Aplication of nanogold and nanosilver to reduce rheumatic arthritis: Case study at leprosy patients

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Abstract. This study aims to ensure the treatment of rheumatoid arthritis cases suffered by leprosy patients. Special inspection is carried out every 2 weeks during the treatment. Treatment by giving nanogold and nanosilver volunteers every morning and night as much as 20 ml 20 ppm in drinking water. The number of volunteers 24 people with an age range of 40-70 years. The sex of male volunteers is 12 people and women are 12 people. The condition is divided into 4 categories; weight, moderate, mild and cured. In the beginning, volunteers were chosen in the weight and moderate categories. Research data were medical records and interviews. The results show a gradual recovery process towards recovery. One person with an initial condition in the weight category had not recovered for 3 months of treatment. Overall there was an improvement in conditions from weight to moderate, mild and recovered. Gender has no effect on the recovery process. The conclusions of the nanogold and nanosilver case studies succeeded in alleviating to cure rheumatoid arthritis volunteers for leprosy patients. This case study has the impact give new hopes for leprosy patients to keep their spirits alive. This is very important for the future of leprosy patients free from rheumatoid arthritis.

1. Introduction
It is interesting when the nanogold and nanosilver clinical trials in leprosy volunteers. They have difficulty walking. This difficulty walking has two causes. First because of injuries to the legs. Second, due to rheumatism in the joints, especially the knee. This is interesting because gold is a rheumatic medicine. The initial use of gold as a drug is rheumatoid arthritis drug [1]. It is important to be questioned in this study. Is nanogold can also cure rheumatism in leprosy patients. Given the leprosy patients who experience arthritis are still attacked by leprosy bacteria. Nanosilver is a broad-spectrum antimicrobial including leprosy bacteria. Such is the complexity of the disease experienced by volunteer leprosy patients who also suffer from rheumatoid arthritis. The effort of combining nanogold and nanosilver is scientifically reasonable [1].

Nanogold is an active material even though it is in the form of inactive gold solids [2]. Au reacts very strongly with CN ions produced in protein reshuffle [3]. In the case of rheumatism, a protein reshuffle occurs in the joint area. A buildup of CN- in the joint area causes pain when the foot is moved. This is experienced by rheumatic patients. Therefore, the design of rheumatic drugs is based on the following reaction mechanisms: \( \text{Au} + \text{CN}^- \rightarrow \text{Au(CN)}^- \) the direction of the reaction to the right shows a very strong reaction. With a very strong reaction to the formation of Au(CN) molecules, it is hoped that all CN- react with Au. Thus there is no buildup of CN- in the patient's joints. Aurum cyanide is found in the excretion system in the sweat glands, kidneys and the removal of veses [1]. There is no
concern about the buildup of Au in the user's or patient's body. Nanogolds are easily excreted outside the body. Nanosilver is a very strong antimicrobial and influenza antiviral agent [4]. Nanosilver kills various germs including bacteria in leprosy [5]. Nanosilver has been shown to kill germs in cases of herpes [6]. The use of nanosilver in this study to help the work of nanogolds. Nanosilver-weakened leprosy will be reduced. Antibodies can work best with this. Nanogold helps glutathione to maintain the body's immune power [7]. The body is more ready to face the rheumatoid arthritis suffered. The antibody is ready to deal with rheumatic arthritis. This is what will be proven in clinical trial activities with leprosy volunteers. Rheumatism suffered by leprosy patients will be analyzed from time to time. The reduction of complaints and even complete recovery is the aim of this study.

Nanogold and nanosilver are found as natural minerals present in mountainous raw water sources. In mountain eruptions, high heat causes gold and silver to melt. This melt with hot smoke carried out to form colloidal hot smoke. Rainwater brings smoke back to the ground and into water sources. Colloidal gold and silver are scattered in all the water in the soil. Nanogold and nanosilver subsequently build minerals in ground water [8]. This ground water is then used as drinking water. In this study nanogold and nanosilver were also presented in the drinking water of the volunteers. The concentration used is 20 ppm higher than drinking water. However, 20 ppm can also be diluted with drinking water in its application [9]. Special inspection is carried out every 2 weeks during the treatment. Treatment by giving nanogold and nanosilver volunteers every morning and night as much as 20 ml 20 ppm in drinking water. The use of nanogold and nanosilver can be drunk immediately or diluted with drinking water. Nanogold and nanosilver are tasteless, so it's like ordinary drinking water or mineral water in general. Nanogold and nanosilver are very good for drug delivery because it can be taken with the drug. The efficacy of the drug will be greater because the active material meets more receptors [10]. This is because nanogold and nanosilver are uncharged. This uncharged nature removes the obstruction of the molecular load of the drug to bind to the receptor [11]. Minimum charge barriers cause more and more drug molecules to reach the receptor. Increased drug activity occurs despite constant drug concentration.

