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ORIGINAL RESEARCH

EFFECTIVENESS OF THE GIVING STARFRUIT LEAF EXTRACT (*AVERRHOA BILIMBI L.*) AND CINNAMON (*C. BURMANII*) AS AN ALTERNATIVE TO ANTIBACTERIALS FOR THE HEALING OF PERINEUM WOUNDS IN *RATTUS NORVEGICUS*

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ABSTRACT

Background: The prevalence of infections that occur during the puerperium is 7.3%, due to poor hygiene in wounds The perineum is one of the causes of bacterial proliferation. Pharmacological treatment with antibiotics results in resistance. Non-pharmacological treatment using starfruit leaf extract and cinnamon is a safer alternative solution to reduce the number of bacteria. Objective: To prove the effectiveness of giving starfruit leaf extract (Averrhoa Bilimbi L.) and cinnamon (C. Burmanii) as an antibacterial alternative to perineal wound healing in rats. Methods: True experiment the using study design pre-test post-test with control group. Data collection involved 5 rats, selected through probability sampling technique with method simple random sampling which was divided into 2 groups, namely the treatment group which was given a combination of starfruit leaf extract and cinnamon at a dose of 400 mg/kg rats (equivalent to 0.4 mg /gram body weight rats), while the control group was only given amoxicillin 0.045 mg/200 grams of body weight rats for 7 days. Results: There was a difference before and after giving of starfruit leaf extract and cinnamon on the REEDA scale score (p value <0.05) in the intervention group compared to the control group which was only given amoxicillin 0.045 mg/200 grams, then the t test showed no significant difference between the intervention group and the control group (p value > 0.05). Conclusion: The combination of starfruit leaf extract and cinnamon which was effective in healing perineal wounds based on the REEDA scale score compared to the control group, but was not effective in reducing the number of colonies of bacteria Staphylococcus Aureus.

Keywords

Starfruit Leaf Extract (Averrhoa Bilimbi L.), Cinnamon (C. Burmanii), Antibacterial, Perineal Wounds in Rats.

INTRODUCTION

According to the World Health Organization (WHO) in 2014, an important indicator in determining the degree of public health and the success of sector development Health is the Maternal Mortality Rate (MMR). MMR in Indonesia in 2012 reached 359 per 100,000 KH. This is not in accordance with the target of the Sustainable Development Goals (SDGs), which is below 70 per 100,000 KH.[1-2]

One of the main causes of AKI is infection that occurs during the puerperium. The prevalence of puerperal infection in Indonesia was ranked fourth in 2013, which was 7.3%. In 2009, the incidence of perineal injuries caused by tearing of the birth canal during childbirth in the world reached 2.6 million cases and in 2050 it is estimated that these cases could reach 6.3 million cases. In 2010-2011, the incidence of perineal injuries caused by second degree birth canal tears in the UK increased, from 5.6% to 5.9% compared to first and third degree birth canal tears. The scope of Asia itself, the incidence of perineal injuries caused by tears in the birth canal reaches 50% of cases in the world.[2-3]

The cause of infection during the puerperium is due to lack of cleanliness in the perineal wound. Moist perineal wounds due to the presence of lochea (fluid from the uterine cavity and vagina that occurs during the puerperium) and adjacent to the waste disposal site (faeces) can become a fertile place that will lead to the proliferation of bacteria and microorganisms that are pathogenic. Bacteria commonly found in cases of puerperal infection are Staphylococcus aureus, while bacteria that are rarely found in puerperal infections are Clostridium Welchii.[4-8]

Efforts have been made to maintain the cleanliness of the perineal wound by maintaining the cleanliness of the body and genital area (vulva hygiene), changing bandages regularly, cleaning the wound using soap, keeping the perineum clean and dry as an infection prevention measure.[9-10]

Another pharmacological treatment to kill bacteria in perineal wounds is the administration of antibiotics such as amoxicillin. Chemical effects in the use of antibiotics can damage cells in the body and cause side effects, including antibiotic-associated diarrhea, anaphylaxis, antibiotic skin allergies, yeast infections in the vagina and mouth and phlebitis complications from intravenous (IV) treatment. The weakness of the use of antibiotics that are not in accordance with the rules can make the bacteria resistant to antibiotics.[11-14]

