Physiological and Biochemical Study of Nano-Gold Oxide for the Healingin Dogs.

Haidar k.a. alsaedi
Department of Basic Science, Faculty of Dentistry, Al-Qadisyah University, Iraq
Email: haider.alsaedi@qu.edu.iq
Email: haider.k.abaas@gmail.com

Abstract
The purpose of this research was to evaluate the effects of a right lung middle lobe resection on lung tissue healing when treated with gold oxide nanoparticles and the harmonic scalpel. A total of 24 adult dogs were utilized. They were divided in half, with each half being the same size (control and treated group). Using a harmonic scalpel and titanium clamps, The right lung's medial lobe was taken out, preventing further bleeding and the introduction of air bubbles. Two weeks after surgery, the animals' physical and mental well-being were evaluated. On days 1, 2, 4, 8, 16, 22, 28, and 36 following surgery, interleukin-6 and tumor necrosis factor- were measured to examine their molecular activity. Clinical observations revealed that the dogs in both groups needed between two and four days to return to normal activity levels following surgery. The patient's heart rate and breathing rate were both normal prior to and throughout the operation. After the animal began to feel better, its heart rate and breathing rate increased and became irregular. Within 24 hours after the procedure was finished, everything was back to normal. Whereas the control group's heart rate and breathing rates did not change for several days after surgery, the experimental group's heart rate and breathing rates, these changes were observed in all of the treated animals. Interleukin-6 and tumor necrosis factor- were two molecules whose mean values were different in the molecular evaluation between the control and treated groups.

1. Introduction

Lung diseases include cancer, trauma, torsion of the lung lobes, chronic lung diseases, and cystic fibrosis. The removal of lung lobes is sometimes the only effective treatment for these diseases (1). Compared to open surgery, laparoscopic procedures are more humane for the animals because they cause less discomfort and trauma. It's quicker, easier, and safer (2). The use of thoracoscopes for the diagnosis and treatment of thoracic lesions, both pulmonary and non-pulmonary, has become increasingly common in veterinary medicine. This is because there is less of a chance of infection and less time spent recuperating after surgery. However, full or partial lobectomies performed via thoracoscopy had successful outcomes (3). Ultrasonic harmonic scalpel dissection tools have been developed as an alternative to traditional electrosurgical equipment. Ultrasonic waves are used by these tools to make clean incisions in the tissue. This allows for a cleaner incision with less collateral tissue damage than is possible with monopolar electrosurgical tools. Surgeons can have a better view of the affected area, reduce surgical smoke and charring, and speed up the process of controlling bleeding and dissecting simultaneously (4). Materials that are very different from their bulk counterparts in terms of their biological, chemical, and physical properties are at the heart of nanotechnology, which is at the vanguard of the world's technological rise (5). Because it is the only metal oxide NP with rigidity, high ionic properties, a crystal structure, and a simple stoichiometry, gold oxide (AuO) has been the subject of extensive research (6). Gold ions are not toxic, and AuO is bioactive and safe for use around living things (7). In terms of how it interacts with living organisms, AuO NP is one nanomaterial that has not yet been fully explored (8).
It has been shown in numerous scientific studies that NP, plays a beneficial role in cells or animals, and that it decreases pain and inflammation.

2. Materials and Methods

Layout of an Experiment

Twenty-four adult male dogs of a local breed were used in this study, with an average age of 1-2 years and a weight of 15-25 kg. The canines were divided into two groups at random. The animals were housed for a period of 14 days prior to surgery. Ivermectin 1.2%, at a dose of 0.2-0.5 mg/kg B.W., was used to treat all of the dogs for both internal and external parasites. subcutaneously, with a repeat injection 14 days later (9). The surgical animal fasted for 24 and 6 hours, respectively. Prior to the procedure, a spirometer was used to measure the patient's tidal volume.