2. Methods
The number of volunteers 24 people with an age range of 40-70 years. The sex of male volunteers is 12 people and women are 12 people. The condition is divided into 4 categories; weight, moderate, mild and cured. In the beginning, volunteers were chosen in the weight and moderate categories. Research data were medical records and interviews. The agreement between the researcher and volunteer leprosy patients was carried out at the beginning of the activity. Medical personnel namely doctors become witnesses in making agreements. Volunteers included in this activity were leprosy patients who had arthritis in the moderate to severe leg joints. 12 male volunteers and 12 female volunteers. Age of volunteers in the range of 40-70 years. Volunteers were treated by getting 20 ml of nanogold and nanosilver each morning and night. Nanogold and nanosilver can be drunk directly or put in drinking water. This activity is carried out every day by taking data every 2 weeks. Medical data in the form of general medical records of volunteer health development. The main questionnaire data to determine the development of rheumatoid arthritis recovery.

3. Results and discussion

3.1. Medical records data
Medical record data in the form of body temperature, heart rate, blood pressure and wound size or width are as follows (Table 1).

Reference states that nanosilver was an anti-microbial that has a broad spectrum so that various bacteria are killed during treatment. Indications that can be observed are that of normal body temperature during the treatment. Various bacterial activities that cause pain and fever are resolved during treatment. Volunteers have normal body temperature not fever. Similar with the heart rate during the treatment was also normal [11]. Nanogold maintains the body's immune system namely glutathione works more actively and is ready to face disease attacks from outside the body. Similarly, blood pressure during the
treatment. Volunteer blood pressure is maintained stable at normal levels. The wound closes because nanogolds makes cell proliferation and collagen biosynthesis increase. This is followed by good wound closure [2].

Table 1. Average body temperature of volunteers during treatment.

| Volunteer | Data-1 | Data-2 | Data-3 | Data-4 | Tada-5 | Data-6 | Data-7 |
|------------|--------|--------|--------|--------|--------|--------|--------|
| Male       | 36.5   | 36.6   | 36.5   | 36.7   | 36.6   | 36.5   | 36.6   |
| Female     | 36.6   | 36.5   | 36.6   | 36.6   | 36.7   | 36.6   | 36.5   |

The body temperature of the volunteers is generally normal in the range of 36-37 °C. They are actually not hot or feverish. The treatment of nanogold and nanosilver did not change the body temperature. Male and female volunteers have body temperatures that are not different. Both with body temperature like healthy people. This is because the antibacterial nanosilver has a role in killing microbes during the treatment [11].

Table 2. Average heart rate of volunteers during treatment.

| Volunteer | Data-1 | Data-2 | Data-3 | Data-4 | Tada-5 | Data-6 | Data-7 |
|------------|--------|--------|--------|--------|--------|--------|--------|
| Male       | 61     | 63     | 64     | 64     | 62     | 63     | 65     |
| Female     | 64     | 63     | 67     | 65     | 66     | 62     | 63     |

Volunteer heart rate is generally normal as is the heartbeat of a healthy person which is 60-90 / minute. Their daily activities like humans in general. They have enough time to work and rest. The administration of nanogolds and nanosilver has no effect on voluntary heart beats. Male and female volunteers have a heart rate that is no different. Both have heartbeats like healthy people. This is very appropriate nanogold normalizes the activity of various important organs including the heart and lungs. The heart rhythm of volunteers is normal as healthy people are during treatment [1,3].

Table 3. Average blood pressure of volunteers during treatment.

| Volunteer | Data-1 | Data-2 | Data-3 | Data-4 | Tada-5 | Data-6 | Data-7 |
|------------|--------|--------|--------|--------|--------|--------|--------|
| Male       | 122    | 124    | 121    | 117    | 119    | 121    | 122    |
| Female     | 110    | 112    | 113    | 112    | 112    | 113    | 113    |

Voluntary blood pressure in this case is the upper pressure that is the blood pressure coming out of the heart. Volunteers have normal upper human blood pressure of 120 mmHg for men and 110 mmHg for women. There is a difference between the average blood pressure of male and female volunteers. The average blood pressure of male volunteers is slightly higher than that of female volunteers. This is normal as in humans generally. The administration of nanogold and nanosilver had no effect on the blood pressure of male and female volunteers. Volunteer blood pressure during the treatment indicates a normal person's blood pressure. This is because the heart organs and blood vessels during normal functioning. The role of the nanogold is clearly seen. Nanogolds make the heart function normally [1,3].