Non-pharmacological treatment as an alternative to killing bacteria in perineal wounds using starfruit leaves and cinnamon, such as research by Fithria Rifatul H. (2018) showed that the tannin compounds in starfruit leaf extract were effective in inhibiting bacterial growth in vitro, as well as research by Das et al. 2011) showed that the leaf and fruit extract of star fruit was effective as an antibacterial in vitro. Then research by Citra Adityarini S. (2018) showed that cinnamon extract had the same ability as Amoxicillin as an antibacterial in vitro and research by Anggraini Puspita (2014) showed that cinnamon extract could reduce the growth ofbacteria Streptococcus mutans in vitro.[15-18]

Starfruit leaves contain active compounds in the form of flavonoids, tannins and saponins that can inhibit bacterial growth. This active compound is able to form complex bonds with proteins so that it inactivates bacterial adhesins, enzymes, bacterial protein coagulation and activity inhibits glucosyltransferase which causes protoplasmic coagulation resulting in shrinkage of bacterial cell walls resulting in increased bacterial wall permeability. Increased membrane permeability is followed by intracellular leakage which causes cell components to come out, so that the physiological activity of bacterial cells decreases and causes inhibition of bacterial growth.[19-20]

Cinnamon contains active compounds in the form of flavonoids, tannins and alkaloids which have antibacterial activity properties. The active compounds in cinnamon damage the cytoplasmic membrane which can cause leakage of important metabolites and

inactivate bacterial enzyme systems. This damage allows nucleotides and amino acids to seep out and prevent the entry of active ingredients into cells, this situation can lead to bacterial death.[21-22]

Various studies continue to be carried out in order to find alternatives to overcome resistance to antibiotic drugs, both in vitro and in vivo. One of the non-pharmacological efforts to kill bacteria is to use starfruit leaf extract and cinnamon. Giving antibacterial derived from natural ingredients will reduce bacterial resistance in the body and will not cause side effects. This medicinal plant extract presents a safer alternative solution to overcome antibiotic resistance.

METHODS

This type of research uses True Experiment research with a research design pretest posttest with control group. Researchers arranged two groups, namely the intervention group which was given a combination of starfruit leaf extract and cinnamon at a dose of 400 mg/kg rats (equivalent to 0.4 mg/gram body weight of rats), while the control group was only given amoxicillin 0.045 mg/200 grams BW rats. Giving a combination of starfruit leaf extract and cinnamon and amoxicillin administered for 7 days at the prescribed dose. Measurement of perineal wound healing can be done using the scale instrument REEDA and recorded on the observation sheet, while to determine the number of bacteria Staphylococcus aureus, an examination is carried out in the laboratory. Measurement of the REEDA scale and laboratory examinations on rat perineal wounds were carried out before (pre-test) and after the therapeutic action (post-test).

The population in this study were rats that matched the sample that had been determined in the study at the Experimental Animal Laboratory, Faculty of Medicine, Diponegoro University, Semarang. Determination of the minimum sample size using probability sampling technique with method simple random sampling and based on inclusion and exclusion criteria as many as 10 rats were divided into two groups with 5 rats each in the intervention group (a combination of starfruit leaf extract and cinnamon) and 5 rats. rats in the control group (therapy drug amoxicillin without a combination of starfruit leaf extract and cinnamon).

This research was conducted after ethical clearance with the number: 926/VII/HREC/2019. The ethical principles applied in research using experimental animals are known as 3R (40) which include: Replacement, Reduction and Refinement.

In this study, researchers collected data by means of observation, identification and filling out the observation sheet. The collected data were analyzed through the IBM SPSS version 24.0, and continued with different tests, namely parametric and non-parametric (Wilcoxon test, Kristal Wallis test and Mann Whitney). The processed data is used as the basis for discussing the statement problem, which is then presented in tabular form so that conclusions can be drawn.