To Perform a Surgical Procedure

The right side of the chest was sterilized from the first rib to the last rib in preparation for the operation. The animal was premedicated with an intramuscular injection of atropine sulfate at a dose of 0.05 mg/kg B.W. After waiting ten minutes, the animal's veins were injected with 12 mg/kg B.W. of 2.5% thiopental to render it unconscious and facilitate the insertion of an endotracheal tube. An inhalation anesthetic machine (closed method) containing a mixture of

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halothane and oxygen with a minimum alveolar concentration (MAC) of 1-1.5 and oxygen flow of 1-2.5 L/min was then connected to the animal. The animal was lying on its side with its head propped up on the operating table, where it was safely restrained. Prior to, during, and after surgery, patients received intravenous infusions of 8-10 ml/kg/hour of Ringer lactate solution (11).

A tiny incision measuring about 1 centimeter in length was made in the skin between the tenth and eleventh ribs, in the exact middle of the rib cage. Pursing sutures of size 2/0 polyglactin 910 were used to close the incision. The intercostal muscles were then opened with a blunt dissection to allow the trocar and cannula access to the thoracic space for the pneumo-thorax to be arranged. Depending on the size of the animal's chest, the primary parameters for intrathoracic pressure on the insufflator were set between 3 and 6 mm/Hg. This was the access point through which a telescope was used to look at the right lung and its environs. Lung lobectomy followed, necessitating two more ports. First, a 5 mm needle was inserted into the anterior 2/3 of the 9th intercostal space (for the grasper). Using the same technique as the first port and a telescope, a second one, this one 10 mm in diameter and positioned in the dorsal third of the ninth intercostal space (for the harmonic scalpel and clip applicator), was successfully inserted. Once the hilus of the right lung lobe was located, the middle lobe was grasped with a forceps, and the bronchus and blood vessel were tied off with two 10 mm titanium clips. After that, using the coagulation and cutting mode at levels 3–5 on the device's footswitches, the right middle lobe was coagulated and cut above the titanium clips. The severed lobe of lung was then removed through an enlarged dorsal port. The only difference between the treated and control groups was the injection of a AuO NP solution (100 g/ml) into and around the lobe stump. The AuO NP solution was prepared by dissolving AuO NP in distal water. A thoracoscopic needle was used for this procedure (12). A look at the stump revealed no signs of air leakage or bleeding. For diagnostic purposes, normal saline was injected into the thoracic cavity at the stump site. If so, a suction-irrigation device was used to remove the salt water. After deflating the pneumothorax, the instruments, telescope, and ports were removed. After the ports were inserted, the pleura, intercostal muscles, and subcutaneous tissues were closed using a simple, continuous technique and polyglactin 910 No. 1/0. The skin was closed using straightforward interrupted sutures made of silk No. 0. After surgery, pain was managed with intravenous tramadol at a constant dose of 1-4 mg/kg body weight twice daily for the first two days (10). Stitches were removed from the skin after ten days.

Clinical Laboratory Testing of Blood Samples

Prior to the start of surgery, or "time zero," blood was drawn from the animals. After the initial day, subsequent blood samples were taken on days 1, 3, 5, 7, 14, 21, 28, and 35. Serum was separated from the blood at room temperature by spinning the blood sample at 3500 RPM for 10 minutes. After that, a pipette was used to remove the serum and transfer it to a plastic vial. Serum samples were analyzed using canine-specific ELISA and diagnostic kits for interleukin-6 and TNF.

Preparing for the subcellular environment

The bronchial vein was used to collect blood from 12 birds total (3 birds per replicate). Tubes of tetraethylene potassium were used to store blood samples. After centrifuging the blood at 3000 rpm for 15 minutes, the plasma was frozen at -20 ° C before its activity10 could be measured. After 112 days, three of the birds in each replicate (12 birds total) were killed, and their livers were frozen at -18°C so that the enzyme levels in the livers could be measured.

Generalized scavenger-scavenger-oxidoreductase (GSH.To evaluate GSH's status, the "method of 12" was applied.Measurement of Enzyme Activity (CAT).Calculating CAT activity in liver subcellular fluid using the method of 13 was performed.Determine the level of GPx activity.The GPx activity was evaluated using the method of 14.Tips for calculating LPO.MDA can be calculated using the TBA method, and its value is related to the health of cells. 15.

A look at the numbers

One-way analysis of variance and multiple range testing were used to examine the data for Duncan. Three broiler chickens per group represents one standard deviation. The analysis took into account the significance level of a p-value of 0.05.

