Original Article

A systematic review and meta-analysis of lifestyle nursing interventions for patients with cardiovascular disease

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Background: The purpose of this study was to compare the clinical efficacy and safety of post-treatment nursing intervention (NI) with routine nursing care (RC) of patients with cardiovascular disease (CVD).

Methods: PubMed, EMBASE, the Cochrane Library, the China National Knowledge database, and other databases were used to comprehensively evaluate post-treatment NI versus RC for patients with CVD. Review Manager 5.0 was used to assess the impact of the results in the selected articles. Forest map analysis, sensitivity analysis, and bias analysis were performed on the collected data.

Results: In total, eight studies met the inclusion criteria. The systolic blood pressure in the RC group was higher than that in the NI group (MD =–3.72, 95% CI: –4.64 to –2.80, P<0.00001, I^2=92%). The diastolic blood pressure in the NI group was lower than that in the RC group (MD =–5.36, 95% CI: –6.55 to –4.16, P<0.00001, I^2=96%). There was a significant difference in fasting blood glucose levels between the NI group and the RC group (MD =–5.00, 95% CI: –9.47 to –0.52, P=0.03, I^2=88%). The total cholesterol in the NI group was lower than that in the RC group (MD =–9.99, 95% CI: –14.52 to –5.45, P<0.0001, I^2=85%). The triglyceride value of the NI group was lower than that of the RC group, with significant heterogeneity (MD =–24.24, 95% CI: –26.25 to –22.23, P<0.0001, I^2=96%). A sensitivity analysis and funnel plot indicated that the study was reliable and publication bias was limited.

Discussion: The results showed that the efficacy and safety of NI were superior to RC after treatment of CVD. NI is worth popularizing.

Keywords: Cardiovascular disease (CVD); nursing intervention; routine care

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Introduction

Cardiovascular disease (CVD) and its complications have a high incidence and mortality rate and present a global public health challenge (1-3). In recent decades, the control of CVD has tended to be stable, highlighting the problems of patient compliance with medication and changes in lifestyle. The effectiveness of medication adherence and nursing intervention (NI) have been reviewed previously, but few studies have examined adherence to lifestyle changes. This meta-analysis review aimed to determine the impact of NI on blood pressure control and adherence to lifestyle changes.

Currently, NI is widely used in the later stages of CVD treatment in many countries (4-6). It differs from the traditional idea of routine nursing care (RC) (7-9). NI is an individualized lifestyle education program based on remote

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nursing consultation by telephone and has been found to improve blood pressure control and other indicators and improve adherence to lifestyle recommendations. Therefore, to enhance the prevention and control of CVD risk factors, effective nursing measures should be employed in the later stages of CVD treatment. However, in China, our understanding of the post-discharge treatment of patients with CVD is limited.

The NI management plan is a comprehensive strategy. It usually involves a detailed telephone assessment and intervention designed to improve CVD patients' knowledge and support their lifestyle changes. A typical teleconsultation intervention provides health maintenance services for patients by telephone follow-up. A computer-based patient intervention is also considered a potentially effective strategy for improving the prognosis of patients. It focuses on the development of a network-based information transmission strategy, online patient support, and intervention. The internet-based intervention strategy enables patients to obtain available information on a daily basis without the need for face-to-face contact with health professionals. In addition, as an intervention tool, computers offer other advantages. They provide a private learning environment and immediate reinforcement of previously learned strategies. Because of the computer-based intervention strategy, more interactive information and intervention can be delivered to patients at a lower cost. Novel computer-based intervention strategies focus on self-management, reduce the risk factors of CVD, and are more conducive to reducing secondary CVD. To date, there has been no evaluation of the effectiveness of NI reminder programs. Therefore, we conducted a meta-analysis to compare the differences between post-treatment NI and RC. Our objective was to evaluate whether NI can improve the existing primary prevention strategies for cardiovascular risk factor management. We present the following article in accordance with the PRISMA reporting checklist (available at https://dx.doi.org/10.21037/apm-21-2189).

