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The Effect of Trigona Honey as a Therapy for Burns in Rattus Norvegicus

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ABSTRACT

Introduction: Wound healing is an important physiological process to maintain skin integrity after trauma. Contact burns are damage or loss of tissue caused by heat sources. The growing interest in natural therapies has prompted the exploration of trigona honey due to its antioxidant, anti-inflammatory, and antimicrobial properties. Another study discusses trigona honey on an incised wound, but only a few discuss burns. This study evaluates the effectiveness of Trigona spp honey as a therapy for burns in Rattus norvegicus.
Methods: A quasi-experimental with a non-randomized control group pretest-posttest design method. In this study used 20 subjects, there are Rattus norvegicus of the Sprague Dawley strain weighing 100-250 grams and aged 2-3 months, divided into 5 subjects for 4 groups. This study assesses wound size and use one-way ANOVA as the analysis technique.
Result: There is significant wound healing initially in all groups before intervention, average wound area is 3.5 cm. Then treatment was given for 15 days and it was seen that the group with the best wound healing was treatment on group II (Trigona honey 2 g) with an average wound area of 0.42 cm, followed by treatment group I (Trigona honey 1 g) is 0.72 cm, followed by the positive control group (silver sulfadizine 0.5 g) is 0.86 cm and then on negative control group (aquadest) is 1.74 cm. In the one-way ANOVA test, the *P value* (Between Groups) was 0.000 (<5%).
Conclusion: Trigona honey is effective as a therapy for burns in rattus norvegicus.

Keywords: Burns; honey; trigona spp; rattus norvegicus

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Introduction

Wound healing is an important physiological process to maintain the integrity of the skin after trauma. Functional improvement and anatomical continuity are complex dynamic processes in wound healing.[1] Burns are damage or loss of tissue caused by contact with a heat source such as flames, exposure to hot water, contact with hot objects, electric shock, chemicals and sunburn.[2]

Some plants that are useful in burn therapy include: aloe vera, honey, noni leaves, cherry leaves, mangosteen peel, guava leaves, annona leaves, gotu kola herb, seaweed, betel leaves and banana plants. The compounds contained medicinal plants that are useful in accelerating burn wound closure include flavonoids, tannins, saponins, polyphenols, alkaloids, vitamin B, vitamin C, as well as enzymes and amino acids.[3-5]

Honey has been used by humans for a long time, as a mixture of food and drinks as a sweetener and flavoring agent. Since ancient times, honey has been known, for its nutritional value and therapeutic effects.[6] Based on existing studies, honey has been proven to have antioxidant activity because it contains high levels of flavonoids. Other antioxidants contained in honey are protein and amino acids as well as polyphenol group phytochemicals (quercetin-3, caffeic acid, gallic acid, apigenin, cinnamic acid and catechin). Apart from that, honey has also been proven to contain several enzymes, including glucose oxidase and catalase, as well as several vitamins that are important for the body, such as vitamins A, B complex, C and E as antioxidants.[7-10] The reason for carrying out this study is to contribute to *Thibb Al-Nabawi,* which is sourced from the Al-Qur'an in surah An-Nahl [16] verses 68-69.[11] Trigona honey was administered orally to rodents at doses ranging from 1 to 2 g/kg/day as previously used in clinical trials for increasing antioxidant levels. [12,13]

Methods

Study Design

This study is a quasi-experimental, utilizing a non-randomized control group pretest-posttest design method. In this study were used 20 subjects, consisting of Rattus norvegicus of the Sprague Dawley strain weighing 100-250 grams and aged 2-3 months, divided into 5 subjects across 4 groups. This study assessed wound size and used one-way ANOVA as the technique analysis.[14,15]

One-way ANOVA:

Minimum: $n = 10/k + 1$; n= 10/4 + 1 = 3,5

Maximum: $n = 20/k + 1$; n= 20/4 + 1 = 6

Note: k = number of groups

Study Site

This study was conducted from August to October 2024. The location for testing honey's active substances was at Health Laboratory Center South Sulawesi Province and the intervention was carried out at the Animal Laboratory, Faculty of Medicine, Universitas Muslim Indonesia

Materials

This study used a material included trigona honey, silver sulfadiazine ointment, distilled water and lidocaine prilocaine (5%) cream.

Result

The results of the observations are presented in the following table:

Table 1. The size of the burn wound on before and after intervention

Groups	Wound area (pre-intervention) (cm)			Wound area (post-intervention (cm)		
	Lenght	Widht	Wound area	Lenght	widht	Wound area
Treatment Group 1 (Trigona Honey 1 g)	2,1	2	4,2	0,98	0,98	0,96
	2,1	1,8	3,78	0,94	0,89	0,84
	1,8	2,1	3,78	0,93	0,51	0,47
	2	1,9	3,8	0,94	0,79	0,74
	1,8	1,8	3,24	1	0,59	0,59
Treatment Group 2 (Trigona Honey 2 g)	1,8	2	3,6	0,97	1,06	1,03
	2	1,6	3,2	0,97	0,23	0,22
	1,8	1,8	3,24	0,57	0,47	0,27
	1,7	1,6	2,72	0,43	0,53	0,23
	1,8	1,7	3,06	0,74	0,53	0,39
Positive control: Silver Sulfadiazine 0,5 g)	1,9	1,8	3,42	0,88	0,83	0,73
	1,9	1,8	3,42	0,93	0,81	0,75
	2	2	4	0,88	1,16	1,02
	2	1,9	3,8	1,01	0,81	0,82
	1,9	1,9	3,61	0,83	1,23	1,02

	1,9	1,9	3,61	1,33	1,52	2,02
	1,9	2	3,8	1,38	1,3	1,79
Negative control: (Aquadest)	1,9	1,9	3,61	1,39	1,51	2,10
	1,7	1,8	3,06	0,68	1,26	0,86
	1,6	1,9	3,04	1,33	1,45	1,93

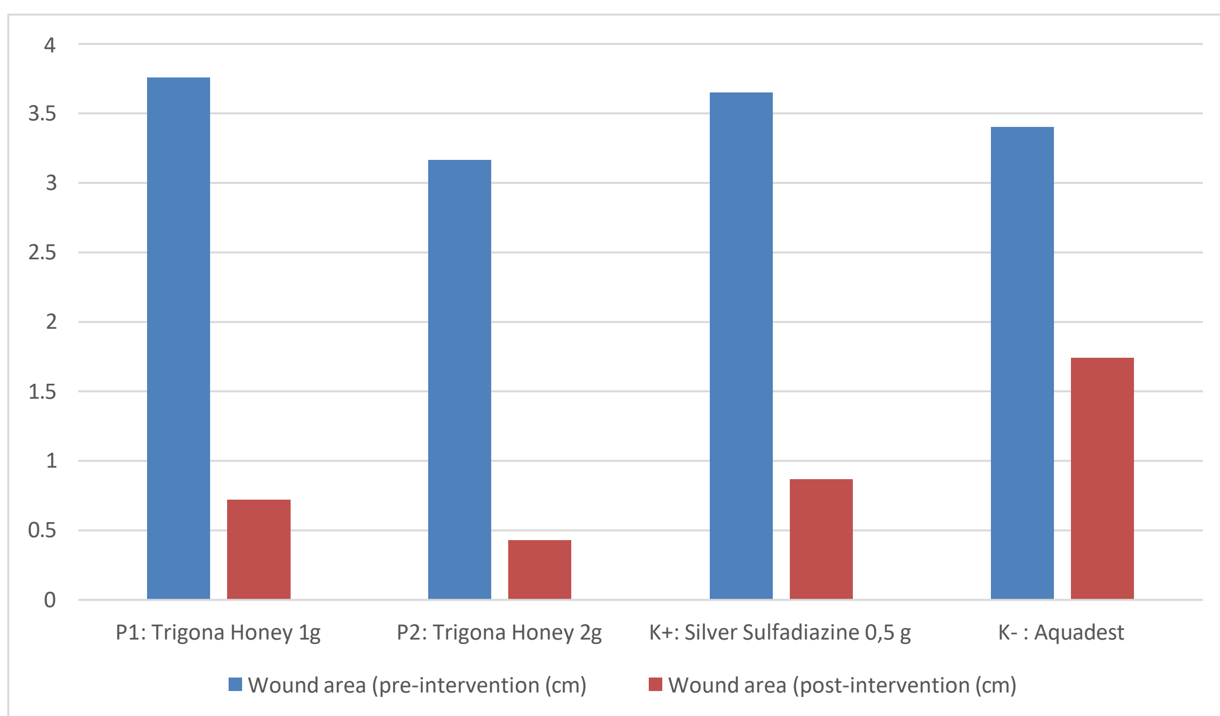

Diagram 1. Average value of burn area at 2 measurement times

The following are the changes in the average burn area in all groups at pre- and post-intervention. In the 2-gram per day honey group, the pre-intervention was 3.7 cm, while the post-intervention was 0.4 cm, resulting in burn healing of around 3.3 cm. In the 1-gram per day honey group, the pre-intervention was 3.1 cm, while the post-intervention was 0.7 cm, resulting in burn healing of around 2.4 cm. In the positive control group, the pre-intervention was 3.6 cm, while the post-intervention was 0.8 cm, resulting in burn healing of around 2.8 cm. In the negative control group, the pre-intervention was 3.4 cm, while the post-intervention was 1.7 cm, resulting in a burn healing of around 1.7 cm. If ranked, the average healing area from the best is the 2-gram honey group, followed by the positive control group (silver sulfadiazine), then the 1-gram honey group, and finally the negative control group (aquadest).