3. Results

Antioxidants such as vitamins C and E were tested to see if they mitigated the effects of summertime heat stress in chickens.All clinical observations, such as the animals' levels of activity, were recorded daily during the daily observations (posture, motion, alert to surrounding, appetite, urination and defection). It took most of the dogs in both groups between 2 and 4 days after surgery to resume normal activity. However, four control group dogs did not move around at all during the first four to seven days after surgery. When compared to the treated group, the control group's animals experienced normal body

temperatures, whereas the control group's animals experienced a slight increase in temperature, particularly in the first 2-4 days after surgery (dogs in both groups show slight decrease in the body temperature at the end of operation and continued 1-3 hour after operation).

The Art of Measuring Oxygen and Carbon Dioxide

In order to monitor the patient's oxygen and carbon dioxide levels before, during, and after surgery, a capnograph was used. Before and during the procedure, the oxygen level in the patient's blood was maintained at a level of 90 to 100 percent by continuously injecting fresh oxygen into the veins. It could take the body up to two hours to adjust, so this was done even after the animal had recovered. However, in some cases, the concentration of O2 dropped to 70% after the operation when the supply of fresh O2 was cut off. The CO2 level in the blood was measured at 30–35% before surgery and remained stable throughout the procedure. In other words, the concentration of carbon dioxide stayed within the normal range of 25 to 50% and never went higher than 50%. After the procedure, the CO2 level fluctuated outside of the typical range, but it stabilized and returned to its pre-surgery levels within a few hours.

Vital signs and respiratory rates

According to this research, participants' heart and breathing rates changed before and after surgery. The heart rate was within the normal range (around 85 beats per minute) prior to and throughout the operation. The dogs' heart rates increased irregularly from the time they began to recover, reaching a maximum of around 150 to 160 beats per minute when they were fully healthy. About three to five hours after the operation, the heart rate returned to normal after experiencing an irregularity. All of the treated animals eventually returned to a normal heart rate over the course of the next few days. With the exception of four dogs, whose heart rates remained slightly elevated for an additional three weeks after the operation, the average heart rate in the control group remained elevated for seven days after the procedure.As expected, their breathing rate increased after the operation (23 breaths per minute). In the first few hours after surgery, the patient's breathing rate increased, reaching 80 to 90 breaths per minute (3-5 hours). The patient's rate of breathing eventually normalized and decreased, reaching 40 to 50 breaths per minute on the first day after surgery as his body adjusted to its new state. The rate then began to decline and by day 4 or 5 had returned to normal. All of the experimental animals were able to meet this breathing requirement. For 7-10 days after surgery, breathing was normal in the control group, with the exception of 4 animals whose breathing was slightly higher than normal up until the time of the biopsy. The treated group appears to be breathing normally during exercise, whereas four of the animals in the control group become fatigued after only a short period of activity and lay down. In addition, they begin to breathe more rapidly, and it remains elevated for some time.

Flow rate

Although tidal volumes vary from animal to animal, researchers found that the mean value was between 450 and 500 ml. The second reading showed a decrease in tidal volume of 10-15% compared to the initial reading taken just before surgery. The unsteady breathing patterns in the first postoperative hour made it difficult to accurately measure tidal volume. Tidal volume decreased, however, as breathing became more regular. The tidal volume then began to increase, and within three to four days, all of the treated animals had returned to their pre-treatment levels. For the animals in the control group, it took about 10 days to return to pre-surgery levels, with the exception of 4 animals whose tidal volume did not return to pre-surgery levels until 3 weeks post-op.

Interleukin-6

and 5B show that there was a statistically significant difference between the two groups in terms of IL-6 mean values on days 1, 2, 4, 8, 16, 22, 28, and 36 following surgery. Similarly, when comparing mean values of IL-6 across days within the same group, we found a statistically significant difference (P Value 0.01).

and monitored patients at various stages of recovery.

Cytotoxic TNF-a

On days 1, 2, 4, 8, 16, 22, 28, and 36 after surgery, the mean values of TNF- were significantly different between the control and treatment groups. Mean TNF- levels varied significantly from one day to the next, even within the same group.