Methods

Search strategy

We conducted a literature search of PubMed, the Cochrane Library, EMBASE, and the China National knowledge database for the following keywords: (I) cardiovascular disease; (II) nursing intervention; (III) routine nursing. We searched for articles dated January 1999 to October 2016 that focused on NI and routine nursing care following CVD treatment. To improve the sensitivity of the search strategy, we manually cross-searched the reference list of retrieved documents. We used the Boolean operator "and" to obtain a list of two or more words used in the search article. The literature search was not limited to any specific published language so as to discover the maximum number of relevant publications.

Selection process

After determining the research parameters, we reviewed the available literature and included articles in line with the following research parameter standards: randomized controlled trials that involved:

(I) A comparative study of NI versus RC;
(II) Patients receiving treatment for CVD;
(III) Efficacy of treatment for patients with CVD;
(IV) Articles where the full text was provided.

Excluded studies were determined by the following criteria:

(I) Nonrandomized studies;
(II) Other patients without CVD;
(III) Studies lacking available data or comparable results.

Data extraction

Two researchers independently reviewed the complete text, and the quality of the study was assessed. The relevant research data were extracted, including essential information such as the year of publication and the name of the first author, sample size, age, and the physical condition of each group. We also extracted detailed information about the interventions and results of each study.

Statistical analysis

Review Manager (Version 5.0, The Cochrane Collaboration, 2011) was used to estimate the outcomes among the selected reports. For continuous variables, the mean difference was calculated. The I^2 statistic, a quantitative measure of inconsistency, was used to measure heterogeneity across studies. Studies with an I^2 of 25–50% were considered to have low heterogeneity, an I^2 of 50–75% was deemed to reflect moderate heterogeneity, and an I^2>75% reflected high heterogeneity. If the I^2 was >50%, potential sources of heterogeneity were tested by conducting a sensitivity analysis by eliding each study in turn to investigate the

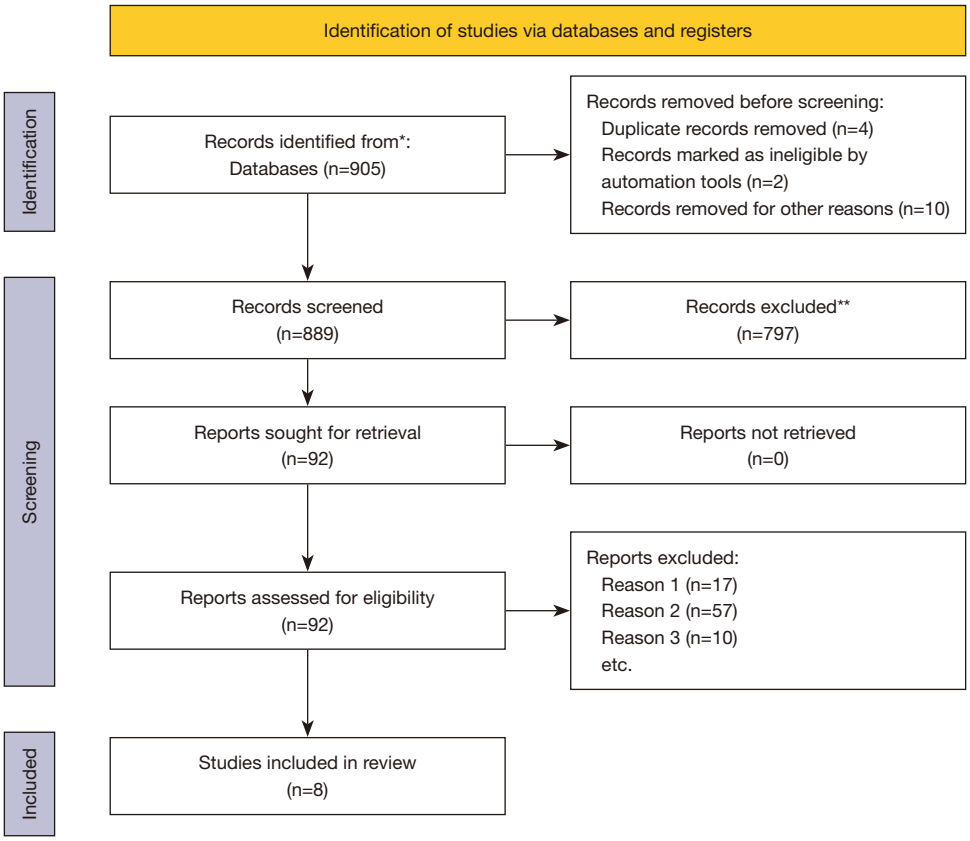

Figure 1 Flow diagram of the study selection. *, consider, if feasible to do so, reporting the number of records identified from each database or register searched (rather than the total number across all databases/registers); **, if automation tools were used, indicate how many records were excluded by a human and how many were excluded by automation tools. From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, *et al.* The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ* 2021;372:n71. doi: 10.1136/bmj.n71.

