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ORIGINAL RESEARCH

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## FACTORS INFLUENCING THE OCCURRENCE OF HYPERTROPHIC SCARS AMONG POSTOPERATIVE PATIENTS IN GARUT, INDONESIA

Andri Nugraha<sup>1\*</sup>, Rizal Chaidir<sup>2</sup>, Urip Rahayu<sup>3</sup>, Santi Rinjani<sup>4</sup>

<sup>1</sup>Department of Medical Surgical Nursing, School of Nursing of Karsa Husada Garut, Indonesia

<sup>2</sup>Department of Orthopedics and Traumatology, Faculty of Medicine, Padjadjaran University, Indonesia

<sup>3</sup>Department of Medical Surgical Nursing, Faculty of Nursing, Padjadjaran University, Indonesia

<sup>4</sup>Department of Medical Surgical Nursing, Nursing Academy of Bidara Mukti, Indonesia

\*Corresponding author:

Andri Nugraha, SKep., Ners., M.Kep

Department of Medical Surgical Nursing, School of Nursing of Karsa Husada, Jl. Nusa Indah No. 24, Garut, West Java, Indonesia, 44151, phone +62262-235860

E-mail: andrinugraha@outlook.com

### ABSTRACT

**Background:** Hypertrophic scar causes physical and psychological problems. Thus, understanding the factors related to the occurrence of hypertrophic scar tissue is needed. Little is known about its influencing factors in Indonesia, especially in Garut.

**Objective:** This study aims to examine the relationships between hypertrophic scar and its influencing factors, and identify the most dominant factor of the occurrence of hypertrophic scars.

**Methods:** This was an observational case control study using retrospective approach in Polyclinic of Surgery of Regional Public Hospital of dr. Slamet of Garut Regency. There were 40 samples recruited in this study by purposive sampling, which was divided to be case group (20 patients) and control group (20 patients). Data were collected using Stony Brook Scar Evaluation Scale by observation and documentation of the medical records of patients. Data were analyzed using logistic regression analysis.

**Results:** Findings indicated that there were significant relationships between the surgical wound infection ( $p = 0.02$ ), family history ( $p = 0.026$ ), and type of suture ( $p = 0.043$ ) with the occurrence of hypertrophic scars. The most dominant factor on the occurrence of hypertrophic scars was type of suture, acid polyglactin 910. The variables that had no significant relationships with the occurrence of hypertrophic scar tissue were age ( $p = 0.34$ ), area of surgical wound ( $p = 0.177$ ), and smoking habit ( $p = 0.479$ ).

**Conclusion:** There were significant relationships between infection of surgical wound, genetic history, the type of suture, and the occurrence of hypertrophic scar tissue. The most dominant factor that influenced the occurrence of hypertrophic scar tissue was the type of suture. Therefore, it is suggested to health professionals to modify the using of acid polyglactin 910 sutures, and nurses particularly need to provide the information regarding the family history and genetic-related hypertrophic scar, and prevent the infection of surgical wound after operation.

**Keywords:** hypertrophic scar, postoperative, related factors

## INTRODUCTION

The hypertrophic scar occurs in every hundred million people in the world every year, which is approximately 55 millions of them are caused by elective surgery, 25 million by post traumatic surgery, and 4 million by burns.<sup>1,2,3</sup> Meanwhile in the United Kingdom, hypertrophic scar occurs in 23 million postoperative patients,<sup>4</sup> and literature indicated that it occurs in postoperative patients between 40% to 70%.<sup>2</sup> Surgery and injury can cause hypertrophic scar tissue if the damage is more than 33.1% of the skin, which lead to the change of its function and cosmetic defect.<sup>5</sup>

The hypertrophic scar causes both physical and psychological problems. The physical problems are itchy rash, stiffness, wound contracture, and pain,<sup>6,7</sup> while the psychosocial problems cause disturbance in social interaction, anger, stigmatization, disturbance in daily activities, the loss of self-confidence, isolation on social environment, anxiety, and depression.<sup>6</sup>

The priority to decrease these physical and psychological problems in postoperative patients is by preventing the occurrence of hypertrophic scars.<sup>3,6,8</sup> Prevention will improve the quality of life of the patients<sup>9</sup> and also prevent keloids.<sup>10,6</sup> The hypertrophic tissue can be treated but it will cost extra money while there is also bad side effect of the treatment.<sup>11,12,13</sup>

The hypertrophic scar tissue formation is influenced by factors that can be modified and unmodified. The factors that cannot be modified such as genetic<sup>14,15</sup> and age<sup>2,16</sup>, while the factors that can be modified such as smoking, infection, location and suture material.<sup>8, 17, 18</sup>