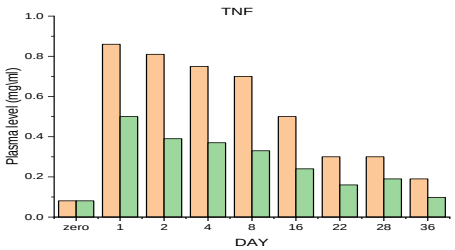

Figure 1: Show the difference values of IL-6 within each group at different period post-operation

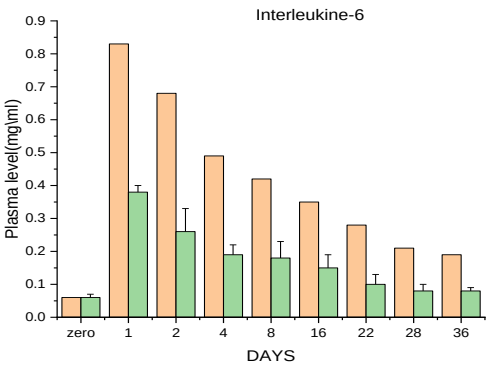

Figure 2: Show the difference values of IL-6 in control

TABLE 1. The effect of addition of Nano- Gold on the antioxidant status in dogs.			
NO.	PARAMETERS	GROUPS	
		CONTROL±S.D.	Treatment±S.D.
1 2 3 4	GSH (nmol/Mg Protein) GPX (U/g Hb) CAT (U/L) MDA (nmol/g tissue)	761.07±0.67a 16.28±0.88a 0.068±0.83a 1.682±0.098a	812.78±0.71b 18.05±1.21b 0.594±0.74b 0.196±0.0108b
**The different litters, the various treatments differed in important ways at a statistically. * The mean values are ±S.D. ($p < 0.05$) (statistical One column)			

4. Discussion

Clinical indicators in physiology

Two to three hours after surgery, both groups' core temperatures dropped slightly. Possible cause: the effects of inhalation anesthesia on the body's temperature control system. It was consistent with the findings of Kurz (14), who demonstrated the profound impact that anesthesia and surgery have on the body's ability to regulate temperature. This resulted in a core temperature of 1 to 3 degrees Celsius during the operation. Body temperature was within normal limits in the treatment group but slightly elevated in the control group. For the control group, a return to a normal core temperature took three to four days. The antibacterial and inflammatory effects of nanomaterials may account for the difference. In their study, Maji et al. (15) found that Gold oxide nanoparticles exhibited significant antibacterial activities.

While heart rates were within normal ranges in both groups during surgery, they increased during the post-op recovery phase and remained abnormal for the first three to five hours after the procedures were completed, before returning to normal over the following twenty-four hours. All treated animals' heart rates began to decrease gradually and reached within normal level within 2-3 days after surgery, whereas in the control group it lasted until 7 days after surgery. Erol et al. (16) reported that postoperative cardiac complications were the most frequently observed complication in patients for whom lung resection was performed, which could explain the observed irregularity, elevation, and subsequent decrease and return to normalcy after thoracoscopic lobectomy. It is common for patients to experience postoperative atrial arrhythmias following pulmonary lobectomy, and these arrhythmias are linked to increased risks of stroke, death, hospital length of stay, and readmission. To develop effective preventative measures, it is necessary to first identify those patients who are most likely to be affected.

The rate of breathing and the heart rate both changed simultaneously. After an initial increase in the first 3–5 postoperative hours, the patient's breathing rate stabilized and decreased in the following 24 hours. Normal breathing and heart rates were achieved by days 4-5. All of the treated animals met this standard for breathing, while the control group's breathing rate remained unchanged for 7-10 days after surgery. It's possible that this is due to the lungs compensating for the absence of their right middle lobe. These findings corroborated those of Wakamatsu et al. (17), who found that canines quickly learned to adapt their breathing following pneumonectomy, maintaining adequate oxygen levels and a steady blood pressure despite the surgical procedure. Dogs that are getting a pneumonectomy may have already started to make up for their decreased lung function, which would explain why the pulmonary parenchyma that is still there works better. When compared to lobectomy, pneumonectomy may allow for greater growth in the lungs' contralateral lobes.