influence of a single study on the combined estimates. Furthermore, when heterogeneity was observed, a random-effects model was adopted; otherwise, a fixed-effects model was used. Funnel plots were used to investigate potential publication bias.

Results

Study selection

Our initial database search is shown in *Figure 1*. The flow chart reflects the search process and reasons for exclusion. According to our search criteria, a total of 889 articles were initially identified, 797 duplicate articles were excluded, and 92 papers were available for analysis. A further 57 articles were excluded from the study due to poor research design, insufficient data, or article type. Eight papers were included in the final analysis (10-17).

Characteristics of included studies

The eight articles in *Table 1* were published between 1999 and 2016. Sample sizes ranged from 4 to 762. The extracted data included the type of study and the total number of patients included in each group. The content consisted of author, year of publication, country/region, age, grouping, and sample size. The analysis included 3,162 patients. The characteristics of the research are shown in *Table 1*.

Risk of bias

After conducting a risk assessment, we found only one study that displayed a reporting bias. One other study showed

Table 1 Characteristics of the meta-analysis of NI versus RC

Study	Year	Type of study	Language	Country	Intervention	n	Mean age (years)	Duration of study
Marco Aurélio	2013	RCT	English	Brazil	NI	38	58±9	December 1999 to November 2013
					RC	36	59±9	
Javier Muñiz	2010	RCT	English	Spain	NI	762	62.1±11.6	December 2004 to November 2006
					RC	748	63.6±11.4	
G. Cicolini	2014	RCT	English	Italy	NI	100	58.3±13.9	December 2011 to November 2012
					RC	98	59.8±15.0	
LS Evangelista	2009	RCT	English	USA	NI	5	56.4±6.6	December 2000 to November 2008
					RC	4	62.2±9.7	
Madelon Minneboo	2017	RCT	English	Netherlands	NI	360	58.2±9.0	December 2013 to November 2013
					RC	351	59.2±9.4	
LS van den Wijngaart	2015	RCT	English	Netherlands	NI	176	65.0±10.6	December 2010 to November 2014
					RC	176	65.3±13.4	
Pan Zhang	2017	RCT	English	China	NI	100	66.6±2.2	December 2011 to November 2016
					RC	99	65.3±1.5	
Clinical trial	2016	RCT	English	Chile	NI	53	53±5.5	December 2010 to November 2016
					RC	56	52±5.8	

NI, nursing intervention; RC, nursing care; RCT, randomized controlled trial.

a tendency towards a reporting bias. The Cochrane bias risk assessment tool was used in six clinical trials to assess the chance of patient selection bias. After evaluation, we concluded that six studies had no risk of bias. The remaining two studies showed some risk of bias. The detailed results of the quality assessment are shown in *Figures 2* and *3*.

Meta-analysis results

In the NI group, blood pressure, blood glucose, total cholesterol, and triglyceride levels of patients with CVD were better than those in the RC group.

The means and standard deviations of systolic blood pressure were reported in six articles (*Figure 4*). Heterogeneity test results showed that the systolic blood pressure of the RC group was higher than that of the NI group (MD =–3.72, 95% CI: –4.64 to –2.80, P<0.00001, I^2=92%)

This meta-analysis included five studies that reported the differences between the NI and RC groups by comparing the means and standard deviations. *Figure 5* shows the heterogeneity between the NI and RC groups. The results showed that the diastolic blood pressure in the NI group was lower than that in the RC group (MD =–5.36, 95% CI: –6.55 to –4.16, P<0.00001, I^2=96%).

As shown in *Figure 6*, the heterogeneity of fasting blood glucose was evaluated based on a fixed-effects model. No significant heterogeneity was observed in these studies. The results showed that there was a significant difference in fasting blood glucose levels between the NI and RC groups (MD =–5.00, 95% CI: –9.47 to –0.52, P=0.03, I^2=88%).