In this regard, nurses play roles in reducing the occurrence of hypertrophic scar tissue. They provide health education, prevention of wound infection and advocacy for treatment selection.<sup>19</sup> Nurses also have a role to increase self-acceptance

and self-perception of patients due to the changes of body image that affects to the psychology of patients.<sup>20</sup>

The prevalence of patients with hypertrophic scar tissue in Regional Public Hospital of dr. Slamet of Garut Regency was increased from 160 patients in 2013 to 200 patients in 2014. In addition, the number of post-operative wound infection was 10% of the total number of operations with 480 patients per month,<sup>21</sup> while according to the Ministry of Health of the Republic of Indonesia, the postoperative wound infections should be less than 1.5%. On the other hand, the number of smokers as considered as influencing factor of hypertrophic scars in Garut regency was higher (30% of the total population of 2,309,77).<sup>22</sup> Therefore, this study aimed to identify the factors related to hypertrophic scars among postoperative patients in Garut, Indonesia.

## METHODS

### *Design*

This was an observational case control study using retrospective approach to determine the relationships between hypertrophic scar and its influencing factors,<sup>23</sup> and to identify the most predominant factors on the occurrence of hypertrophic scars.

### *Sample size*

There were 40 samples in this study, which was divided to be case group (20 patients) and control group (20 patients). Samples were recruited using purposive sampling with inclusion and exclusion criteria as the following: (1) clean wound postoperative patients at Regional Public Hospital of dr. Slamet of Garut Regency, (2) postoperative patients with > 14 days, and (3) willing to be a respondent in this research. The exclusion criteria included: (1) contaminated wound, and (2) not having treatment of hypertrophic scar.

### *Instruments*

Stony Brook Scar Evaluation Scale was used to measure the hypertrophic scar tissue. It consists of five criteria: height, width, color, suture mark and general appearance. The score for each criterion was summed, and if the result is 0 then it indicates the occurrence of hypertrophic scar tissue, and if the result is 5 then it indicates no hypertrophic scar tissue.<sup>24</sup> Another instrument was also used to describe the demographic data, genetic, smoking, area of surgery, surgical wound infections, and type of suture.

### *Ethical consideration and data collection*

This research had been approved by the Committee and Ethics Review Board (ERB) Committee for Research Involving Human Research Subjects, University of Padjadjaran, Bandung, Indonesia. Permission of data collection was obtained from the head of the health department of Garut regency and the director of Regional Public Hospital dr. Slamet of Garut Regency. Data were collected between May 1-June 15, 2015.

### *Data analysis*

Chi-square analysis was used to identify the relation between factors that can be modified (smoking, infections of surgical wound, area of surgical wound, and type of suture) and unmodified factor (age and genetic) that cause hypertrophic scar tissue on postoperative patients at Regional Public Hospital of dr. Slamet of Garut Regency. Phi statistical analysis was also used to examine the strength of the relations.

## **RESULTS**

### *Characteristics of the respondents*

Data on the Table 1 showed that the majority of the patients (55%) were in the age of risk of hypertrophic scar tissue, and they all had the hereditary history of

hypertrophic scar tissue. Of 75% were at risk of wound area, and 65% were at risk of having infection. In addition, 67.5% of respondents (67.5%) used risky suture types (acid polyglactin 910), and 72.5% of them were non-smokers. This also showed that the sample was divided with 20 respondents had hypertrophic scar tissue, and 20 respondents did not have hypertrophic scar tissue.

### *The relationship between respondent characteristics and the occurrence of hypertrophic scars*

Chi square analysis showed that there was a significant relationship between infection of surgical wound ( $p = 0.02$ ), genetic history ( $p = 0.026$ ) and the type of suture ( $p = 0.043$ ), and the occurrence of hypertrophic scar tissue, while the age variable ( $p = 0.34$ ), the area of surgical wound ( $p = 0.177$ ) and smoking ( $p = 0.479$ ) had no significant association with the occurrence of hypertrophic scar tissue (see Table 2).

Postoperative patients who had genetic history of hypertrophic scar tissue were potentially as much as 10.057 times (95% CI: 1.527 to 66.22) compared to postoperative patients who did not have genetic history of hypertrophic scar tissue after being controlled with genetic history and type of suture. Postoperative patients who experienced infections of surgical wound were 18.576 times (95% CI: 1.767 to 195.252) compared to postoperative patients who did not experience infection after being controlled with genetic history and the type of suture; and postoperative patients who used type of suture (acid polyglactin 910) were at risk of hypertrophic scar tissue 27.524 times (95% CI: 2.117 to 357.877) compared to patients who did not use acid polyglactin 910 suture after being controlled with genetic history and infections of surgical wound.