Table 2. Descriptive; Wound Area (Post-Intervention)

Groups	N	Mean	Std. Deviation	Std. Error	Lower Bound	Upper Bound	Minimum	Maximum
Trigona Honey 1 g	5	0,7200	0,19481	0,08712	0,4781	0,9619	0,47	0,96
Trigona Honey 2 g	5	0,4280	0,34325	0,15351	0,0018	0,8542	0,22	1,03
Positive control (silver sulfadiazine 0,5 g)	5	0,8680	0,14272	0,06383	0,6908	1,0452	0,73	1,02
Negative control (aquadest)	5	1,7400	0,50522	0,22594	1,1127	2,3673	0,86	2,10
Total	20	0,9390	0,58509	0,13083	0,6652	1,2128	0,22	2,10

Table 3. Test of Within-Subjects Effects

Measure: Wound Area

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
Time	Sphericity Assumed	65,556	1	65,556	369,165	0,000
	Greenhouse-Geisser	65,556	1,000	65,556	369,165	0,000
	Huyn-Feldt	65,556	1,000	65,556	369,165	0,000
	Lower Bound	65,556	1,000	65,556	369,165	0,000

Based on the repeated-ANOVA statistical test, the P value obtained for Greenhouse-Geisser = 0.000, it can be concluded that there is a significant difference at 2 different measurement times (before and after intervention).

Table 4. Wound Area (Post-Intervention)

	Sum of Squares	df	Mean Square	F	Sig.

Between Groups	4,779	3	1,593	14,770	0,000
Within Groups	1,726	16	0,108		
Total	6,504	19			

Followed by a one-way ANOVA test on measuring the area of burns after intervention to see the differences between the treatment group and the control group, in Between Groups the P value was 0.000 (<0.05) so it could be concluded that Trigona Spp Honey. effective as a burn therapy.

Table 5. Post Hoc Tests (Multiple Comparisons)
Dependent Variable: **Wound Area (Post-Intervention)**

Turkey HSD

(I) Groups	(J) Groups	Mean Difference (I-J)	Std. Error	Sig.	Lower Bound	Upper Bound
Trigona Honey 1 g	Trigona Honey 2 g	0,29200	0,20770	0,514	-0,3022	0,8862
	Positive control	-0,14800	0,20770	0,891	-0,7422	0,4462
	Negative control	-1,02000*	0,20770	0,001	-1,6142	-0,4258
Trigona Honey 2 g	Trigona Honey 1 g	-0,29200	0,20770	0,514	-0,8862	0,3022
	Positive control	-0,44000	0,20770	0,189	-1,0342	0,1542
	Negative control	-1,31200*	0,20770	0,000	-1,9062	-0,7178
Positive control	Trigona Honey 1 g	0,14800	0,20770	0,891	-0,4462	0,7422
	Trigona Honey 2 g	0,44000	0,20770	0,189	-0,1542	1,0342
	Negative control	-0,87200*	0,20770	0,003	-1,4662	-0,2778
Negative control	Trigona Honey 1 g	1,02000*	0,20770	0,001	0,4258	1,6142
	Trigona Honey 2 g	1,31200*	0,20770	0,000	0,7178	1,9062
	Positive control	0,87200*	0,20770	0,003	0,2778	1,4662

The difference in group averages can be seen in the Multiple Comparisons table (by looking at the * sign), the improvement in the area of burns in the Treatment group 1 is significantly different from negative controls group, the improvement in the area of burns in the Treatment group 2 is significantly different from negative controls group, the improvement in the area of burns Positive controls group is significantly different from negative controls group and negative controls group is significantly different from all groups. Statistically, the mean difference between groups 1 and 2 was not significantly different (p=0.514). This means that administering 1 g and 2 g had the same effect.

Figure 1. The process of shaving, cleaning and administering topical anesthesia (lidocaine prilocaine 5%)

Figure 2. Preparation for the induction of burns using a metal plate

Figure 3. Measuring the area of burns before administering honey and silver sulfadiazine intervention

Figure 4. The process of treating burns using honey and also silver sulfadiazine ointment

Figure 5. Measurement of burns after administering honey intervention and silver sulfadiazine ointment

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LAPORAN HASIL UJI
Report of Analysis
No : 24018924 / LHU / BBLK-MKS / VII / 2024

Nama Customer / *Customer Name* : dr. NUR FADHILLAH KHALID M. BIOMED
Alamat / *Address* : BTN Minasa Upa D 11/4
Jenis Sampel / *Type of Sample (S)* : Madu Trigona
No. Sampel / *No. Sample* : 24018924
Tanggal Penerimaan / *Received Date* : 18 Juli 2024 / *July 18, 2024*
Tanggal Pengujian / *Test Date* : 18 Juli 2024 s/d 24 Juli 2024 / *July 18, 2024 to July 24, 2024*

HASIL PEMERIKSAAN

No / *No*	Parameter / *Parameters*	Satuan / *Units*	Hasil Pemeriksaan / *Test Result*	Spesifikasi Metode / *Method Specification*
1	Flavonoid	mg/kg	149,35	Spektrofotometrik
2	Polifenol	mg/kg	405,73	Spektrofotometrik
3	Alkaloid	mg/kg	123,54	Spektrofotometrik
4	Vitamin A	mg/L	< 0,04	Spektrofotometrik
5	Vitamin C	mg/kg	400,89	Spektrofotometrik
6	Calsium (Ca)	mg/L	61,86	AAS
7	Kalium (K)	mg/L	33,45	AAS

Catatan / *Note* :
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NIP : 19830228201012001

DP/084/BBLKM - Mks; Rev 3, 15 Februari 2024

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LAPORAN HASIL UJI
Report of Analysis
No : 24018924 / LHU / BBLK-MKS / VII / 2024

Nama Customer / *Customer Name* : dr. NUR FADHILLAH KHALID M. BIOMED
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HASIL PEMERIKSAAN

No / *No*	Parameter / *Parameters*	Satuan / *Units*	Hasil Pemeriksaan / *Test Result*	Spesifikasi Metode / *Method Specification*
1	pH	-	4,22	IKM/KKT/149/BBLKM-MKS
2	Besi (Fe)	mg/L	2,6184	SM APHA 23rd Ed.,3111 B, 2017
3	Mangan (Mn)	mg/L	4,6085	SM APHA 23rd Ed.,3111 B, 2017
4	Seng (Zn)	mg/L	0,7412	SM APHA 23rd Ed.,3111 B, 2017

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NIP : 19830228201012001

DP/084/BBLKM - Mks; Rev 3, 15 Februari 2024

Figure 6. Examination nutritional contents of Trigona honey Spp.

Discussion

Trigona honey has various active substances that are beneficial for health. The following is the

composition and characteristics of honey which play a role in wound healing, including, flavonoids have antioxidant, anti-inflammatory and antimicrobial activity. Phenolic acid have antioxidant and antimicrobial activity. Amino acids have anti-inflammatory activity. Vitamins A, C and E have antioxidant activity. The sugar content (fructose, glucose and sucrose) is related to osmolality, the osmotic effect causes drainage of lymph fluid. Besides that, pH (degree of acidity) is < 4, the acidic nature of honey causes more oxygen supply from the circulation. And enzymes content (glucose oxidase and catalase), these enzymes are naturally produced by bees in making honey which is useful as an antibacterial. [6,7,9,12-15]

In Hendy & Lister's (2019) research entitled Level of Effectiveness in Healing Grade IIA Burns by Giving Honey and Nebacetin Ointment to White Rats (Rattus Norvegicus), the results showed that honey was effective in healing burns. This is shown by the results of wound healing in the group given honey once a day which healed in 7 days, given honey three times a day healed in 10 days, the group given topical nebacetin gel once healed in 9 days and in the control group healed in 13 days. This study is in line with the results of our study that honey is effective in healing wounds.[18]

The antioxidant and anti-inflammatory effects work by accelerating the rate of healing and modulating the immune response, increasing granulation tissue and epithelialization, reducing the amount of exudate and sterilizing wounds, stimulating leukocytes to release cytokines and growth factors needed for tissue repair and disrupting the process of inflammatory amplification by ROS (reactive oxidative stress). Then for the antimicrobial effect, honey has broad spectrum performance (honey is able to inhibit the growth of gram-positive or negative germs, as well as aerobic or anaerobic germs), effective against germs that are resistant to antibiotics such as Pseudomonas, MRSA (methicillin-resistant Staphylococcus aureus), coagulase negative Staphylococci, VRE (vancomycin-resistant Enterococci), Acinetobacter baumannii, and Stenotrophomonas maltophilia. Apart from that, honey also has other advantages compared to antibiotics that there is no decrease in bacterial sensitivity to honey after long-term use and it is effective against bacteria hidden in biofilms so honey is known to have anti-resistance. Due to the high sugar content in honey (Fructose, Glucose and Sucrose) it causes an increase in osmolarity which will attract bacterial intracellular fluid, so that ultimately plasmolysis occurs. The content of hydrogen peroxide, a chemical compound that is formed slowly by the enzyme glucose oxidase, which is naturally added by bees during honey production, is also useful as an antibacterial.[19-21]

The positive control active substance that we use is silver sulfadiazine, which is a sulfonamide and has broad antimicrobial activity. This drug acts on the cell walls and membranes of gram-positive and gram-negative bacteria. Apart from that, sulfadiazine is also effective as an antifungal. Silver sulfadiazine acts bactericidally by increasing cell wall permeability through interference with DNA replication, direct modification of cell membrane lipids, and/or the formation of free radicals. The mechanism of action of this drug is to release silver ions, slowly and in a controlled manner, when interacting with body fluids containing sodium chloride in the wound area. Then, the ionized silver atoms will accelerate the formation of disulfide

bonds, change protein structure, and inactivate thiol-containing enzymes. Silver ions can also change DNA, there by interfering with bacterial replication and transcription. Silver is a biocide that can bind to a fairly broad target. Silver ions can bind to nucleophilic amino acids, causing denaturation and enzyme inhibition. With this mechanism, silver ions will bind to the membrane surface and proteins, and cause proton leakage in the membrane. This will result in cellular death.[22-27]

Sulfadiazine is a competitive inhibitor of paraaminobenzoic acid (PABA) bacteria. Inhibited PABA will inhibit bacterial dihydropteroate synthesis, the ability of bacteria to form folic acid which is useful for DNA synthesis, so the bacteria will die. Silver sulfadiazine is useful for treating infections caused by burns, decubitus ulcers and wounds that occur due to injuries to the fingertips or abrasions. The results of this experiment are that silver sulfadiazine is also effective in healing burns due to the mechanism of action that has been explained. [22-27]

Conclusion

The findings of this study confirm that Trigona spp. honey. effective as a burn wound therapy in white Sprague Dawley rats. Flavonoid, phenolic acid, amino acids, vitamins A,C,E, enzymes (glucose oxidase and catalase), characteristic of pH<4, sugar content (fructose, glucose and sucrose), and minerals contribute to faster wound closure with mechanism of action as antioxidant, anti-inflammatory, and antimicrobial. Future studies should explore the long-term effects of Trigona spp. honey, evaluate the efficacy dan adds another parameter to see the wound healing.