Figure 7 compares the total cholesterol values between the NI and RC groups. Five studies described the subtle differences in heterogeneity between the NI and the RC groups. The results showed that the total cholesterol of the NI group was lower than that of the RC group (MD =–9.99, 95% CI: –14.52 to –5.45, P<0.0001, I^2=85%)

The heterogeneity evaluation indicated that five studies showed significant heterogeneity in the triglyceride values between the NI and RC groups (MD =–24.24, 95% CI: –26.25 to –22.23, P<0.0001, I^2=96%) (*Figure 8*).

A sensitivity analysis was performed to examine which parameters significantly influenced the system or model to determine its stability. Except for the relative outliers, the results showed that, for heterogeneity, the sensitivity

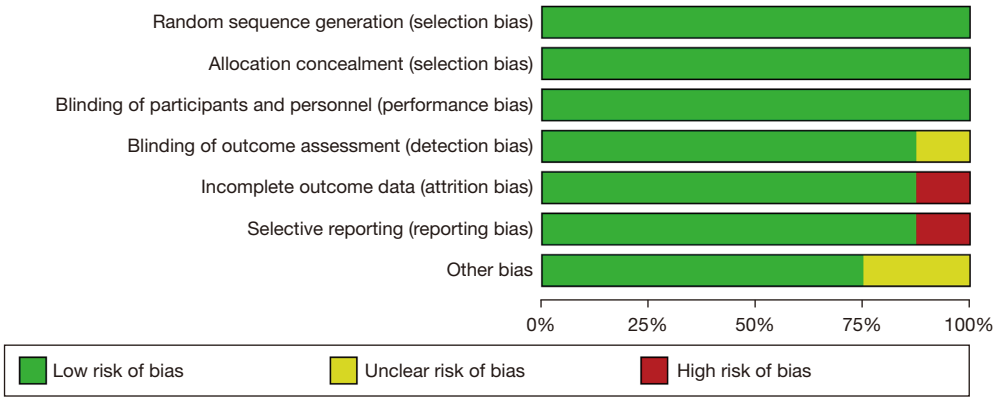

Figure 2 Quality assessment of included studies.

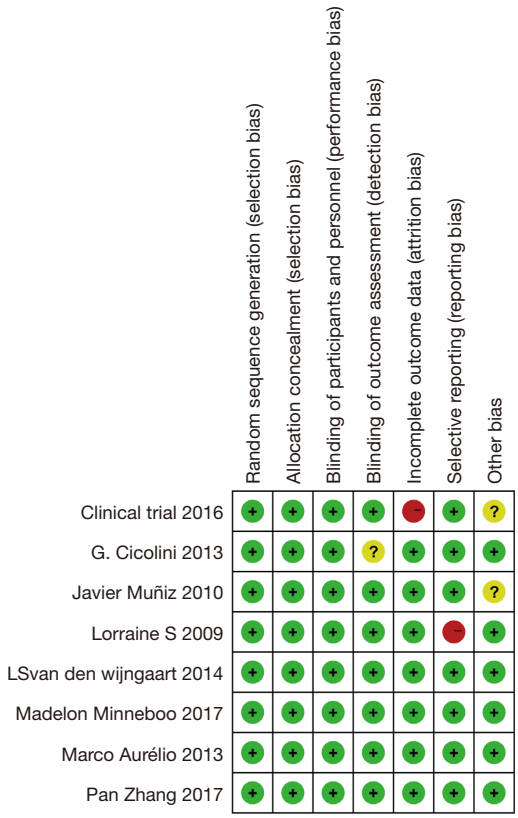

Figure 3 Assessment of the quality of the included studies: low risk of bias (green hexagons); unclear risk of bias (blank hexagons); and high risk of bias (red hexagons).

of systolic pressure did not change, but its P value changed from 0.01 to 0.23. The results showed that the heterogeneity was mainly attributed to the Julio study in 2016, as shown in *Figure 9*.

Publication bias analysis

A funnel plot was used to analyze publication bias and included a total of six studies. The results showed no deviation due to the excellent symmetry of the funnel plot (*Figure 10*).