**Table 1** Frequency Distribution of Respondent Characteristics (n = 40)

Patient Characteristics	F	%
Age 10-30 years	22	55
Age< 10 years and>30 years	18	45
Having genetic history	22	55
Not having genetic history	18	45
Risky area of surgical wound	27	75
• Neck	14	51
• Extremities	5	18.5
• Chest	4	14.8
• Stomach	2	7.4
• Backs	2	7.4
Not risky area of surgical wound	13	25
• Palms and soles	11	84.4
• Eyelid	2	15.6
Having infection	26	65
Not having infection	14	35
Risky suture type (Polyglactin 910)	27	67.5
Not risky suture type	13	32.5
• Nylon	6	46
• Silk	5	38
• Polyglactin 910	2	15
Smoker	11	27.5
Non-smoker	29	72.5
Having hypertrophic scar tissue	20	50
Not having hypertrophic scar tissue	20	50

*The dominant factors influencing the occurrence of hypertrophic scars*

Logistic regression analysis in Table 3 showed that the hierarchy of strength of correlation or relation of the variables that affected the hypertrophic scar tissue was based on the value of the odds ratio (OR).

The result showed the strength of the relationship from the strongest relationship to the weakest relationship,

included: the type of suture with OR = 27.524, infection of surgical wound with OR = 18.576, and genetic history with OR = 10.057.

From OR values of these variables, type of suture was the most dominant factor associated with the occurrence of hypertrophic scar tissue at Regional Public Hospital of dr. Slamet of Garut Regency.

**Table 2** Relationship between Characteristics and Hypertrophic Scars (n = 40)

Variable	Hypertrophic Scar Tissue				Total		p-value
	Yes		No				
	f	%	F	%	F	%	
Age							0.340
Risky	13	59.1	9	40.9	22	100	
Not risky	7	38.9	11	61.1	18	100	
Genetic History							0.026*
Yes	15	68	7	32	22	100	
No	5	28	13	72	18	100	
Area of Surgical Wound							0.177
Risky	16	59.3	11	40.7	27	100	
Not risky	4	30.8	9	69.2	13	100	
Infection							0.020*
Yes	17	78.6	9	21.4	26	100	
No	3	34.6	11	65.4	14	100	
Type of Suture							0.043*
Risky	17	63	10	37	27	100	
Not Risky	3	23.1	10	76.9	13	100	
Smoking							0.479
Smoker	4	36.6	7	63.4	11	100	
Non-smoker	16	55.2	13	44.8	29	100	

**Table 3** The Results of Multivariate Logistic Regression Analysis (n =40)

Variable	B	S.E.	Wald	OR (95% CI)	P Value
Genetic	2.308	0.962	5.762	10.057 (1.527-66.220)	0.016*
Wound Infection	2.922	1.200	5.926	18.576 (1.767-195.252)	0.015*
Type of Suture	3.315	1.309	6.416	27.524 (2.117-357.877)	0.011*
Constant	-4.286	1.454	8.690	0.014	0.003*

Note: \*) significant when  $\alpha = 0.05$

## DISCUSSION

The results of this research indicated that there was a significant relation between genetic history ( $p = 0.026$ ) and the occurrence of hypertrophic scar tissue. It is because hypertrophic scar tissue is autosomal dominant or a disease that can be passed down through the family. There

are chromosomal genes that may influence the occurrence of hypertrophic scar tissue, namely chromosome 2q23 and 7p11.<sup>25</sup> Therefore, patients who have hereditary history of hypertrophic scar tissue would have more severe hypertrophic scar tissue form and it is growing in more than one area.<sup>26</sup> This occurs due to the increase of

transforming growth factor (TGF- $\beta$ ) gene expression, collagen type I and IV that have an effect on the increase of proliferation and the decrease of apoptosis.<sup>27</sup> The roles of nurses to these patients are to do prevention by doing genetic counseling to provide information to individuals or families who have the possibility of having hypertrophic scar tissue, and also the information of the treatments. On the other hand, the therapeutic treatment is to inhibit the production of extra cellular matrix and excessive inflammation by providing anti-inflammatory drugs such as corticosteroids, inhibit DNA transcripts by providing antimetabolic drug mitomycin-c and 5-fluorouracil, and using gene therapy by using RNA Enzyme.<sup>28</sup>

Infection of surgical showed a significant relationship with the occurrence of hypertrophic scar tissue. It is because an infection delays wound healing and results in long inflammatory process so fibroblast proliferation and synthesis of ECM (Extracellular Matrix) process becomes slower, and more synthesis and collagen deposits 2-3 times formed resulting in hypertrophic scar tissue.<sup>29,30</sup> The infection occurred in hospitals were marked by wound with ooze pus, red, edema and wounds for >14 days postoperative. It is mentioned that postoperative patients are recovered up to 10 to 14 days after surgery, it should be no increase of the synthesis of collagen.<sup>29</sup>