Conflicts of Interest

There is no conflict of interest.

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Association of Hyperuricemia with Hypertension in Adult without Major Metabolic Comorbidities

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ABSTRACT

Introduction: Hypertension is a major global health problem and a leading cause of cardiovascular morbidity and mortality. Hyperuricemia has been increasingly recognized as a potential metabolic factor associated with elevated blood pressure, although its independent role remains unclear, particularly in individuals without obesity, diabetes mellitus, or chronic kidney disease (CKD).
Methods: Hypertension is a major global health problem and a leading cause of cardiovascular morbidity and mortality. Hyperuricemia has been increasingly recognized as a potential metabolic factor associated with elevated blood pressure, although its independent role remains unclear, particularly in individuals without obesity, diabetes mellitus, or chronic kidney disease (CKD).
Result: Hypertension occurred in 72.5% of participants with hyperuricemia compared with 25.0% without hyperuricemia. Hyperuricemia was significantly associated with hypertension ($p < 0.001$; contingency coefficient = 0.429). Participants with hyperuricemia had a 2.91-fold higher risk of hypertension (RR = 2.91; 95% CI: 1.64–5.13). This association persisted across age groups, with RR = 2.41 (95% CI: 1.31–4.44) in participants aged <60 years and RR = 3.73 (95% CI: 1.25–11.16) in those aged ≥ 60 years.
Conclusion: Hyperuricemia was associated with an increased risk of hypertension independent of major metabolic comorbidities and age, suggesting its potential role as an additional metabolic risk factor for hypertension.

Keywords: Hyperuricemia; hypertension; uric acid serum; metabolic risk factor

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Introduction

Hypertension remains a major global health problem and is a leading contributor to cardiovascular morbidity and mortality(1). It is often referred to as a silent killer because it may progress without specific symptoms and is frequently diagnosed only after target organ damage occurs. Numerous risk factors have been implicated in the development of hypertension, including age, sex, genetic predisposition, smoking habits, body mass index, and metabolic disorders such as diabetes mellitus and obesity(2).

In addition to these well-established risk factors, hyperuricemia has increasingly attracted attention as a metabolic condition potentially associated with elevated blood pressure(3,4). Uric acid exerts antioxidant effects at physiological concentrations; however, at elevated levels, it may act as a pro-oxidant, promoting oxidative stress, endothelial dysfunction, and vascular inflammation. These mechanisms are believed to contribute to increased peripheral vascular resistance and activation of the renin-angiotensin system (RAS), both of which play important roles in the pathogenesis of hypertension(5,6).

Previous studies have demonstrated an association between hyperuricemia and hypertension(7,8). Nevertheless, many of these studies were conducted in populations with major metabolic comorbidities, particularly obesity, which is a strong and independent risk factor for hypertension. Obesity may confound the assessment of the role of hyperuricemia, making it difficult to determine whether elevated uric acid levels contribute independently to the development of hypertension(9,10). Furthermore, several studies have focused primarily on statistical significance without emphasizing the quantitative risk estimation.

Therefore, studies evaluating the association between hyperuricemia and hypertension in non-obese populations are limited. Assessing this relationship in a non-obese population may provide a clearer understanding of the contribution of hyperuricemia within the context of other classical risk factors, such as smoking, genetic predisposition, and variations in body mass index(9). In addition, the use of medical record–based data reflects real-world clinical conditions in which hyperuricemia is frequently encountered in routine healthcare settings.

This study aimed to assess the relative risk of hyperuricemia for the occurrence of hypertension in a non-obese clinical population at Sultan Agung Islamic Hospital, Semarang, using medical record data from 2016 to 2020. The findings of this study are expected to clarify the role of hyperuricemia as an additional risk marker for hypertension and support early screening and preventive strategies for hypertension in clinical practice.

Methods

Study Design and Ethical Approval

This study employed an analytic observational design with a retrospective cohort approach using medical record data from Sultan Agung Islamic Hospital, Semarang, which were collected between 2016 and 2020. Ethical approval for this study was obtained from the Health Research Ethics Committee of Sultan Agung Islamic Hospital (approval no. 55/EC/KEPK/2020).

Study Population

The target population consisted of both inpatients and outpatients at Sultan Agung Islamic Hospital who presented with joint pain. The accessible population included patients with and without hyperuricemia whose blood pressure measurements were recorded in the hospital medical records during the study period (2016–2020).

Sampling Technique

Sampling was performed using a consecutive sampling method, in which all patients who met the eligibility criteria were included sequentially until the required sample size was reached.

Inclusion and Exclusion Criteria

The inclusion criteria were patients aged ≥18 years with a documented history of hypertension or without hypertension. The exclusion criteria were coronary heart disease, obesity, diabetes mellitus, chronic kidney disease, and incomplete medical record data. Obesity was defined as a body mass index (BMI) of ≥30 kg/m^2.

Data Collection

Data collection was conducted between October and December 2020. Relevant variables, including hyperuricemia status and blood pressure measurements, were obtained from medical records. The collected data were reviewed for completeness, coded, tabulated, and entered into the Statistical Package for the Social Sciences (SPSS) software for analysis.

Statistical Analysis

Statistical analyses were performed using IBM SPSS Statistics for Windows, version 25.0 (IBM Corp., Armonk, NY, USA). The association between hyperuricemia and hypertension was analyzed using the non-parametric Contingency Coefficient test. Statistical significance was determined based on the Approximate Significance (Approx. Sig.) Statistical significance was set at $p < 0.05$.

Potential confounding factors were minimized through restriction at the study design stage by excluding participants with obesity, diabetes mellitus, chronic kidney disease, a smoking history, and a family history of hypertension. For non-modifiable risk factors that could not be equally distributed between the study groups, particularly age, an additional stratified analysis was conducted to evaluate the association between hyperuricemia and hypertension across age categories (<60 and ≥60 years).

Result

Eighty participants were included in the analysis. The baseline characteristics of the study population according to hyperuricemia status are presented in **Table 1**. Among participants with hyperuricemia (n = 40), the mean age was 54.4 ± 12.2 years, whereas participants without hyperuricemia had a mean age of 41.5 ± 13.5 years. Participants aged ≥60 years constituted 35.0% of the hyperuricemia group compared with 12.5% of the non-hyperuricemia group, indicating a higher proportion of older adults among those with hyperuricemia.

The mean body mass index was comparable between the two groups, with values of 21.78 ± 2.18 kg/m² in the hyperuricemia group and 21.70 ± 2.42 kg/m² in the non-hyperuricemia group. All participants were classified as non-obese (BMI <30 kg/m²). Male participants predominated in both groups, accounting for 70.0% of the hyperuricemia group and 52.5% of non-hyperuricemiacemia group. No participant in either group was diagnosed with diabetes mellitus or chronic kidney disease, indicating a relatively homogeneous metabolic profile of the study population.

Table 1. Baseline Characteristics of Study Participants (n = 80)

Variable	Hyperuricemia (n=40)	Non-hyperuricemia (n=40)
Age (years)	54.4 ± 12.2	41.5 ± 13.5
Age <60 years	26 (65.0%)	35 (87.5%)
Age ≥60 years	14 (35.0%)	5 (12.5%)
BMI (kg/m²)	21.78 ± 2.18	21.70 ± 2.42
Sex		
Male	28 (70.0%)	21 (52.5%)
Female	12 (30.0%)	19 (47.5%)
Hypertension		
Yes	29 (72.5%)	10 (25.0%)
No	11 (27.5%)	30 (75.0%)
Diabetes Mellitus		
No	40 (100%)	40 (100%)

Chronic Kidney Disease		
No	40 (100%)	40 (100%)
Smoking History		
No	40 (100%)	40 (100%)
Family history of hypertension		
No	40 (100%)	40 (100%)

Data are presented as mean ± standard deviation or numbers (percentages). All participants had a normal body mass index (BMI <30 kg/m²). None of the participants had diabetes mellitus, chronic kidney disease, a smoking history, or a family history of hypertension.

The association between hyperuricemia and hypertension is presented in **Table 2**. Among participants with hyperuricemia, hypertension was observed in 29 individuals (72.5%), while 11 (27.5%) were normotensive. In contrast, among participants without hyperuricemia, hypertension was present in 10 individuals (25.0%), whereas 30 individuals (75.0%) were hypertensive. Statistical analysis demonstrated a significant association between hyperuricemia and hypertension ($P < 0.001$). The contingency coefficient value of 0.429 indicates a moderate positive association between hyperuricemia and hypertension. Relative risk analysis showed that participants with hyperuricemia had a 2.91-fold higher risk of hypertension than those without hyperuricemia (RR = 2.91; 95% CI: 1.64–5.13).

Table 2. Association Between Hyperuricemia and Hypertension

		Hypertension n (%)	Normotension n (%)	Total n (%)	CC value	p-value	RR (95% CI)
Hyperuricemia	Yes	29 (36.3)	11 (13.8)	40 (50.0)	0.429	<0.001	2.91 (1.64–5.13)
	No	10 (12.5)	30 (37.5)	40 (50.0)			

CC: Contingency Coefficient.

To further evaluate the potential influence of age on the association between hyperuricemia and hypertension, a stratified analysis by age group was performed (Table 3). Among participants aged <60 years, hypertension was observed in 18 of 26 participants (69.2%) with hyperuricemia compared with 9 of 35 participants (25.7%) without hyperuricemia, corresponding to a relative risk of 2.41 (95% CI: 1.31–4.44).

Table 3. Stratified Analysis of the Association Between Hyperuricemia and Hypertension by Age Group

Age Group	Hyperuricemia with Hypertension n/N (%)	Non-hyperuricemia with Hypertension n/N (%)	RR	95% CI
< 60 years	18/26 (69.2%)	9/35 (25.7%)	2.41	1.31–4.44
≥ 60 years	11/14 (78.6%)	1/5 (20.0%)	3.73	1.25–11.16

In the elderly group (≥60 years), hypertension was observed in 11 of 14 participants (78.6%) with

hyperuricemia, whereas only one of five participants (20.0%) without hyperuricemia had hypertension. The relative risk of hypertension associated with hyperuricemia in this age group was 3.73 (95% CI: 1.25–11.16). Overall, the stratified analysis demonstrated that the association between hyperuricemia and hypertension persisted across both age groups.