Table 4. Average wound width of volunteers during treatment.

| Volunteer | Data-1 | Data-2 | Data-3 | Data-4 | Data-5 | Data-6 | Data-7 |
|------------|--------|--------|--------|--------|--------|--------|--------|
| Male       | 5.2    | 5.1    | 5.1    | 4.9    | 4.4    | 4.1    | 3.3    |
| Female     | 4.7    | 4.5    | 4.3    | 3.7    | 3.6    | 3.3    | 3.2    |

The width of the wound is measured by the diameter of the wound which is generally circular. The average width of a male volunteer wound is greater than that of a woman. During the treatment changes occur in both men and women. The change leads to recovery, which is getting smaller and smaller. The
open part of the wound closes and shrinks. This is very much in accordance with the previously reported nanogold activity. Nanogold has the activity of increasing cell proliferation [12]. Nanogold also has the activity of increasing collagen biosynthesis [13]. Both of these activities are very supportive in the process of wound healing. Nanogold also suppresses free radicals [14]. Free radicals are always present in the area of the wound which aggravates the wound. Damped free radicals can reduce wound widening [15].

3.2. Questionnaire the development of rheumatoid arthritis recovery

Volunteers prior to the study were classified into 4 categories in terms of their health condition. The weight category is volunteers who have difficulty walking. Joint pain, swelling, and rheumatic pain. Moderate category if the volunteer can walk even though the joints are sick, swollen and rheumatic pain. Light category when volunteers easily walk but joints still hurt when pressed. Small swollen feet and mild rheumatic pain. Cured category if there are no complaints on the joints and easy to walk.

The function and role of nanogold and nanosilver are clearly visible. Antimicrobial nanosilver that kills microbes in joint inflammation [11]. The joint is not inflamed and the pain disappears. The nanogold originally for rheumatic diseases. Nanogold brings out inflammatory fluid in the joints. This liquid is a degradation of protein from both the body of the patient and dead bacteria. With the release of joint fluid, inflammation is reduced and rheumatism gradually heals [17].

| Volunteer | Data-1 | Data-2 | Data-3 | Data-4 | Tada-5 | Data-6 | Data-7 |
|-----------|--------|--------|--------|--------|--------|--------|--------|
| **Male**  |        |        |        |        |        |        |        |
| Weight    | 12     | 11     | 9      | 6      | 4      | 2      | 0      |
| Moderate  | 0      | 1      | 2      | 3      | 2      | 0      | 1      |
| Mild      | 0      | 0      | 1      | 2      | 2      | 2      | 0      |
| Recovered | 0      | 0      | 0      | 1      | 4      | 8      | 11     |
| **Female**|        |        |        |        |        |        |        |
| Weight    | 11     | 9      | 7      | 5      | 3      | 0      | 0      |
| Moderate  | 1      | 3      | 2      | 2      | 2      | 3      | 0      |
| Mild      | 0      | 0      | 3      | 5      | 4      | 2      | 0      |
| Recovered | 0      | 0      | 0      | 3      | 3      | 7      | 12     |

**Figure 1.** Recovery process of male volunteer from weight rheumatic until recovered.

Arthritis rheumatism recovery process (RA) is characterized by changing conditions from severe to recovering or recovering. The number of volunteers who experienced RA weight categories decreased. On the other hand, the number of volunteers who experienced RA in the mild category to recover increased. This can be seen in Figure 1 for male volunteers and Figure 2 for female volunteers.
Basically, both men and women do not differ in the composition of joint fluid associated with rheumatic disease. The occurrence of accumulation of joint fluid due to microbes and protein degradation of the patient's body. Nanosilver plays a role in killing microbes and nanogolds bring out accumulated joint fluid. Nanogold and nanosilver play an important role in the healing of rheumatism gradually [1,7,11].

Figure 2. Recovery process of female volunteer from weight rheumatic until recovered.

The process of recovery of rheumatoid arthritis (RA) in male and female volunteers is not much different. The speed of RA recovery in men and women can be compared from the graph gradient in Figure 3. Both graphs have the same slope or slope. This means that the speed of recovery of male and female volunteers is no different. Giving nanogold and nanosilver together can reduce RA levels in research volunteers. Research volunteers were leprosy sufferers who also suffered from RA. Proven for rheumatic conditions in the severe category also healed. There is no difference between men and women in the process of recovery of rheumatism in the heavy category. Although volunteers are leprosy patients, rheumatism suffered can be cured. This further emphasizes the role of nanogold and nanosilver to cure rheumatism [1]. The role of nanosilver kills microbes that cause leprosy is also seen. Thus nanosilver is also antimicrobial for leprosy bacteria [11].