Animals in the treatment group adapt to the physical activity and resume normal breathing afterward. A few of the animals in the control group collapsed from exhaustion or developed a rapid heartbeat. This difference between the two groups could be because of what AuO NPs do to help the healing process. These observations of our results were made by Kim et al. (18), who show that lobectomy patients had a big drop in their functional reserve, with both lung function and exercise capacity getting worse by almost the same amount. When the lung parenchyma is removed during a thoracotomy, the patient's pulmonary functional reserve and exercise capacity decrease. Maximum cardiac output, the ability to breathe deeply, and the capacity for diffusion are all reduced proportionally to the amount of lung tissue that is removed. Because of this, the amount of oxygen the body can consume at once is capped (19).

Lung parenchyma loss is one reason for the drop in exercise capacity and functional reserve, but pain and restrictions on the chest wall caused by surgery are another (20). Patients who have had lung resections have a significant decrease in exercise capacity within the first two weeks, despite the fact that techniques like video-assisted thoracoscopic surgery have been developed to cause less damage to the chest wall. Many interrelated factors contribute to this, including chest pain and diminished lung capacity as a result of surgical removal (19). Moreover, Torabi et al. (21) demonstrated that Nano- AuO has greater analgesic and anti-inflammatory effects via central and peripheral mechanisms, and that nanoparticles at lower doses were able to improve anxiety and pain perception in the presence of acute stress, resulting in faster exercise tolerance in the treated group compared to the control group.

Results on blood CO2 and O2 levels

After a lung thoracoscopic lobectomy, the oxygen concentration in a dog's blood drops from the

normal range of 90 to 100% to the lower 70% range, so the animal is given oxygen for another two to three hours to help it adjust and maintain a normal level of oxygen in its blood. This decrease in blood O2 levels following lobectomy may be due to changes in the way air travels between alveoli and interstitial tissue after the removal of the right lung's middle lobe. Post-extubation respiratory failure following major surgery is common, according to Maggiore et al. (22), and many patients in this situation require long-term mechanical ventilation and an extended stay in the intensive care unit or hospital. Patients who have had thorax surgery, especially lobectomy, have a particularly poor prognosis due to postoperative lung problems such as hypercapnia and atelectasis, which can increase the risk of death. The loss of lung volume after lobectomy can prevent adequate gas exchange in some patients. A positive airway pressure is required to increase lung volume at the end of expiration and thereby improve oxygenation in these situations.

Flow rate

After surgery, the average tidal volume dropped to between 450 and 500 ml, a decrease of about 15% to 20%. The tidal volume increased after the breathing rate normalized, and it returned to normal in all treated animals within 3-4 days, while it took most animals in the control group about 10 days to get back to where they were before. These findings corroborate the findings of Nomori et al. (23), who found that lung tissue loss can exacerbate existing breathing difficulties. The extent of surgical lung tissue removal is variable. As a result of a greater loss of functional lung volume immediately after surgery, pulmonary function decreased significantly.

Analyzing Interleukin-6

The levels of interleukin-6 were different between the two groups on days 1, 2, 4, 8, 16, 22, 28, and 36 after surgery (P value 0.01). There may have been inflammation to blame for the significantly higher interleukin-6 levels in the untreated group compared to the treated group. Serum IL-6 levels are low in healthy people, as found by Stormann et al. (24). These concentrations rise rapidly and may approach high levels in the mg/mL of serum when there is inflammation, trauma, or injury, or when someone is very ill. The level of IL-6 elevation is proportional to the extent of tissue injury. Measuring IL-6 is a more accurate indicator of disease progression than C-reactive protein (CRP). Consequently, elevated IL-6 levels serve as an early indicator of infection or inflammation and play a crucial role in the body's natural defenses. Blood IL-6 levels peak within 24 hours of injury in large animal models like canines and pigs, as shown by Qiao et al. (25). Possible use in foreseeing post-injury problems.