Discussion

The present study identified an association between hyperuricemia and hypertension in a non-obese population without diabetes mellitus or chronic kidney disease. By restricting the study population to individuals without major metabolic comorbidities, this study aimed to minimize the influence of well-established risk factors and better elucidate the role of hyperuricemia in relation to hypertension.

This association is consistent with previous epidemiological studies that reported a relationship between elevated serum uric acid levels and hypertension. Fuchs et al. demonstrated that higher uric acid levels were associated with an increased risk of hypertension, while Thangadurai et al. reported a high prevalence of hyperuricemia among hypertensive adults, suggesting a close link between these conditions across different populations(9,11). More recent clinical studies have also shown significant correlations between serum uric acid levels and both systolic and diastolic blood pressure, supporting the concept that hyperuricemia is an emerging metabolic factor associated with blood pressure elevation(7).

Several biological mechanisms may explain the association between hyperuricemia and hypertension. At elevated concentrations, uric acid may act as a pro-oxidant, promoting oxidative stress and endothelial dysfunction(2,12). Increased production of reactive oxygen species reduces nitric oxide bioavailability, resulting in impaired vasodilation and increased peripheral vascular resistance. In addition, hyperuricemia has been shown to stimulates smooth vascular muscle cell proliferation through the activation of mitogen-activated protein kinase pathways and platelet-derived growth factors, contributing to vascular remodeling and arterial stiffness(6,13). These vascular changes are key contributors to the development and persistence of hypertension.

Hyperuricemia may also affect blood pressure regulation via renal mechanisms. Experimental studies have demonstrated that elevated uric acid levels can induce renal microvascular injury, leading to impaired sodium handling and increased salt sensitivity(14,15). Activation of the renin–angiotensin system and upregulation of inflammatory mediators, such as cyclooxygenase-2, further contribute to sustained increases in blood pressure. These renal and vascular mechanisms provide a plausible pathophysiological basis for the association observed in the present study, even in the absence of overt chronic kidney disease(16,17).

Stratified analysis by age showed that the association between hyperuricemia and hypertension persisted in both younger and older participants. This finding suggests that the observed relationship is

not solely explained by age, a well-known, non-modifiable risk factor for hypertension. Although the relative risk appeared higher among elderly participants, the wider confidence interval in this group indicates limited precision due to the smaller sample size and warrants a cautious interpretation. Nevertheless, the persistence of the association across age strata supports the robustness of these findings.

In this study, hypertension was more frequently observed among male participants, which is in line with previous reports that indicated a higher prevalence of hypertension in men than in women. Sex-related differences in lifestyle factors, occupational stress, and hormonal influences may contribute to these patterns. Estrogen exerts protective effects on vascular function in premenopausal women, whereas estrogen deficiency after menopause may increase susceptibility to blood pressure elevation. However, smoking status and family history of hypertension were absent in the study population, reducing the potential confounding effects.

Several limitations should be acknowledged when interpreting the results of this study. The retrospective approach and reliance on secondary medical record data restricted the evaluation of several variables, including dietary habits, physical activity levels, and psychosocial stress. Furthermore, the relatively limited number of participants may reduce the broader applicability of these findings. In addition, serum uric acid levels were classified into categories rather than analyzed as continuous values, which made it impossible to evaluate the potential dose–response relationship. Nevertheless, the application of restriction and stratified analyses helped improve the internal validity of the study by reducing the potential impact of major confounding variables.

In conclusion, this study provides evidence of an association between hyperuricemia and hypertension in a nonobese population without major metabolic comorbidities. These findings support the consideration of hyperuricemia as an additional metabolic factor associated with hypertension and highlight the potential value of early identification and monitoring of elevated uric acid levels in clinical practice.

Conclusion

This study demonstrated that hyperuricemia was associated with an increased risk of hypertension in a nonobese clinical population without diabetes mellitus or chronic kidney disease. This association remained evident after age stratification, suggesting that the relationship between hyperuricemia and hypertension was not solely explained by age. These findings support the consideration of hyperuricemia as an additional metabolic factor associated with hypertension. Further studies with larger sizes and prospective designs in non-obese populations are warranted to elucidate the causal relationship and the role of serum uric acid in the prevention and management of hypertension.

Conflicts of Interest

There is no conflict of interest.

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Spirometry-Based Screening for Pulmonary Function Abnormalities in Dukuh Kupang: A Pilot Cross-Sectional Study

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ABSTRACT

Introduction: Pulmonary function abnormalities are often underrecognized in the community, particularly in their early stages. This pilot study aimed to describe spirometry findings in a community setting and examine their associations with age, sex, body mass index (BMI), and smoking history.
Methods: A pilot cross-sectional study was conducted among residents of Dukuh Kupang, Surabaya, during a community-based spirometry program. Fifty-eight participants were recruited consecutively. Variables included age group, sex, BMI category, smoking history, and spirometry results (normal, obstructive, restrictive, or mixed), which were further classified as normal versus abnormal. Data were obtained through structured interviews, anthropometric measurements, and spirometry testing. Associations were analyzed using the chi-square or Fisher–Freeman–Halton test, as appropriate.
Result: Abnormal spirometry findings were identified in 32 of 58 participants (55.2%). Obstructive patterns were found in 36.2%, restrictive patterns in 13.8%, and mixed patterns in 5.2%. Abnormal results were significantly associated with age ($p < 0.001$), sex ($p < 0.001$), smoking history ($p < 0.001$), and BMI category ($p = 0.009$).
Conclusion: This pilot community-based study identified a substantial proportion of pulmonary function abnormalities among residents of Dukuh Kupang, Surabaya. The findings support the potential value of spirometry as an early community-level tool for identifying pulmonary function abnormalities and informing targeted respiratory health strategies and follow-up planning.

Keywords: Community-based screening; pulmonary function abnormalities; spirometry

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Introduction

Chronic respiratory diseases, including chronic obstructive pulmonary disease (COPD), asthma, interstitial lung disease, post-infectious sequelae, and environmentally or occupationally related lung disorders, continue to impose a substantial burden on global health [1]. These conditions may lead to measurable abnormalities in pulmonary function, which can be identified by spirometry as obstructive, restrictive, or mixed ventilatory patterns, sometimes even before overt clinical symptoms become apparent [2]. Recent global statistics indicate that chronic respiratory diseases affected 468.3 million individuals in 2021, while asthma affected approximately 262 million people and COPD accounted for 3.5 million deaths worldwide [3,4].

The decline in pulmonary function and the development of chronic respiratory disease are shaped by the cumulative and interacting effects of multiple risk factors, particularly tobacco use, indoor and outdoor air pollution, household biomass smoke, and occupational exposure to dust, fumes, and chemical vapors, as well as age, body mass index (BMI), and sex [5]. Among these, tobacco exposure remains a major concern, especially in low- and middle-income countries. Globally, approximately 1.25 billion adults continue to use tobacco [6,7]. In Indonesia, tobacco exposure also remains substantial, with 70.2 million adults reported to use tobacco, while daily smoking among individuals aged ≥15 years remains common [8]. In such settings, objective pulmonary health assessment at the community level becomes increasingly relevant, and spirometry may help identify individuals with pulmonary function abnormalities at an earlier stage.

Despite the established role of spirometry in respiratory assessment, community-based data describing spirometric patterns and their associations with commonly encountered individual characteristics remain limited. In particular, evidence from local community settings is still insufficient regarding how spirometry findings are distributed according to age, sex, BMI, and smoking history. Such information is important for informing targeted early detection strategies and referral pathways. Therefore, this pilot cross-sectional study aimed to map the distribution of spirometry findings (normal, obstructive, restrictive, and mixed patterns) in a community setting and to examine their associations with age, sex, BMI category, and smoking history. We hypothesized that community-based spirometry screening would identify pulmonary function abnormalities and that the distribution of spirometric patterns would vary according to these individual characteristics. The findings are expected to provide preliminary evidence to support future larger-scale studies and to inform community-based respiratory health interventions.

Methods

This pilot cross-sectional study was conducted in Dukuh Kupang, Surabaya, Indonesia, to obtain a preliminary overview of the distribution of pulmonary function patterns based on spirometry findings in a community setting. The study was reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines [(9)].

The target population comprised residents of Dukuh Kupang, Surabaya, who participated in the community screening program. Participants were eligible if they were aged ≥18 years, were able to understand instructions and perform spirometry maneuvers cooperatively, and provided written informed consent before examination. Participants were excluded if they had significant acute respiratory infection or symptoms at the time of screening, contraindications to spirometry, or were unable to produce acceptable and repeatable spirometry maneuvers despite repeated instruction. Spirometry procedures, maneuver quality criteria, and quality assurance were conducted in accordance with the 2019 American Thoracic Society (ATS) and European Respiratory Society (ERS) technical standards [(10)].

Participants were recruited consecutively during the community-based screening program until the required sample size was reached. The minimum sample size was estimated using the formula for proportions in prevalence studies [(11)], assuming a 95% confidence level (Z = 1.96), an expected proportion (p) of 0.50, and an absolute precision (d) of 0.13:

$$n = \frac{Z^2 \times p(1-p)}{d^2}$$

$$Z^2 = 1{,}96^2 = 3{,}8416$$

$$p(1-p) = 0{,}5(1-0{,}5) = 0{,}25$$

$$d^2 = 0{,}13^2 = 0{,}0169$$

$$n = \frac{3{,}8416 \times 0{,}25}{0{,}0169} = 56{,}8 \approx 57$$

The minimum required sample size was 57 participants; 58 participants were ultimately included in the study.