Figure 3. Comparation of recovery process male and female volunteer.

The results show a gradual recovery process towards recovery. One person with an initial condition in the weight category had not recovered for 3 months of treatment. Overall there was an improvement in conditions from weight to moderate, mild and recovered. Gender has no effect on the recovery process.

4. Conclusion
Nanogold and nanosilver heal the wounds of volunteers with leprosy. The wounds gradually close, dry out and shrink. The size of the wound diameter gradually decreases towards healing. The conclusions of the nanogold and nanosilver case studies succeeded in alleviating to cure rheumatoid arthritis.
volunteers for leprosy patients. This case study has the impact give new hopes for leprosy patients to keep their spirits alive. This is very important for the future of leprosy patient free from rheumatoid arthritis.

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References
[1] Alanazi F K, Radwan A A and Alsarra I A 2010 Biopharmaceutical applications of nanogold Saudi Pharmaceutical Journal 18 4 179-193
[2] Taufikurohmah T, Winarni D, Baktir A, Sanjaya I G M and Syahrani A 2013 Histology study: pre-clinic test of nanogold in mus musculus skin, at fibroblast proliferation and collagen biosynthesis Chemistry and Materials Research 3 5
[3] Taufikurohmah T, Sanjaya I G M, Baktir A and Syahrani A 2012 Activity test of nanogold for reduction of free radicals, a pre-assessment utilization nanogold in pharmaceutical as medicines and cosmetics Journal of Materials Science and Engineering B 2 12 611-617
[4] Taufikurohmah T, Wardana A P, Tjahjani S, Sanjaya I G M, Baktir A and Syahrani A 2018 The Clinical Test of Nano gold Cosmetic for Recovering Skin Damage Due to Chemicals: Special Case Journal of Physics: Conference Series 947 1 012056
[5] Houška J, Peña-Méndez E M, Hernandez-Fernaund J R, Salido E, Hampl A, Havel J and Vaňhara P 2014 Tissue profiling by nanogold-mediated mass spectrometry and artificial neural networks in the mouse model of human primary hyperoxaluria 1 Journal of Applied Biomedicine 12 2 119-125
[6] Saha P P, Bhowmik T, Dasgupta A K and Gomes A 2014 In vivo and in vitro toxicity of nanogold conjugated snake venom protein toxin GNP-NKCT1 Toxicology reports 1 74-84
[7] Dykman L A and Khlebtsov N G 2011 Gold nanoparticles in biology and medicine: recent advances and prospects Acta Naturae (англоязычная версия) 3 2
[8] Carnovale C, Bryant G, Shukla R and Bansal V 2016 Size, shape and surface chemistry of nanogold dictate its cellular interactions, uptake and toxicity Progress in Materials Science 83 152
[9] Murai T, Sato M, Nishiyama H, Suga M and Sato C 2013 Ultrastructural analysis of nanogold-labeled cell surface microvilli in liquid by atmospheric scanning electron microscopy and their relevance in cell adhesion International journal of molecular sciences 14 10 20809-20819
[10] Katsnelson B A, Privalova L I, Gurvich V B, Makeyev O H, Shur V Y, Beikin Y B and Vasilyeva M S 2013 Comparative in vivo assessment of some adverse bioeffects of equidimensional gold and silver nanoparticles and the attenuation of nanosilver’s effects with a complex of innocuous bioprotectors International journal of molecular sciences 14 2 2449-2483
[11] Sarsar V, Selwal K K and Selwal M K 2014 Nanosilver: potent antimicrobial agent and its biosynthesis african journal of Biotechnology 13 4
[12] Podejmowan N and Deczyż T 2011 Silver nanoparticles - Making Difficult Decisions Obtaining nanomaterials 18 2
[13] Johnston J H and Nilsson T 2012 Nanogold and nanosilver composites with lignin-containing cellulose fibres Journal of Materials Science 47 3 1103-1112
[14] Shameli K, Ahmad M B, Jazayeri S D, Shabanzadeh P, Sangpour P, Jahangirian H and Gharayebi Y 2012 Investigation of antibacterial properties silver nanoparticles prepared via green method Chemistry Central Journal 6 1 73
[15] Taufikurohmah T, Sanjaya I G M, Baktir A and Syahrani A 2015 Stability of Colloidal Silver Nanoparticles Synthesized with Variance Silver Ions as Antimicrobial in Cosmetic Formulation Asian Journal of Chemistry 27 4 1525-1528