RESULTS

Table 1. The difference in the mean of wound healing and bacteria Staphylococcus Aureus in the intervention group and control group

Variable	Intervention	Control
	Mean±SD	Mean±SD
Skor *REEDA*		
Day 1	6.40±1.52	6.20±1.30
Day 2	6.60±0.89	5.60±0.55
Day 3	2.60±2.07	4.20±2.05
Day 4	0.20±0.45	1.00±0.71
Day 5	0.80±0.84	0.80±1.30
Day 6	0.40±0.55	0.20±0.45
Day 7	0.60±0.89	0.20±0.45
Staphylococcus Aureus		
Pre	3.50±3.87	3.40±2.30
Post	1.00±2.00	0.60±1.34

Based on table 1 above, it shows that there is a decrease in the mean of wound healing from day to day in the intervention and control groups. The intervention group experienced a decrease from the first day to the fourth day, but increased on the fifth day, on the sixth and seventh days there was a decrease again. Meanwhile, the control group also experienced a decrease from the first day to the fourth day but increased on the fifth day and decreased again on the sixth and seventh days.

Table 2. The difference in the mean of wound healing before and after treatment in the intervention group and control group

Paired data test*		
	Intervention	Control
	Mean±SD	Mean±SD
Day 1	6.40±1.52	6.20±1.30
Day 2	6.60±0.89	5.60±0.55
Day 3	2.60±2.07	4.20±2.05
Day 4	0.20±0.45	1.00±0.71
Day 5	0.80±0.84	0.80±1.30
Day 6	0.40±0.55	0.20±0.45
Day 7	0.60±0.89	0.20±0.45
P-Value	0.00	0.00
Paired Post-Hoc Test**		
	Intervention	Control
	P-Value	P-Value
D1-D2	0.84	0.43
D2-D3	0.00	0.11
D3-D4	0.06	0.01
D4-D5	0.21	0.62
D5-D6	0.18	0.21
D6-D7	0.37	0.00
D1-D7	0.00	0.00

**Friedman test*

***Pos-Hoc LSD*

Based on table 2 above shows that the results of the paired data effectiveness test p-value the intervention group was 0.00 (P<0.05) meaning that the combination of starfruit leaf extract and cinnamon accelerated the perineal wound healing process. Meanwhile, the p-value of the control group was 0.00 (P<0.05), meaning that amoxicillin accelerated the perineal wound healing process. Evidenced by the results of the test, Pos Hoc paired data showed differences in the intervention group (P= 0.00) on the second day compared to the control group (P= 0.11).

Table 3. Analysis of the difference in the mean of wound healing between the intervention group and control group

Unpaired Data Test*			
	Intervention	Control	P-Value
	Mean±SD	Mean±SD	
Day 1	6.40±1.52	6.20±1.30	0.17
Day 2	6.60±0.89	5.60±0.55	0.13
Day 3	2.60±2.07	4.20±2.05	0.17
Day 4	0.20±0.45	1.00±0.71	0.30
Day 5	0.80±0.84	0.80±1.30	0.89
Day 6	0.40±0.55	0.20±0.45	0.94
Day 7	0.60±0.89	0.20±0.45	0.39
Unpaired Post-Hoc Test**			
	Combination-Starfruit Leaf	Combination-Cinnamon	Combination-Amoxicillin
	P-Value	P-Value	P-Value
Day 1	0.86	0.07	0.86
Day 2	0.10	0.04	0.04
Day 3	0.74	0.33	0.20
Day 4	0.64	0.64	0.08
Day 5	0.53	1.00	1.00
Day 6	1.00	1.00	0.62
Day 7	0.27	0.10	0.27
Unpaired Test Value Change (Data Δ)*			
	Intervention	Control	P-Value
	Mean±SD	Mean±SD	
D1-D2	-0.20±2.05	0.60±2.19	0.11
D1-D3	3.80±2.95	2.00±2.55	0.07
D1-D4	6.20±1.64	5.20±1.30	0.13
D1-D5	5.60±1.95	5.40±1.14	0.33
D1-D6	6.00±1.73	6.00±1.00	0.29
D1-D7	5.80±1.92	6.00±1.00	0.10
Unpaired Post-Hoc Test Value Change (Data Δ)**			
	Combination-Starfruit Leaf	Combination-Cinnamon	Combination-Amoxicillin
	P-Value	P-Value	P-Value
D1-D2	0.44	0.02	0.53
D1-D3	0.74	0.08	0.33
D1-D4	1.00	0.11	0.42