Age was categorized into four groups: <20 years, 20–39 years, 40–59 years, and ≥60 years. Sex was classified as male or female. Body mass index (BMI) was categorized as underweight, normal, overweight, or obese. Smoking history was classified dichotomously as yes or no. The primary outcome was spirometry result category, defined as normal, obstructive, restrictive, or mixed. Based on the ERS/ATS interpretative strategy, an obstructive pattern was defined by a reduced ratio of forced expiratory volume in 1 second (FEV_1) to forced vital capacity (FVC) below the lower limit of normal (LLN); a restrictive pattern was defined by FVC below the LLN with a preserved FEV_1/FVC ratio; and

a mixed pattern was defined by both a reduced FEV_1/FVC ratio and FVC below the LLN. A restrictive pattern on spirometry was interpreted as presumptive, as definitive confirmation requires measurement of total lung capacity (TLC).

Data were collected through structured interviews, anthropometric measurements, and spirometry testing performed on the same day. Demographic variables included age and sex. Smoking history was recorded as a dichotomous variable, with "yes" indicating current or former smoking and "no" indicating never-smoking. Body weight and height were measured using calibrated instruments, and BMI was calculated as weight in kilograms divided by height in meters squared (kg/m^2). BMI categories followed the 2023 Indonesian Health Survey (SKI) criteria for adults: underweight (<18.5), normal (18.5–<25.0), overweight (25.0–<27.0), and obese (≥27.0). Spirometry was performed by trained personnel according to ATS/ERS standards. Recorded parameters included FEV_1, FVC, and the FEV_1/FVC ratio. Spirometry results were interpreted using the Global Lung Function Initiative (GLI) 2012 all-age, multi-ethnic reference equations and LLN-based z-score criteria [12].

Data analysis was performed using IBM SPSS Statistics. All variables were categorical and were summarized as frequencies and percentages. Descriptive analyses were conducted for participant characteristics and spirometry result categories. Associations between participant characteristics (age, sex, BMI category, and smoking history) and spirometry results were assessed using the chi-square test or Fisher–Freeman–Halton exact test, as appropriate. A p-value <0.05 was considered statistically significant.

All participants received an explanation of the study objectives, procedures, potential benefits, and minimal risks before participation. Written informed consent was obtained from all eligible participants. Individuals with abnormal spirometry findings received brief counseling and were referred to an appropriate healthcare facility for further clinical evaluation when indicated.

Result

A total of 58 participants were included in the analysis (Table 1). The age distribution showed that individuals aged ≥60 years constituted the largest proportion, with 21 participants (36.2%), followed by those aged 40–59 years (16 participants; 27.6%), 20–39 years (12 participants; 20.7%), and <20 years (9 participants; 15.5%). By sex, the sample was predominantly male (38 participants; 65.5%), while 20 participants (34.5%) were female.

According to BMI categories, obesity represented the highest proportion (18 participants; 31.0%), followed by overweight (16 participants; 27.6%), normal BMI (15 participants; 25.9%), and underweight (9 participants; 15.5%). A history of smoking was reported by 33 participants (56.9%), whereas 25 participants (43.1%) had never smoked. Spirometry results indicated that 26 of 58 participants (44.8%)

had normal findings, while 32 of 58 (55.2%) demonstrated pulmonary function abnormalities, consisting of obstructive patterns (21/58; 36.2%), restrictive patterns (8/58; 13.8%), and mixed patterns (3/58; 5.2%).

Table 1. Screening sample characteristics (N = 58)

Variable	Category	n (%)
Age group	< 20	9 (15.5)
	20-39	12 (20.7)
	40-59	16 (27.6)
	≥60	21 (36.2)
Sex	Female	20 (34.5)
	Male	38 (65.5)
Body Mass Index	Underweight	9 (15.5)
	Normal	15 (25.9)
	Overweight	16 (27.6)
	Obese	18 (31.0)
History of smoking	No	25 (43.1)
	Yes	33 (56.9)
Spirometry result	Normal	26 (44.8)
	Obstructive	21 (36.2)
	Restrictive	8 (13.8)
	Mixed	3 (5.2)

Bivariate analysis demonstrated significant differences in the proportion of abnormal spirometry results (obstructive, restrictive, and mixed patterns) across age groups, sex, smoking history, and BMI categories (Table 2). The proportion of abnormal spirometry increased progressively with age, from 0.0% in the <20-year group to 33.3% in those aged 20–39 years, 68.8% in the 40–59-year group, and 81.0% among participants aged ≥60 years. These patterns are further illustrated in Figures 1–4. As shown in Figure 1, the proportion of abnormal spirometry increased across older age groups. Figure 2 demonstrates a higher frequency of abnormal findings among males, while Figure 3 shows a corresponding increase across higher BMI categories. Figure 4 further highlights the greater proportion of abnormal spirometry among participants with a history of smoking.

Moreover, as several cells had expected counts <5, the association between age group and spirometry status was analyzed using the Fisher–Freeman–Halton exact test, revealing a highly significant association

($p < 0.001$) with a strong effect size (Cramer's V = 0.591).

Table 2. Bivariate analysis of participant characteristics in relation to pulmonary function abnormalities

Variable	Category	Spirometry Result		p-value	Effect size
		Normal (n%)	Abnormal (n%)		
Age	<20	9 (100.0)	0 (0.0)	<0.001*	0.591
	20–39	8 (66.7)	4 (33.3)		
	40–59	5 (31.3)	11 (68.8)		
	≥60	4 (19.0)	17 (81.0)		
Sex	Female	15 (75.0)	5 (25.0)	<0.001#	0.440
	Male	11 (28.9)	27 (71.1)		
History of smoking	No	21 (84.0)	4 (16.0)	<0.001#	0.686
	Yes	5 (15.2)	28 (84.8)		
Body Mass Index	*Underweight*	7 (77.8)	2 (22.2)	0.009*	0.438
	Normal	9 (60.0)	6 (40.0)		
	Overweight	7 (43.8)	9 (56.3)		
	Obese	3 (16.7)	15 (83.3)		

*Fisher-Freeman-Halton with Cramer's V effect size, #Chi-Square with Phi effect size

By sex, males exhibited a substantially higher proportion of abnormal spirometry compared with females (71.1% vs 25.0%). This difference was statistically significant on chi-square testing ($p < 0.001$), with a moderate effect size (Phi = 0.440). Smoking history was also strongly associated with pulmonary function abnormalities; 84.8% of participants with a history of smoking had abnormal spirometry findings, compared with 16.0% among never-smokers. This association was statistically significant ($p < 0.001$) with a strong effect size (Phi = 0.686).

Across BMI categories, the proportion of abnormal spirometry increased from 22.2% in the underweight group to 83.3% in the obese group. Given the presence of cells with expected counts <5, comparisons across BMI categories were conducted using the Fisher–Freeman–Halton exact test, which

demonstrated a statistically significant association ($p = 0.009$) with a moderate effect size (Cramer's V = 0.438).

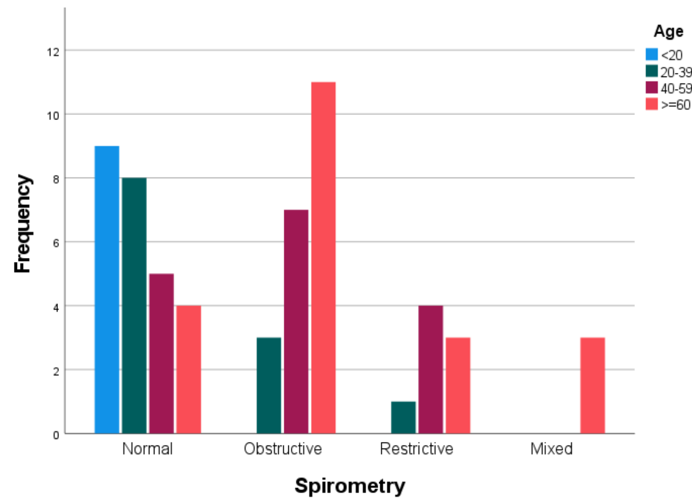

Figure 1. Distribution of spirometry result categories across age groups among residents of Dukuh Kupang Subdistrict, Surabaya, Indonesia (N = 58). The x-axis shows spirometry categories (normal, obstructive, restrictive, and mixed), and the y-axis shows the number of participants. Coloured bars represent age groups: <20 years, 20–39 years, 40–59 years, and ≥60 years.

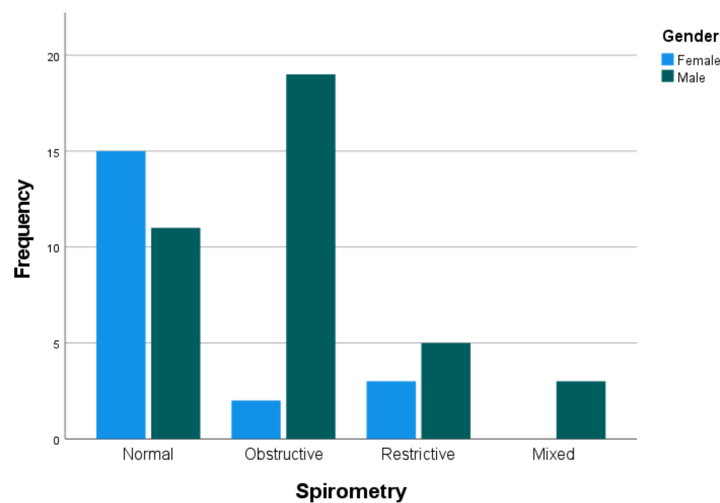

Figure 2. Distribution of spirometry result categories by sex among residents of Dukuh Kupang Subdistrict, Surabaya, Indonesia (N = 58). The x-axis shows spirometry categories (normal, obstructive, restrictive, and mixed), and the y-axis shows the number of participants. Coloured bars represent female and male participants.