Individuals within the same cohort at different postoperative time points vary greatly. These data demonstrated that interleukin-6 levels decreased over time following surgery. Consistent with the findings of Das et al. (26), this study found that serum interleukin-6 levels increased after surgery and returned to pre-operative levels only very slowly for a patient without postoperative complications. The stress response, the production of cytokines, the ratio of inflammatory to anti-inflammatory factors, and immune suppression can all be mitigated with competent postoperative analgesic nursing care. In addition to alleviating postoperative pain, intraoperative analgesia and patient-controlled analgesia after surgery can reduce blood levels of proinflammatory factors and halt an exaggerated stress response. This explains why the treated group had lower levels of IL-6 and TNF- than the control group. The nano-sized may be helpful because it reduces inflammation and alleviates pain. AuO NPs have been found to be beneficial by other researchers, including Moeini-Nodeh et al. (27). Protecting against diabetes-related diseases and reducing inflammation are two of AuO NPs' many benefits.

Considering TNF- for Evaluation

On days 1, 2, 4, 8, 16, 22, 28, and 36 after surgery, we found that there were differences in tumor necrosis factor levels between the two groups (P value 0.01). The levels of tumor necrosis factor were found to be higher in the untreated group compared to the treated group. As a result of infection and inflammation, macrophages and lymphocytes secrete tumor necrosis factor to repair the damage they've done to nearby cells. According to Faz-Lopez et al. (28), TNF- levels are high in both the serum and the bronchoalveolar lavage fluid, which plays a role in the pathophysiology of the systemic inflammatory response in critically ill patients with conditions like acute lung injury.

Acute inflammation relies heavily on tumor necrosis factor-, as demonstrated by Liu and Tang (29). Most immune cells, including monocytes and macrophages, produce this inflammatory cytokine. TNF- is typically associated with immune cells, but it is also produced by non-immune cells like fibroblasts, neurons, keratinocytes, and smooth muscle cells. In cases of severe injury, plasma TNF- levels rise. Injured tissue can heal or be replaced with the help of low levels of TNF-, which stimulates fibroblast growth. Blood TNF- levels peaked at 24 hours post-injury and gradually decreased thereafter. In addition, Fehaid and Taniguchi (30) showed that TNF- is a major proinflammatory cytokine, is typically detected in the earliest stage of cell inflammation, and has many known signal transduction pathways, including the induction of cell death. When cells are exposed to both TNF- and NPs, however, both bind to TNFR1; however, TNF- binds to the receptor more specifically than the nanoparticles do. Receptor-mediated endocytosis is then used to bring the TNFR1-TNF-NPs complex into the cell. The receptor then secretes TNF-, which triggers cell death.

The receptors may still bind to NPs, which could alter their size, shape, and other properties and disrupt

their normal recycling pathway to the cell membrane, resulting in lower levels of TNFR1 outside the cells and higher levels inside. These results demonstrate a molecular mechanism by which TNFR1 may promote NP uptake by cells and attenuate TNF-induced apoptosis.

The pathway for re-expression of membrane receptors is inhibited by the NPs-TNFR1 complex, as shown by the mechanism. This weakens the effect of TNF- on signal transduction and apoptosis. All of these explanations square with our findings that TNF- was reduced in the treatment group compared to the control.

TNF- levels fluctuate significantly over time, even within the same cohort. It's possible that this is due to the fact that TNF- levels are highest at the start of an inflammatory response and tissue damage. This is consistent with the findings of Shapouri-Moghaddam et al. (31), who demonstrated the importance of TNF-, which is released by activated M1 macrophages and has multiple biological effects including cell differentiation, proliferation, and amplification of the immune response. and The increased blood concentration of TNF- indicates that pro-inflammatory cytokines are being produced and that inflammation is worsening.

5. Conclusion

Nanoparticles of Gold oxide improve wound healing with minimal pathological changes.