Discussion

Eight studies met the inclusion criteria to evaluate the efficacy and safety of NI compared with RC (18,19). The meta-analysis of these studies showed a significant difference in systolic and diastolic blood pressure between the groups (20). The NI group's systolic blood pressure and fasting blood glucose were lower than that of the RC group. The total cholesterol and triglyceride levels were lower in the NI group than in the RC group.

NI programs included routine CVD prevention and guidance education for all patients (21-23). Patients in the NI group also received email reminders and calls from nursing care managers at weekly or monthly intervals up to six months post-discharge (24,25). The emails contained a reminder plan of the need to adhere to a healthy lifestyle and follow current guidelines. The nursing initiatives were designed to improve perioperative treatment measures and promote patients' rapid recovery.

van Ballegooijen *et al.* (26) reported a comparison of the differences between the NI and RC groups. NI was added to the treatment of CVD patients and compared with traditional nursing (27-29). The results showed that NI promoted postoperative recovery, reduced blood pressure, blood sugar, total cholesterol, and triglyceride levels. NI was also shown to reduce postoperative hospitalization and

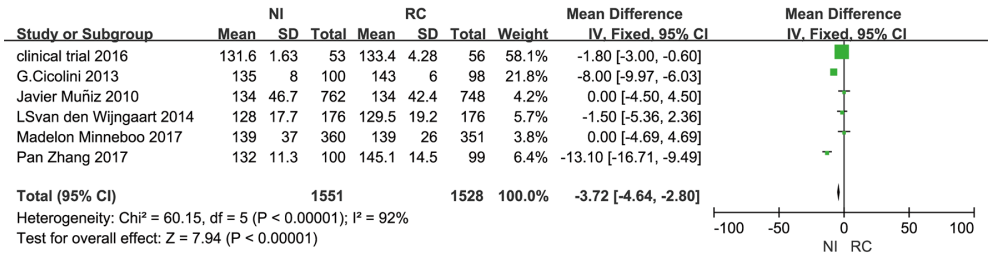

Figure 4 Forest plot of systolic blood pressure comparisons between the NI and RC groups. NI, nursing intervention; RC, nursing care.

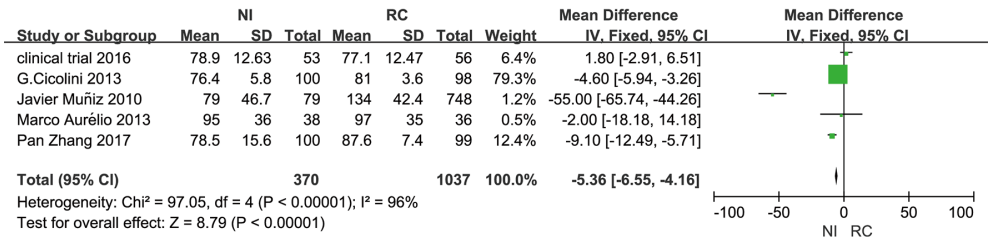

Figure 5 Forest plot of diastolic blood pressure comparisons between the NI and RC groups. NI, nursing intervention; RC, nursing care.

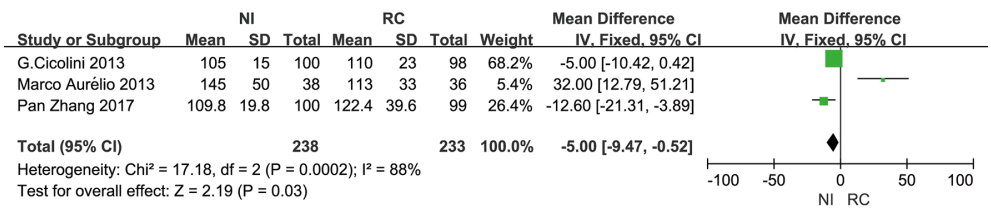

Figure 6 Forest plot of fasting blood glucose comparisons between the NI and RC groups. NI, nursing intervention; RC, nursing care.