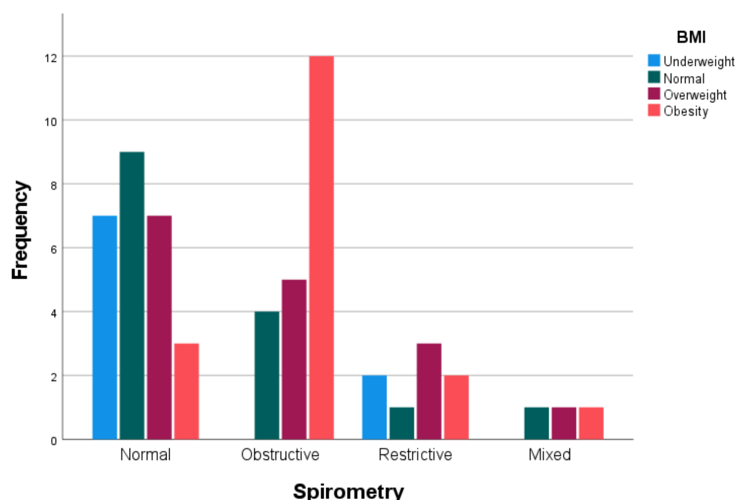

Figure 3. Distribution of spirometry result categories across body mass index (BMI) categories among residents of Dukuh Kupang Subdistrict, Surabaya, Indonesia (N = 58). The x-axis shows spirometry categories (normal, obstructive, restrictive, and mixed), and the y-axis shows the number of participants. Coloured bars represent BMI categories: underweight, normal, overweight, and obesity. BMI, body mass index.

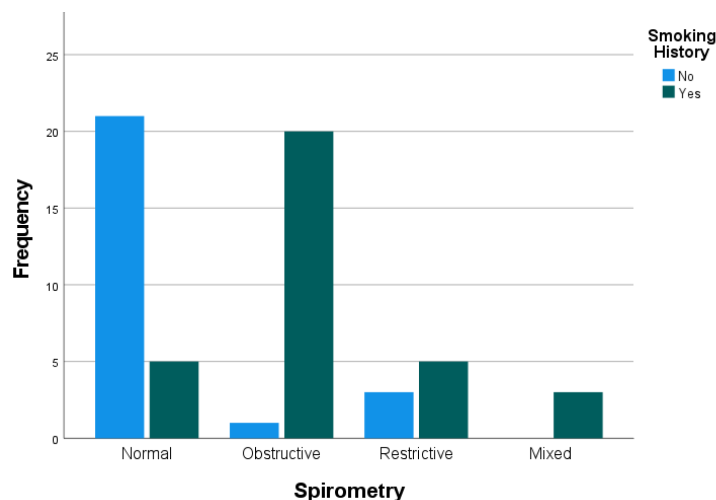

Figure 4. Distribution of spirometry result categories by smoking history among residents of Dukuh Kupang Subdistrict, Surabaya, Indonesia (N = 58). The x-axis shows spirometry categories (normal, obstructive, restrictive, and mixed), and the y-axis shows the number of participants. Coloured bars represent participants with no smoking history (never smokers) and those with a history of smoking (current or former smokers).

Discussion

This pilot study demonstrates that the implementation of spirometry as a community-based screening tool can identify a substantial proportion of individuals with abnormal pulmonary function, while revealing patterns of association consistent with established biological and behavioral determinants reported in previous studies [13–16]. These findings support the feasibility and potential value of spirometry as an early detection strategy at the community level, particularly in populations with significant exposure to respiratory risk factors. From a methodological perspective, the application of spirometry in community-

based research requires strict attention to procedural quality, including maneuver acceptability and repeatability, as well as appropriate interpretative strategies. Spirometric results may be influenced by biological variability, maneuver performance, and the classification approach used to define ventilatory patterns. The 2019 ATS/ERS technical standards and the updated ERS/ATS interpretative framework emphasize rigorous quality control and caution in interpreting obstructive, restrictive, and mixed patterns to avoid misclassification and overinterpretation [10].

The strong association between older age groups and abnormal spirometry is consistent with the established understanding that pulmonary function declines physiologically with advancing age, and that such decline becomes more pronounced in the presence of chronic exposures—particularly tobacco smoke—and comorbid conditions. In the epidemiology of chronic respiratory diseases, aging is a well-recognized determinant of abnormal lung function and increased respiratory morbidity across diverse populations [1,3]. The findings of this pilot study reinforce the argument that community-based spirometry screening may yield greater clinical utility when targeted toward middle-aged and older adults, given the higher probability of detecting abnormal ventilatory patterns in these age strata.

The higher proportion of abnormal spirometry observed among males may be explained through several interrelated pathways. First, in many settings, males have a greater likelihood of exposure to key respiratory risk factors—particularly tobacco use and occupational inhalational exposures—such that the observed difference may reflect disparities in cumulative exposure profiles. Second, a growing body of evidence supports sex-related differences in lung function and susceptibility to environmental exposures, including the influence of biological and hormonal factors, as well as anatomical and physiological variations that may modify spirometric parameters [17]. Given the pilot nature of this study and the use of bivariate analyses, the observed sex differences should be interpreted cautiously as preliminary signals requiring confirmation in larger studies incorporating detailed exposure assessment and multivariable adjustment.

The very strong association observed between smoking history and abnormal spirometry findings represents the most consistent result in relation to the existing body of evidence [18,19]. Longitudinal studies have consistently demonstrated that tobacco exposure accelerates the decline in lung function and correlates with the severity of ventilatory impairment, with cumulative exposure—commonly quantified in pack-years—being associated with a more rapid reduction in FEV_1 [20,21]. Within the context of community-based screening, this finding underscores the potential added value of integrating spirometry screening with smoking cessation interventions, such as brief counseling and referral to cessation services. Individuals identified with abnormal spirometry results may represent a priority group for targeted behavioral interventions and structured clinical follow-up, thereby enhancing the preventive impact of community respiratory health programs.

In this study, the BMI category was also significantly associated with spirometry status. From a physiological perspective, obesity can alter respiratory mechanics through reductions in functional residual

capacity (FRC) and expiratory reserve volume (ERV), increased chest wall load, and decreased lung compliance. On spirometry, these changes are often reflected as reduced FVC and may resemble a restrictive pattern or exacerbate a mixed ventilatory defect [22,23]. However, these findings should be interpreted with caution, considering (1) the small sample size inherent to a pilot study, (2) the absence of adjustment for potential confounders such as age and smoking, and (3) the fact that a "restrictive" pattern on spirometry does not equate to true restriction without confirmation by total lung capacity (TLC) measurement. Future studies should incorporate additional measures such as body composition, waist circumference, physical activity levels, and metabolic comorbidities, as these factors may mediate the relationship between BMI and pulmonary function abnormalities.

In addition, BMI classification in this study followed the Indonesian Health Survey (SKI) 2023 criteria, in which obesity is defined at a lower threshold (BMI $\geq$27 kg/m²) than the conventional WHO definition (BMI $\geq$30 kg/m²). This classification was used to maintain consistency with nationally relevant public health standards and to improve the local interpretability of the findings. The lower threshold may permit earlier identification of excess adiposity and may influence BMI category assignment when interpreting its association with spirometric abnormalities. Nevertheless, the present study was not designed to directly compare pulmonary function outcomes across alternative BMI classification systems. Future studies should consider comparing national and WHO BMI cut off, together with more detailed adiposity measures, to better define their relationship with pulmonary function abnormalities.

This study also highlights the need to distinguish routine COPD screening in asymptomatic adults from community-based early detection of pulmonary function abnormalities among individuals with potential risk exposures. Several studies do not recommend routine COPD screening in asymptomatic adults due to insufficient evidence of clear clinical benefit in this population [19]. In contrast, a number of reviews advocate for a case-finding approach—particularly among individuals with respiratory symptoms and/or established risk factors such as smoking—as a more rational and efficient strategy than universal population screening [24,25]. Within this framework, the pilot study conducted in Dukuh Kupang, Surabaya, provides preliminary justification for positioning spirometry as a community-level risk-mapping and triage tool rather than as a standalone diagnostic instrument in the absence of a clinical context. Practically, this approach enables the identification of individuals who may benefit from further clinical evaluation, targeted risk factor education, and structured referral to primary healthcare services.

Several limitations should be considered when interpreting the findings of this study. First, the cross-sectional design precludes causal inference; the observed associations reflect relationships at a single point in time. Second, as a pilot study employing consecutive sampling, the results may be subject to selection bias, as individuals who attended the screening may differ systematically from the broader community population. Third, smoking exposure was assessed dichotomously; without information on intensity or cumulative exposure (e.g., pack-years), the analysis was unable to evaluate dose–response relationships.

Thus, future studies should incorporate more detailed smoking exposure assessment to better characterize its association with spirometric abnormalities. Fourth, the classification of a restrictive pattern on spirometry should be regarded as “suspected restriction,” as definitive confirmation requires measurement of lung volumes, particularly total lung capacity (TLC). Finally, the use of exact statistical tests in several analyses reflects limited sample size; larger studies are therefore necessary to obtain more precise estimates and to enable robust multivariable analyses.

Overall, this pilot study provides preliminary evidence that community-level spirometry screening at the subdistrict level can identify pulmonary function abnormalities associated with key determinants, including age, sex, smoking status, and body mass index. These findings offer an empirical foundation for designing larger, more representative studies incorporating more comprehensive exposure assessment and standardized referral pathways. Such efforts are essential to strengthen the development of structured, community-based lung health interventions and to optimize early identification and risk stratification strategies in primary care settings.

Conclusion

This pilot study demonstrates that spirometry screening conducted in Dukuh Kupang Subdistrict, Surabaya, was able to identify pulmonary function abnormalities at the community level. These abnormalities were significantly associated with older age, male sex, and a history of smoking, and also showed a relationship with body mass index (BMI) categories. The findings also support the use of spirometry as an initial risk-mapping tool and provide a foundation for planning larger-scale studies with more comprehensive exposure assessment and analytical adjustment.

Conflicts of Interest

The authors have no conflicts of interest to declare. All co-authors have seen and agree with the contents of the manuscript.

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The Connection between Children's Tonsillitis Symptoms and Eating Habits

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ABSTRACT

Introduction: Tonsillitis, an inflammation of the tonsils, can affect all ages but mainly occurs in children. Tonsils can be caused by infections or viruses. Consumption patterns are the actions of a person or group, notably individuals, in choosing what food to consume every day. Foods that contain oil, flavorings such as MSG (Monosodium Glutamate), and preservatives, when consumed in excess, will cause symptoms of itching or pain in the throat and will cause infection in the oral cavity, causing inflammation of the palatine tonsils. In addition, eating foods that are too cold, hot, sour, or spicy can irritate the pharyngeal and esophageal mucosa and trigger inflammation. This study aims to determine the relationship between eating habits and tonsillitis symptoms in children.
Result: 120 respondents who stated that they were at risk, 74 people or 51.4% had tonsillitis symptoms, while 46 people or 31.9% did not have tonsillitis symptoms. Of the 24 respondents who stated that they were not at risk, 9 people, or 6.3%, had symptoms of tonsillitis, while 15 people, or 10.4%, did not have symptoms of tonsillitis.
Conclusion: This indicates that the McNemar test results obtained at the first hypothesis (H1) are accepted due to the p-value of 0.000 (<0.05), indicating a substantial correlation between food consumption patterns and symptoms of tonsillitis in children.

