to define the optimal dose and timing of administration [6]. Wang, Q *et al*., tested Forskolin, theophylline, and caffeine for their ability to accelerate emergence from anesthesia, it was found that caffeine could allow for uniform and rapid emergence from general anesthesia [7].

Table 1: Characteristics of included studies

Author	Aims and objectives	Total number of Sample	Year of publication	Anesthetic	conclusion
Alfaraj, R *et al*.,	Investigates the effect of habitual caffeine intake on lidocaine action and explores the potential involvement of voltage-gated sodium channels in the interaction effect.	32 female rats	2020	Lidocaine	Chronic caffeine consumption enhances the local effects of lidocaine through upregulation of voltage-gated sodium channels in the dorsal root ganglia.
Alobaid, A. S *et al*.,	Investigating the effect of caffeine on the onset, duration and efficacy of local anesthesia.	50 female patients	2019	Lidocaine	Caffeine effect on the LA was not proven
Warner, N *et al*.,	Reviewed intravenous caffeine administration (median dose 150 [125, 250] mg) to 151 heavily sedated patients in the post-anesthesia recovery area, to determine the association between caffeine administration and changes in sedation score	151 patients	2018	General anesthesia	Intravenous caffeine may enhance the speed of recovery following general anesthesia
Wang, Q *et al*.,	Forskolin, theophylline, and caffeine were tested for their ability to accelerate emergence from anesthesia	Adults rat	2014	Intravenous Isoflurane	Caffeine might allow for rapid and uniform emergence from general anesthesia in human patients

DISCUSSION

Caffeine is considered one of the stimulants that improve alertness and prevents sleepiness in many people. Normal consumption of caffeine is less than 500mg daily, this amount is not reported to be harmful. Caffeine is generally taken to relieve pain and is commonly available in pharmacies with no need for a prescription [8]. Caffeine consumption appears to be safe generally. However normal levels of intake should be taken into consideration [9]. Many patients report a previous history of local anesthesia failure, these patients contribute this failure to the excessive caffeine consumption. Because of the shortage of scientific evidence for this theory, our study reviewed all articles discussing the effect of caffeine consumption on anesthetic efficacy. There are several published articles that discussed the pharmacological effect of caffeine. However, few articles discussed the caffeine effect on anesthesia efficacy. Alfaraj, R *et al*., investigated the effect of habitual caffeine intake on lidocaine action and explored the potential involvement of voltage-gated sodium channels in the interaction effect. The results indicated that in the dorsal root ganglion, chronic caffeine consumption upregulated the expression of pain-related voltage-gated sodium channels. The findings showed that chronic caffeine consumption enhances the local effects of lidocaine [3]. Alobaid, A. S *et al*., Investigated the effect of caffeine on the onset, duration, and efficacy of local anesthesia. The duration of pulpal anesthesia was slightly longer in the low caffeine group (11.5 min) compared to the high caffeine group (8 min). The pulpal anesthesia failure was (16%) in the low caffeine group and double (32%) in the high caffeine group. However, the caffeine effect on local anesthesia was not proven due to the fact that the difference was not statistically significant [4]. Warner, N *et al*., reviewed intravenous caffeine administration to 151 heavily sedated patients in the post-anesthesia recovery area, to assess the association between caffeine and changes in sedation score. After administration of caffeine, Richmond Agitation-Sedation Scale scores were increased significantly. In addition, there was no significant drift in oxyhemoglobin saturation over time or after caffeine administration. Warner, N et al suggested that IV administration of caffeine can improve the speed of recovery after general anesthesia. However, Warner, N *et al*., recommended future prospective trials to define the optimal dose and timing of administration [6]. Wang, Q *et al*., tested Forskolin, theophylline, and caffeine for their ability to accelerate emergence from anesthesia. Caffeine was shown to inhibit phosphodiesterase thus increasing intracellular cAMP. Caffeine dramatically increased the speed of recovery from anesthesia by 60%. Wang, Q *et al*., found that caffeine could allow for uniform and rapid emergence from general anesthesia [7].

CONCLUSION

Caffeine administration can affect the post general anesthesia sedation by speeding up recovery through a series of mechanism which contributes to the rapid and uniform emergence from general anesthesia. The effect of caffeine consumption on local anesthesia efficacy is still controversial due to a significant lack of scientific evidence and clinical trials. However chronic caffeine consumption has been reported to enhance the local effect of lidocaine anesthetic in one study.

Conflicts of Interest: The authors reported no conflicts of interest related to this study.

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