References

Yhee JY, Im J, Nho RS. Advanced therapeutic strategies for chronic lung disease using nanoparticle-based drug delivery. J Clin Med. 2016;5(9):82-95. DOI: 10.10.3390/jcm5090082

Malik ZJ, Eesa MJ. Laparoscopic partial splenectomy by using two techniques in goats. Iraqi J Vet Med. 2015;39(1):56-61. DOI: 10.30539/iraqijvm.v39i1

Nylund AM, Hoglund OV, Fransson BA. Thoracoscopic-assisted lung lobectomy in cat cadavers using a resorbable self-locking ligation device. Vet Surg. 2019;48(4):563-569. DOI: 10.10.1111/vsu.13109

Lee D, Jung BK, Roh TS, Kim SK. Ultrasonic dissection versus electrocautery for immediate prosthetic breast reconstruction. Arch Plast Surg 2020;47(1):20-25. DOI: 10.5999/aps.2019.00759

Tang ZX, Lv BF. AuO nanoparticles as antibacterial agent: preparation and activity. Braz J Chem Eng. 2014;31(3):591-601. DOI: 10.10.1590/0104-6632.20140313s00002813

Bindhu MR, Umadevi M, Micheal KM, Arasu MV, Al-Dhabi NA. Structural, morphological and optical properties of AuO nanoparticles for antibacterial applications. Mat Let. 2016;166(1):19-22. DOI: 10.1016/j.matlet.2015.12.020

Zhao Y, Liu B, You C, Chen M. Effects of AuO whiskers on mechanical properties and crystallization behavior of PLLA/ AuO

composites. Mat Desi. 2016;89(5):573-581. DOI: 10.1016/j.matdes.2015.09.157

Starlinger P, Assinger A. Importance of platelet-derived growth factors in liver regeneration. Exp Rev Gast Hepat. 2016;10(5):557-559. DOI: 10.1586/17474124.2016.1158100

Basso W, Grandt LM, Magnenat AL, Gottstein B, Campos M. *Strongyloides stercoralis* infection in imported and local dogs in Switzerland: from clinics to molecular genetics. Parasitol Res. 2019;118(1):255-266. DOI: 10.1007/s00436-018-6173-3

Ko JC. Anesthesia and pain management in dogs and cats. UK: Manson Publishing Ltd; 2013. 92-93 p.

Hosseini SV, Dehghani M, Khazraei H, Karami MY, Karbasi S Banihashmi SH. Human amniotic membrane effect on colorectal anastomosis in dogs undergoing radiotherapy with/without diverting stoma: An experimental preliminary study. Int J Radiat Res. 2017;15(2):213-218. DOI: 10.18869/acadpub.ijrr.15.2.213

Moeini-Nodeh S, Rahimifard M, Baeeri M and Abdollahi M. Functional improvement in rats' pancreatic islets using magnesium oxide nanoparticles through antiapoptotic and antioxidant pathways. Biol Trace Elem Res. 2017;175(1):146-155. DOI: 10.1007/s12011-016-0754-8

Systat Software Inc. Sigma plot V12.0/SYSTAT software. UK; 2016.

Kurz A. Physiology of thermoregulation. Best Pract Res Clin Anaesthesiol. 2008;22(4):627-644. DOI: 10.1016/j.bpa.2008.06.004

Maji J, Pandey S, Basu S. Synthesis and evaluation of antibacterial properties of magnesium oxide nanoparticles. Bullet Mate Sci. 2020;43(1):25-35. DOI: 10.1007/s12034-019-1963-5

Erol Y, Ergonul AG, Ozdil A, Nalbantgil S, Cagırıcı U, Turhan K, Cakan A. Assessment of cardiac complications in patients undergoing pulmonary resection. Heart Lung Circ. 2019;28 (7):1099-1101. DOI: 10.1016/j.hlc.2018.08.019

Wakamatsu I, Matsuguma H, Nakahara R, Chida M. Factors associated with compensatory lung growth after pulmonary lobectomy for lung malignancy: an analysis of lung weight and lung volume changes based on computed tomography findings. Surg Today. 2020;50(2):144-152. DOI: 10.1007/s00595-019-01863-0

Kim SJ, Lee YJ, Park JS, Cho YJ, Cho S, Yoon HI, Kim K, Lee JH, Jheon S, Lee CT. Changes in pulmonary function in lung cancer patients after video-assisted thoracic surgery. Ann Thora Surg. 2015;99(1):210-217. DOI: 10.1016/j.athoracsur.2014.07.066