Keywords: Food consumption patterns; tonsillitis symptoms; children

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Introduction

The infection of the pharyngeal tonsils is known as tonsillitis. Inflammatory response can influence the lingual tonsils and adenoids, two further regions in the rear of the throat. Children also frequently get tonsillitis, even if it is rarely noted in children under two years old year[1]. Epidemiologic data show that chronic tonsillitis is most common in 5-10 years old and young adults aged 15-25 years[2].

Tonsillitis can cause difficulty swallowing, heat, swelling, headaches in joints and muscles, chills, whole body aches, and usually pain in the ears. Excess secretions make patients complain of difficulty swallowing, and the back of the throat will feel thickened[3].

The habit of eating fried foods, if food is not processed hygienically, and open food storage can be contaminated by germs. Refrigerated drinks can even cause vasoconstriction so that blood vessels shrink and the number of white blood cells decreases, which can also stimulate and stretch epithelial cells in the tonsils, so that over time it will cause tonsil hypertrophy. Consuming fast food has an impact on the immune system, which is weakened; finally, the body is susceptible to disease, especially tonsillitis[4].

In addition, unhealthy food is also categorized as unclean food. Many experts recommend choosing foods that don't have a lot of excess oil and use additives such as food coloring, flavoring, and aroma enhancers[5].

According to information released by the Ministry of Health in Indonesia in 2012, about 23% of Indonesians suffer from tonsillitis[6]. In various countries, namely in the United States, according to the National Center of Health Statistics, in 2011 was 24.9%. Cases of tonsillitis in Khyber hospital, Pakistan, in 2011-12 were 37.37% of all diseases in the ENT-KL field[7]. In the province of South Sulawesi, the prevalence of patient visits and the number of patients with Acute Tonsillitis found in each hospital on average ranks fourth, namely 657 (8.1%).(8) Recent data from healthcare facilities in Makassar also indicate that tonsillitis remains a common clinical condition. A study conducted at Ibnu Sina Hospital, Makassar, reported 86 cases of tonsillopharyngitis between January 2023 and May 2024, with the majority of patients experiencing symptoms such as fever (87.21%) and sore throat (75.58%). [16].

Based on the description above and the rising prevalence of tonsillitis, the author conducted a study on the relationship between food consumption patterns and tonsillitis symptoms in children.

Methods

In this study, a cross-sectional design and analytical survey method were used. The sampling technique uses total sampling (n=192), with a total of 144 respondents (n = 144) included in this study. Data collection for this study was conducted from July to August 2023 at SDN 71 Rappojawa in the Tallo sub-district of Makassar city. Data were collected using a questionnaire and examined directly.

Data were analyzed using the McNemar test Statistic.

Result

Considering the outcomes of univariate analysis, the results are as follows:

Table 1: Food consumption pattern

Food Consumption Pattern Results	N	%
At risk	120	16,7 Percent
Not at risk	24	83,3 Percent
Total	144	100 Percent

Source: Primary Data

Table 1 shows that the results of food consumption patterns resulted in a risky number of 12 people or 16.7%. While those who are not at risk are 24 people, or 83.3%.

Table 2: Symptoms of Tonsillitis

Tonsillitis Symptoms	Frequency	Percentage
Yes	83	57,6 Percent
No	61	42,4 Percent
Total	144	100 Percent

Source: Primary Data

Table 2 shows that the results of tonsillitis symptoms were found in as many as 83 people or 57.6%. While those who did not have tonsillitis symptoms were 61 people or 42.4%.

Table 3: Relationship between food consumption patterns and tonsillitis symptoms

Food Consumption Patterns	Tonsillitis Symptoms		Total	*P value*
	Yes	No		
At Risk	74 (51,4%)	46 (31,9%)	120	0,000
Not At Risk	9 (6,3%)	15 (10,4%)	24	
Total	83	61	144	

Source: Primary Data

Table 3 shows that out of 120 respondents who stated that they were at risk, 74 people, or 51.4%, had symptoms of tonsillitis, while 46 people, or 31.9%, did not have symptoms of tonsillitis. Of the 24 respondents who stated that they were not at risk, 9 people or 6.3% had symptoms of tonsilitis while 15 people or 10.4% did not have symptoms of tonsillitis. This indicates that most students have symptoms of tonsillitis. Based on the McNemar test results, the p-value is 0.000 (<0.05) so it is determined that the initial theory (H1) comes from acknowledged, which implies that there is a strong correlation between children's tonsillitis symptoms and their eating habits.

Discussion

The study's findings show that participants who have a habit of consuming cold drinks and experiencing tonsillitis symptoms are more than respondents who have food consumption that is not consume food and experience tonsillitis symptoms. The findings of this study are consistent with those of studies carried out

by Wahyuni (2017) on children of SDN 005 Sungai Pinang, Sungai Pinang Samarinda District, which amounted to 265 respondents. It was found that as many as 139 respondents (52.6%) experienced tonsillitis symptoms, and there was a substantial correlation between eating patterns and tonsillitis symptoms[9].This disease is especially common in children who eat and drink carelessly. Even though the food and drinks consumed by the child do not guarantee hygiene or cleanliness[10]. The findings of this study are consistent with those reported by Basri SWG et al. (2022), which showed that there is a significant relationship between eating habits and the incidence of throat inflammation in elementary school children. The study emphasized that poor dietary patterns, including the consumption of unhealthy and unhygienic foods, contribute to the occurrence of tonsillitis symptoms in children.

Unhealthy eating habits can affect one's health. Cooking oil functions as a heat-conducting medium, adds savory flavor, and adds nutritional value to the calories in foods such as cooking oil and margarine. The cooking oil we consume daily is closely related to our health[11].

Food high in oil content can trigger pharyngeal irritation. If consumed continuously, it can cause inflammation of the tonsils. Consuming too much cold water can trigger inflammation of the tonsils, because cold water can stimulate and stretch the epithelial cells in the tonsils, so that over time it will cause tonsil hypertrophy[12].

Not only foods that contain oil, but excessive use of flavorings can lead to health problems. One of the developments in the field of food production is the number of foods that use addictive substances in the form of food flavoring. The addictive substance MSG (Monosodium Glutamate) is a sodium salt of glutamic acid used in managing food and as a food additive. The fact is that consuming MSG turns out to be very vulnerable for humans from early childhood to old age. Frequent consumption of flavoring ingredients will cause harm to the well-being of the body, and various types of diseases will appear, one of which is tonsillitis[13].

Fast Food serves as a type of food that is convenient, packaged, and/or easy to serve, simply compiled. Fast food typically comes in the shape of sandwiches, kebabs, salads, prepared side dishes, fast noodles, and nuggets[14]. Ultimately, unhealthy dietary behaviors compromise the immune system, making children more vulnerable to recurrent infections such as tonsillitis. Finally, the body is susceptible to disease, especially tonsillitis[4].

Due to involution at puberty, the function of the tonsils will decrease first at the age of five years, then rise at ten years old, and finally fall once more at fifteen years old, resulting in a decrease in the number of antibodies produced and a decrease in tonsil function[15].

Conclusion

This study demonstrates a significant association between food consumption patterns and tonsillitis symptoms in children. Therefore, it is essential to provide education to students and the elementary school community on the intake of "at-risk" foods, such as those containing excessive oil, flavorings, and extremely cold drinks. Furthermore, the parents should be continuously informed about nutritious food choices to ensure children's health is maintained both at home and at school. Although this study provides a preliminary understanding of the link between dietary habits and tonsillitis symptoms, further research involving comprehensive medical examinations is necessary to confirm these findings clinically.

Conflicts of Interest

There is no conflict of interest

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Case Report Open Access

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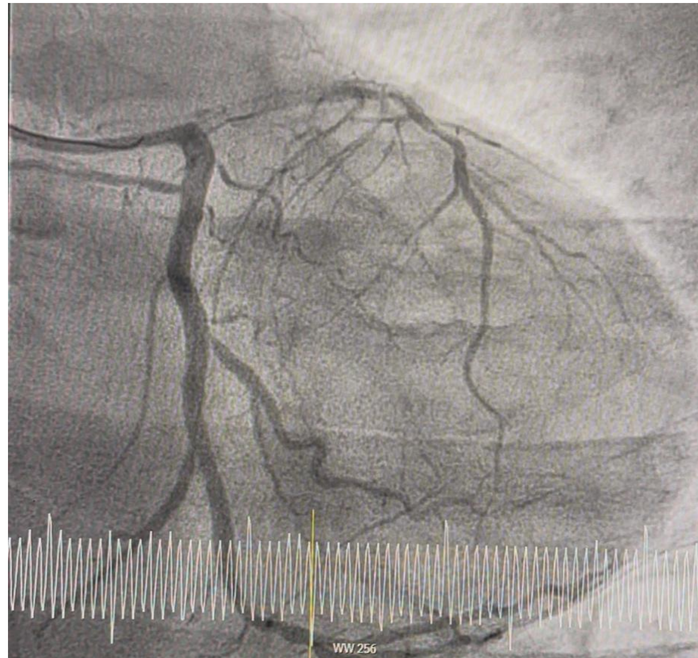

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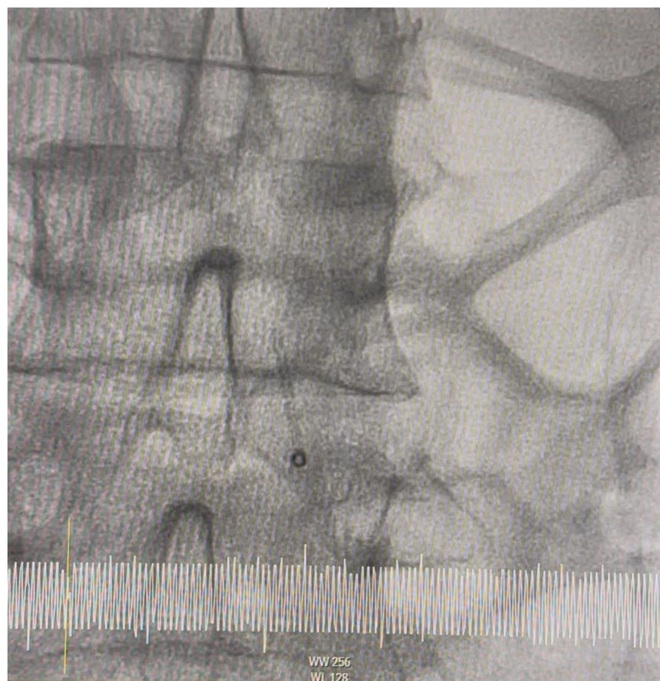

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We elected to retrieve the migrated stent using the twisted guidewire technique. A second guidewire, introduced via the right femoral artery together with a 4F 5 mm snare, was advanced toward the site of embolization. The first guidewire, which had been placed through the right radial artery during the initial procedure, was simultaneously maneuvered until both wires converged at the location of the displaced stent.