D1-D5	0.67	0.13	0.89
D1-D6	0.88	0.11	1.00
D1-D7	0.62	0.03	0.87

**Anova/Kruskal-Wallis **Pos-Hoc LSD*

Based on table 3 above shows that the results of the data effectiveness test are not paired, the p-value of the intervention group and the control group is 0.39 (P<0.05), meaning that the combination of starfruit leaf extract and Cinnamon accelerates the perineal wound healing process compared to amoxicillin. Evidenced by the results of the test, the Pos Hoc unpaired data value of change (Data data) showed differences in the intervention group on the seventh day compared to the amoxicillin control group (P= 0.10).

Table 4. Analysis of mean difference bacteria Staphylococcus Aureus between the intervention and control group

Paired Data Test*			
Groups		Mean±SD	P-Value
Combination	Pre	3.50±3.87	0.28
	Post	1.00±2.00	
Amoxicillin	Pre	3.40±2.30	0.11
	Post	0.60±1.34	

Unpaired Post-Hoc Test**			
	Combination-Starfruit Leaf	Combination-Cinnamon	Combination-Amoxicillin
	P-Value	P-Value	P-Value
Pre	0.32	1.00	0.70
Post	0.88	0.51	0.74

**Wilcoxon **Mann-Whitney*

Based on table 4 above shows that there is no significant difference in the number of colonies of bacteria Staphylococcus aureus in the pre and groups post (p> 0 ,05).

DISCUSSION

1. **Wound Healing Time Based on Total REEDA Score (Redness, Edema, Ecchymosis, Discharge, Approximation) between the intervention group and the control group**

There was a difference before and after administration of a combination extract of starfruit leaf (Averrhoa Bilimbi L.) and cinnamon (C. Burmanii) 400 mg/kg BW rats (equivalent to 0.4 mg/gram BW rats) between the second and third days (P= 0.00) and the first day to the seventh day (P= 0.00) in capsules as an alternative antibacterial on perineal wound healing in rats.

The Kruskal Wallis test showed that there was no significant difference (P>0.05) in perineal wound healing in rats based on the REEDA scale score between the intervention group that was given a combination of star fruit extract and cinnamon and the control group which was only given amoxicillin, but based on test Post-Hoc LSD differences were found between the intervention group and the control group.

It can be concluded that wound healing in the two groups was not significantly different (P>0.05), but based on the total average REEDA score for each group, it gradually decreased every day.

This cinnamon extract shows that the active substance of flavonoids, tannins and alkaloids is proven to be efficacious in wound healing. Flavonoids as anti-inflammatory work by inhibiting the metabolic pathway of arachidonic acid which is an important inflammatory mediator to form prostaglandins and release inflammatory histamine.[23-24] Tannins and alkaloids as anti-inflammatory and antibacterial work by increasing the permeability of the bacterial cell membrane, thereby changing the membrane structure, denaturing membrane proteins and causing damage to the bacterial cell membrane.[25] alkaloids have antibacterial properties and a positive influence to spur an increase in collagen, a protein that plays a role in the wound healing process.[26] The cavity in the

wound area begins to fill with granulation tissue, neovascularization reaches its peak, collagen fibers multiply and begin to cover the wound.[27] Tannins act as an antibacterial in wound tissue, by depositing protein and having bactericidal properties against bacteria Staphylococcus aureus.[28]

At the time of injury, the body responds through several phases in the form of cellular and vascular responses that occur due to tissue damage. The inflammatory phase begins with the aim of stopping bleeding, cleaning the wound area from foreign objects and dead cells and preparing for the start of the healing process.