Taşkin H, Telli AO, Yuncu G, Taşpinar B, Yalman A, Senol H. Postoperative respiratory muscle training in addition to chest physiotherapy after pulmonary resection: A randomized controlled study. Physio Theory Pract. 2018;(1):1-8. DOI: 10.1080/09593985.2018.1488189

Karenovics W, Licker M, Ellenberger C, Christodoulou M, Diaper J, Bhatia C, Robert J, Bridevaux PO, Triponez F. Short-term preoperative exercise therapy does not improve long-term

outcome after lung cancer surgery: A randomized controlled study. Eur J Cardiothora Surg. 2017;52(1):47-54. DOI: 10.1093/ejcts/ezx030

Torabi M, Kesmati M, Pourreza N, Najafzadeh Varzi H, Galehdari H. Neurobehavioral and biochemical modulation following administration of AuO and ZnO nanoparticles in the presence and absence of acute stress. Life Sci. 2018;203(1):72-82. DOI: 10.1016/j.lfs.2018.04.023

Maggiore SM, Battilana M, Serano L, Petrini F. Ventilatory support after extubation in critically ill patients. Lan Respir Med. 2018;6(12):948-962. DOI: 10.1016/S2213-2600(18)30375-8

Nomori H, Shiraishi A, Cong Y, Sugimura H, Mishima S. Differences in postoperative changes in pulmonary functions following segmentectomy compared with lobectomy. Eur J Cardiothorac Surg. 2018;53(3):640-647. DOI: 10.1093/ejcts/ezx357

Störmann P, Wagner N, Kohler K, Auner B, Simon TP, Pfeifer R, Horst K, Pape HC, Hildebrand F, Wutzler S, Marzi I, Relja B. Monotrauma is associated with enhanced remote inflammatory response and organ damage, while polytrauma intensifies both in porcine trauma model. Eur J Trauma Emer Surg. 2020;46(1):31-42. DOI: 10.1007/s00068-019-01098-1

Qiao Z, Wang W, Yin L, Luo P, Greven J, Horst K, Hildebrand F. Using IL-6 concentrations in the first 24 h following trauma to predict immunological complications and mortality in trauma patients: a meta- analysis. Eur J Trauma Emer Surg. 2018;44(5):679-687. DOI: 10.1007/s00068-017-0880-9

Das BC, Alam SMK, Nashid ZF, Khan AS, Khan ZR. Change in serum interleukin-6 levels in patients after pancreatoduodenectomy for periampullary cancer. BSMMU J. 2017;10(1):11-15. DOI: 10.3329/bsmmuj.v10i1.31311

Moeini-Nodeh S, Rahimifard M, Baeeri M, Abdollahi M. Functional improvement in rats' pancreatic islets using magnesium oxide nanoparticles through antiapoptotic and antioxidant pathways. Biol Trace Elem Res. 2017;175(1):146-155. DOI: 10.1007/s12011-016-0754-8

Faz-Lopez B, Mayoral-Reyes H, Hernandez-Pando R, Martinez-Labat P, McKay DM, Medina-Andrade I, Olguin JE, Terrazas LI. A Dual role for macrophages in modulating lung tissue damage/repair during L2 *Toxocara canis* infection. Pathogens 2019;8(4):280-305. DOI: 10.3390/pathogens8040280

Liu C, Tang J. Expression levels of tumor necrosis factor-α and the corresponding receptors are correlated with trauma severity. Oncol Lett. 2014;8(6):2747-2751. DOI: 10.3892/ol.2014.2575

Fehaid A, Taniguchi A. Silver nanoparticles reduce the apoptosis induced by tumor necrosis factor-α. Sci Technol Adv Mater. 2018;19(1):526-534. DOI: 10.1080/14686996.2018.1487761

Shapouri-Moghaddam A, Mohammadian S, Vazini H, Taghadosi M, Esmaeili SA, Mardani F, Seifi B, Mohammadi A, Afshari JT, Sahebkar A. Macrophage plasticity, polarization, and function in health and disease. J Cell Physiol. 2018;233(9):6425-6440. DOI: 10.1002/jcp.26429