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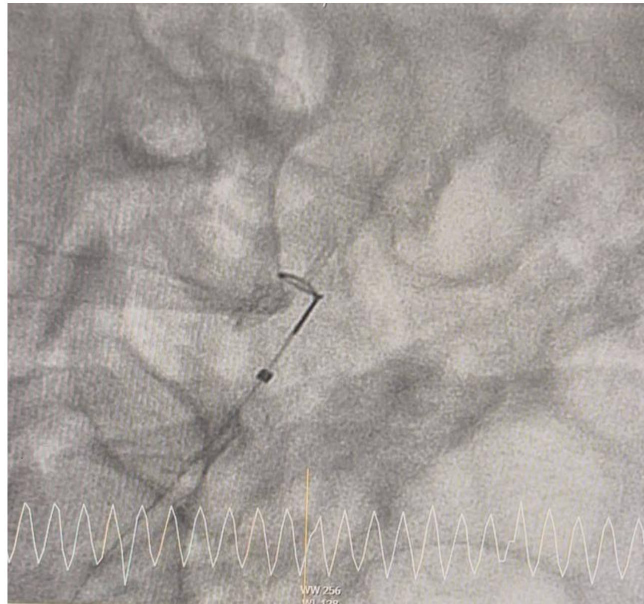

Figure 3. Retrieval of the stent from the body

Discussion

Stent dislodgement during PCI is an uncommon but clinically significant complication, with a reported incidence of approximately 1% in contemporary practice, largely attributable to advancements in stent design and delivery systems.[1,2] However, the risk remains higher in complex lesions, particularly those characterized by severe calcification and marked tortuosity. In addition, coronary tortuosity increases technical difficulty and has been associated with approximately 4% stent delivery failure during PCI.[3]

Several procedural and anatomical factors contribute to stent dislodgement, including inadequate lesion preparation, suboptimal stent sizing, excessive vessel angulation, and insufficient support from the guiding system.[4,5] In tortuous and sclerotic coronary arteries, careful consideration of stent diameter, length, and expansion characteristics during inflation is critical, as inappropriate sizing or excessive force during advancement may increase the likelihood of stent stripping from the delivery balloon.[6,7]

The clinical consequences of stent dislodgement depend on the site of embolization. Coronary embolization may result in acute vessel occlusion and myocardial infarction, whereas peripheral embolization may lead to limb ischemia or require emergent vascular intervention if not promptly managed.[8,9] Therefore, rapid identification of the stent's final position, as performed in this case, is a critical early step before attempting retrieval.

There is no universally accepted standard technique for stent retrieval. Available approaches include snare retrieval, small-balloon trapping, forceps extraction, multipurpose retrieval baskets, and the twisted guidewire technique.[10,11] The selection of technique should consider stent location, vessel diameter, operator experience, and the availability of equipment.[12] Compared with alternative strategies, the twisted guidewire technique offers a rapid and low-profile solution that can be performed using readily available

equipment, making it particularly useful in time-sensitive situations or resource-limited settings.[13]

In the present case, the use of dual guidewires introduced from different vascular access sites enabled effective entrapment of the dislodged stent. Controlled twisting of the wires allowed secure capture and safe retrieval without vascular injury. This technique involves advancing a second guidewire to engage the stent and subsequently twisting both wires to entangle the device before withdrawal.[14] Potential risks such as vessel injury or distal embolization must be considered, although these complications were successfully avoided in this case.[15] The favorable outcome highlights the importance of early decision-making, appropriate technique selection, and effective coordination within an experienced interventional team.[16]

From a procedural perspective, several preventive strategies should be emphasized. Adequate lesion preparation using adjunctive techniques such as buddy wire support, microcatheters, or atherectomy may facilitate stent delivery in complex anatomy.[17] In addition, continuous fluoroscopic monitoring is essential to detect early signs of stent deformation or delivery failure.[18] Importantly, excessive force during stent advancement should be avoided, as it increases the risk of device dislodgement.[19]

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During hospitalization, the patient reported no post-procedure complaints. The patient was counseled to continue GDMT for the CTO of the RCA. He received aspirin 80 mg, clopidogrel 75 mg, ramipril 2.5 mg, and bisoprolol 2.5 mg. At the 1-month follow-up, he did not report any symptoms.

Conclusion

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Conflicts of Interest
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Take home messages

Operators performing PCI should be able to promptly recognize and manage both common and rare complications, including stent dislodgement. Appropriate technique selection, procedural planning, and effective team coordination are critical to achieving optimal outcomes.

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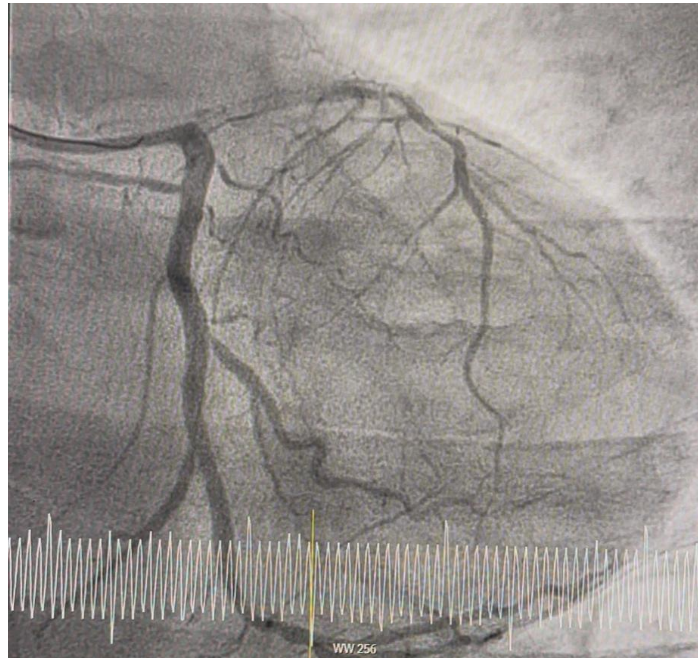

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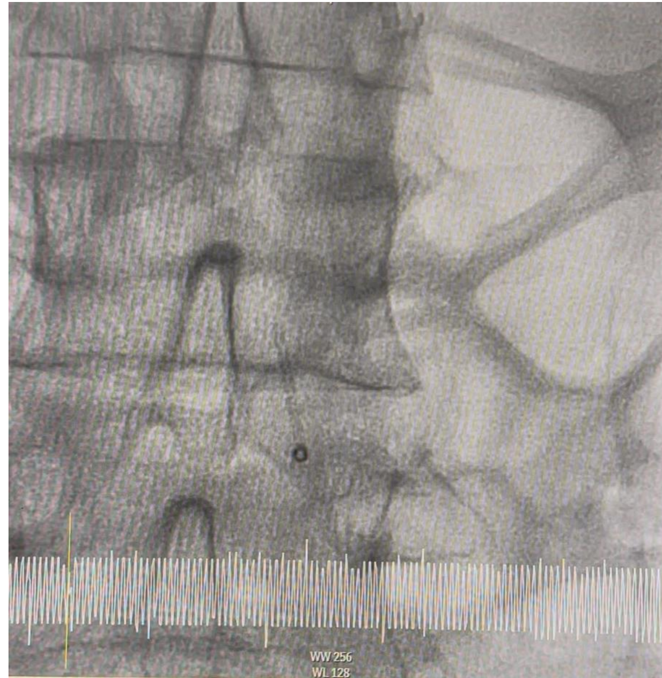

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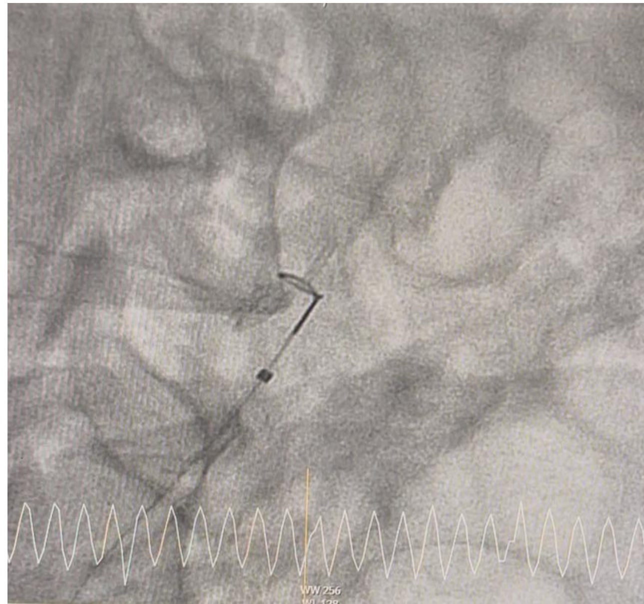

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There is no acknowledgment

Take home messages

Operators performing PCI should be able to promptly recognize and manage both common and rare complications, including stent dislodgement. Appropriate technique selection, procedural planning, and effective team coordination are critical to achieving optimal outcomes.

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