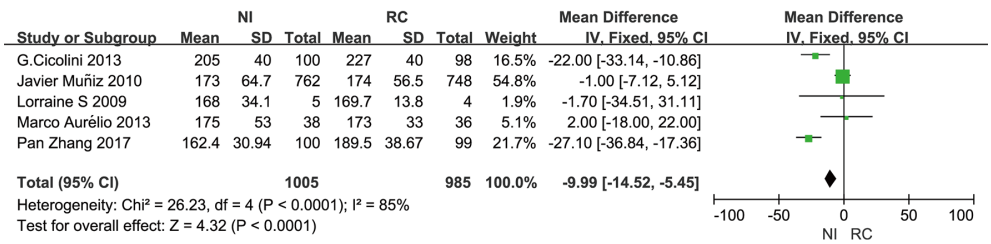

Figure 7 Comparison of total cholesterol between the NI and RC groups. NI, nursing intervention; RC, nursing care.

minimize the stress response of patients.

Similar to our results, Hendriks *et al.* (30) reported differences in various indicators between NI and RC groups (31-33). Results indicated that NI promoted postoperative rehabilitation, reduced blood pressure, blood glucose, total cholesterol, and triglycerides. It would appear from the above results that NI can be safely used in the treatment of most CVDs.

However, the number of CVD treatment protocols using NI remains small, and the NIs applied in current clinical practice are not widely promoted. Furthermore, the clinical research of CVD treatment lacks comprehensive data, and

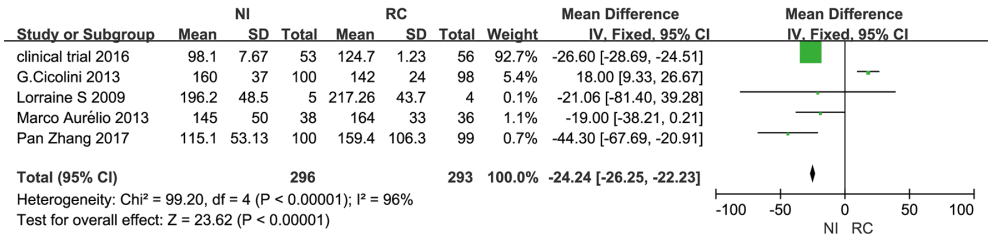

Figure 8 Forest map of triglyceride comparisons between the NI and RC groups. NI, nursing intervention; RC, nursing care.

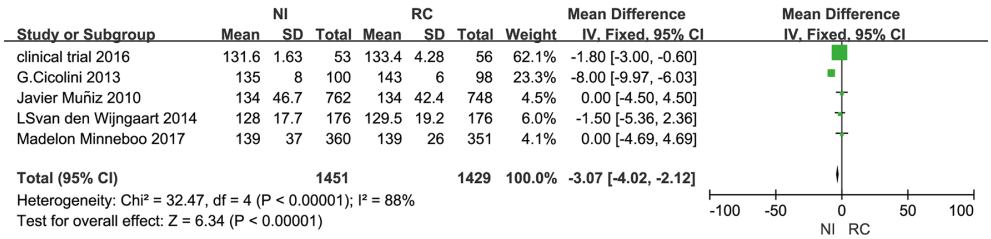

Figure 9 Sensitivity analysis forest map.

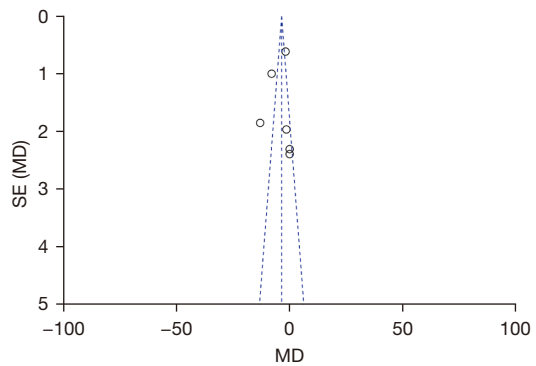

Figure 10 Begg's funnel plot of publication bias.

the number of relevant studies is limited by relatively small case numbers (33-35). In future trials and studies, we need to provide a more reliable theoretical and experimental basis for applying NI during the later stages of CVD treatment.

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Footnote

Reporting Checklist: The authors have completed the PRISMA reporting checklist. Available at https://dx.doi.org/10.21037/apm-21-2189

Conflicts of Interest: Both authors have completed the ICMJE uniform disclosure form (available at https://dx.doi.org/10.21037/apm-21-2189). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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