Quality care affects wound healing which aims to reduce pain and infection in the suture wound.[29] If not treated properly, perineum moist and exposed lochea can cause bacteria to multiply and cause infection in the perineum with tissue damage and wound into a longer recovery.[30]

The perineal wound of the study sample was categorized as a grade I wound so that it did not require suturing, because the wound in principle if properly cared for will heal within 7 days. Wounds are categorized as small wounds so that they will heal in a faster time if there is no infection. Wounds that occur only affect the skin of the posterior commissure, vaginal mucosa, skin and perineal muscles.

Trisnawati's research (2015) states that the most dominant factor in wound healing is the way of perineal care. Perineal care is the fulfillment of the need to nourish the injured area until the reproductive organs return to their pre-pregnancy state. Perineal care is very important, because suture wounds can be an entry point for germs and cause infection, so it is recommended to treat perineal wounds starting as soon as possible after 2 hours of normal delivery.[31]

The purpose of wound care is as a preventive measure against infection in the perineal wound area, reducing pain in the wound area, accelerating wound healing and maintaining the cleanliness of the perineal area. Clean the wound from foreign objects or debris, drainage to facilitate the removal of exudate (fluid from the wound).[32]

2. Decreased number of bacteria Staphylococcus aureus between the intervention group and control group.

The results showed that there was no significant difference in the mean number of bacteria colonies Staphylococcus aureus in the intervention group and the control group, but there was a decrease in the average number of bacteria colonies the control group. Staphylococcus aureus in the intervention group, which was better than in the control group. This is due to several factors such as environmental factors and the ability of rats to heal their own wounds.

Although there was no statistically significant difference in the number of colonies of bacteria Staphylococcus aureus, the decrease in the number of colonies of bacteria Staphylococcus aureus could be seen from the decreasing mean from before the first day of intervention to the seventh day after the intervention was given.

The decrease in the number of bacterial colonies from before and after the intervention indicated that the intervention group could inhibit the inhibition of bacteria better than the control group.

The content of tannin compounds in star fruit leaves has been shown to inhibit the growth of bacteria Staphylococcus aureus. Tannins act as an antibacterial in wound tissue, by precipitating protein and having bactericidal properties against bacteria Staphylococcus aureus.[28]

The results of this study, namely that starfruit leaves inhibit the growth of bacteria are in Staphylococcus Aureus agreement with previous studies, namely the research of Fithri Rifatul H. (2018) showing that the

tannin compounds in starfruit leaf extract are effective in inhibiting the growth ofbacteria S. Haemolyticus, Staphylococcus Aureus. and E. Coli, then Sonia Saini's research (2016) showed that chloroform extract from starfruit leaves had antibacterial activity against gram-positive bacteria such as Staphylococcus aureus and Staphylococcus Epidermis, while Savitri's (2014) study conducted research on the antibacterial effectiveness of starfruit leaf extracts against root canal mix bacteria showed at concentrations of 10.5%, 11% and 12% had antibacterial power against root canal mix bacteria, using concentrations starting from 10.5% because at a minimum concentration for example 1% can kill bacteria Staph ylococcus aureus.[15, 33, 34]

3. Contribution of Findings to Perineal Wound Healing in Postpartum Care

This study is still in the pre-clinical (trial stage*in vivo*). Based on the results of research, belimbing wuluh leaves and cinnamon can accelerate the healing of post-partum perineal wounds. For further researchers, it is hoped that it can be applied to humans through clinical trials by conducting further tests to the next stage so that it can be an alternative non-pharmacological choice made from natural ingredients that are easy to obtain, cheap and available at any time so that they can assist health workers in providing midwifery care during the puerperium. with perineal wounds.

The hope is that spontaneous rupture will occur in mice, but in this study an artificial incision was made where the wound was probably not the same size. Researchers only evaluated the healing of perineal wounds macroscopically and laboratory examinations to assess bacteria only one type of bacteria found in perineal wounds due to limited funds.

CONCLUSION

Based on data processing and analysis of the combination of leaf extract of starfruit (Averrhoa Bilimbi L.) and cinnamon (C. Burmanii) there are differences before and after treatment in capsules as an antibacterial alternative to perineal wound healing in rats based on the REEDA scale score. In conclusion, the combination of starfruit leaf extract and cinnamon in the intervention group accelerated the perineal wound healing process compared to amoxicillin given to the control group.

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