Another factor is the suture had a significant association with the occurrence of hypertrophic scar tissue, especially acid polyglactin 910 suture. Postoperative patients who used multifilament suture in the form of acid polyglactin 910 can cause high skin strain, thus increasing the synthesis of collagen that causes hypertrophic scar tissue, and the type of multifilament suture in the form of polyglactin 910 will enhance the higher

inflammatory reaction of the body, increase the affinity or tie up against microorganisms, which stuck to the interstices of braided suture that results in infection and delayed wound healing.<sup>31,32</sup> In this regard, the management of operation will be better using absorbed or not absorbed monofilament and multifilament sutures that have antibacterial properties. If there is no other type of suture, it can also be done by giving hydrogel or silicone gel in the treatment of wound to accelerate the granulation process, reducing strain injury, and preventing infection in order to reduce the risk of hypertrophic scar tissue.<sup>32</sup>

The findings also showed that there was no significant relation between age and the occurrence of hypertrophic scar tissue. Literature indicated that hypertrophic scar tissue could occur at any level of age. Therefore, it may occur at any age with many characteristics in the area that contains collagen.<sup>33</sup> However, this study showed that the proportion of age of patients who had hypertrophic scar tissue were at age 10-30 years. This can happen because trauma often occurs at that age, and there are also enhancements of production of glycosaminoglycan, collagen and matrix structure of the skin that make the skin becomes more elastic.<sup>34</sup>

Area of surgical wound in this study had no significant with the occurrence of hypertrophic scar tissue. Literature showed that hypertrophic scar tissue could occur anywhere within the human body that contains collagen.<sup>19</sup> This study also found that the majority of the respondents had hypertrophic scar tissue in the areas which are frequently contracted and contain collagen fibers, namely in the area of the neck (51%), the extremities (18.5%), the chest (14.8%), the stomach and the back respectively (7.4%), and the most widely performed surgery in the hospital was in the neck area.



Another variable that had no relationship with the occurrence of hypertrophic scar tissue in this study was smoking. Findings showed that the majority of patients who had hypertrophic scar tissue were non-smokers. Literature said that young and nonsmoker patients are more susceptible to hypertrophic scar tissue compared with those who smoke.<sup>35</sup> It is likely the patients who smoke could reduce the systemic inflammatory response, while cigarettes also contains nicotine which is a vasoconstrictor that reduces the proliferation and migration of macrophages and fibroblasts, the deposition of collagen type 1 and III, and the formation of growth factor  $\beta 1$  (TGF- $\beta 1$ ); while also increases the growth factor  $\beta 3$  (TGF- $\beta 3$ ) so that smoking increases the risk of surgical wound complications but it reduces the risk of hypertrophic scar tissue.<sup>36,37</sup> However, smoking cannot be used as an intervention because it has more negative than positive effect.

Multivariate analysis in this study showed that three factors influence the occurrence of hypertrophic scar tissue, namely genetic history, wound infection and type of suture. The most dominant factor was the acid polyglactin 910 suture, which is made by synthetic materials that can be absorbed and can be degraded by hydrolysis.<sup>38</sup> The advantage of this suture type is stronger than monofilament, soft and regular and easy to use, while the drawback are the cavities that can be a place for a microbial to attach and a bit clogged at the time through the tissue.<sup>39</sup> But although has an advantage by using this suture, the finding in this study revealed that postoperative patients who used acid multifilament polyglactin 910 suture is likely to have 27.524 times more at risk (95% CI: 2.117 to 357.877) compared to patients who did not use the type of suture. In line with literature said that post-operative patients who use acid

polyglactin 910 sutures are 2 times more at risk of the occurrence of hypertrophic scar tissue.<sup>40</sup> Therefore, the use of the suture 910 polyglactin acid sutures should be avoided or modified by the treatment of wounds which can prevent infection and enhance granulation process.

## CONCLUSION

There were significant relationships between infection of surgical wound, genetic history, the type of suture, and the occurrence of hypertrophic scars. The most dominant factor that influenced the occurrence of hypertrophic scars was the type of suture. Therefore, it is suggested to health professionals to modify the using of acid polyglactin 910 sutures, and nurses particularly need to provide the information regarding the family history and genetic-related hypertrophic scar, and prevent the infection of surgical wound after operation.

## Declaration of Conflicting Interest

None declared.

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## Authorship Contribution

The authors contributed equally in this study.

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