Original Article: Complications of blood transfusion in patients who are candidates for heart surgeries patients in Shahid Madani Hospital of Tabriz

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ABSTRACT

Introduction*:* Coronary artery bypass grafting (CABG) surgery is associated with a high frequency of allogeneic blood transfusions in CABG patients due to acquired hemostatic complications. However, allogeneic blood transfusion increases the risk of infection, morbidity and mortality, as well as prolonged hospital stay and increased hospital costs. It is important to identify patients who need injections to reduce their risk and minimize the use of allogeneic blood. The aim of this study was to determine the factors affecting the decision of red blood cell transplantation in patients undergoing elective primary CABG.

Material and Methods: This is a cross section search based on reverse data analysis. All patients who underwent elective primary CABG were included in this study. Variables analyzed included age, gender, body weight, pre-hemoglobin (Hb) levels, patient comorbidities, and other medical conditions. Data were analyzed using SPSS software version 20.

Results: 83.4% patients underwent RBC transfusion. Based on multiple logistic regression analysis, age only (odds ratio [OR] = 1.040, 95% confidence interval [CI]: 1.003, 1.001), Hb level (OR = 0.500, 95% CI: 0.387, 0.644, P < 0.001), and extracorporeal circulation time (OR = 1. 013, 95% CI: 1.004, 1.023, P < 0.001) was an important indicator of RBC cycle.

Conclusion: By classifying patients according to the risk of RBC transfusion, high-risk patients can be identified and should be included in blood transfusion programs to reduce the risk of allogeneic infections.

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Introduction

One of the autologous or autologous blood transfusion methods is Acute Normal Blood Dilution (ANH), in which blood is collected shortly before surgery with hemodilution (blood thinning) and is a useful and cost-effective strategy. Preserves blood and blood products in patients who lose more than one liter of blood during surgery. This method reduces the need for allogeneic blood transfusions and the complications of the transfusion(Figure 1).

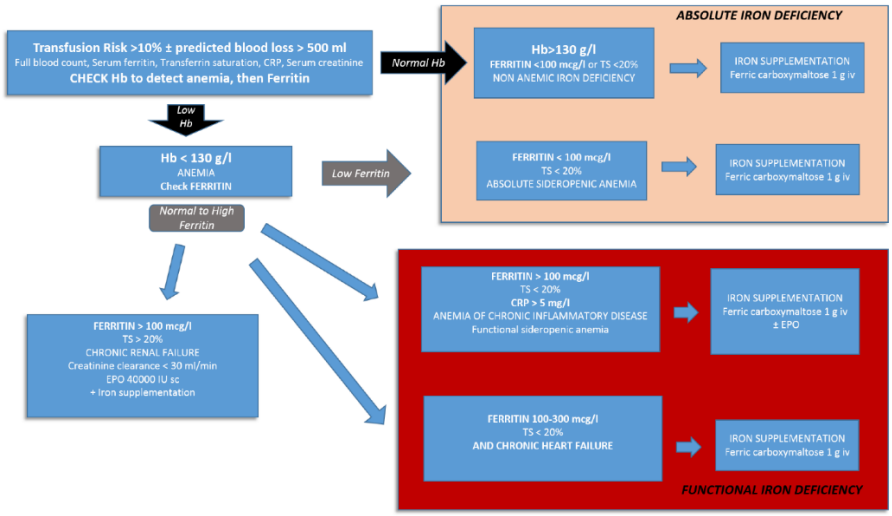

Figure 1: Blood Transfusion challenge in Heart Surgery

ANH is less expensive than preoperative autologous blood donation (PABD). Shortly after induction of anesthesia and before the onset of bleeding and surgery, the patient's own blood is drawn by ANH and a replacement fluid (crystalloid) is injected to maintain intravascular volume. Autologous blood can be returned to the patient whenever the patient needs it clinically or his or her hematocrit drops [2].

One of the potential benefits of ANH is the improvement in tissue oxygenation due to reduced blood viscosity and reduced contact with allogeneic (other) blood antigens and pathogens, and complications of blood transfusion [3-5]. In addition, whole blood drawn from the patient contains coagulation factors and fresh platelets that are made available to the patient for re-injection. Since taking blood from a patient undergoing surgery can make him anemic, in this method the autologist must maintain the patient's hemodynamics (cardiovascular condition) and normalize his blood pressure with a replacement fluid [3]. (Normovolmic) and paid attention to his hemoglobin level. Preoperative blood sampling reduces blood loss during surgery(Figure 2).

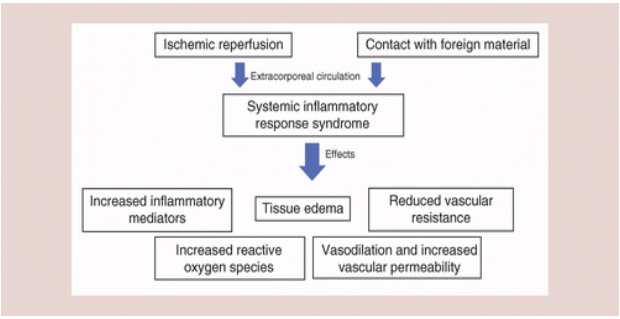

Figure 2: Blood Transfusion need in CABG

ANH is most commonly used in surgeries that involve the loss of large amounts of blood, most commonly in heart surgeries with or without extracorporeal circulation, aneurysm surgery, orthopedic surgery (thigh and knee), vascular

surgery, and Thoracic surgery (removal of one or all of the right or left lung), urological surgery (prostatectomy, cystectomy, and nephrectomy) and general surgery (limited bowel surgery and limited tumor resection) are used[5,6]. The rate of bleeding is more than 10% to 15% of the patient's intravascular volume. It should be examined [6-8].

Material and Methods

Study design: In a retrospective study, a three-day retraining course was held for cardiac surgery staff (specialist physicians and operating room nurses) at Shahid Madani Hospital (Tabriz University of Medical Sciences) and used various autologous blood transfusion methods, including dilution method. Acute blood pressure with normal pressure or ANH received special attention.

Inclusion and exclusion criteria: Inclusion criteria included: Inclusion criteria included cardiovascular islet candidates, autologous blood transfusion and consent to participate in the study, and exclusion criteria also included blood transfusion during a recent month, history of allergies. Previous to blood, blood samples were homologous.

Methodology: Then the information of cardiac surgery patients (including age, sex, weight, type of surgery, hemoglobin, hematocrit, autologous blood sampling rate after anesthesia, blood sampling site, complications during blood sampling and up to half an hour after, stability and instability of hemodynamic status and Using a pump balloon) was sent to the autologous blood transfusion unit in Tehran province. This study was performed retrospectively on Tabriz blood transfusion. All data of cardiac surgery patients for whom autologous blood transfusion was performed by ANH method in the operating room were analyzed. Inclusion criteria included hemoglobin above 12, elective surgery, cardiac output of more than 45%, absence of any infection or kidney and lung disease, seizures, bleeding disorders, hematologic disorders and liver cirrhosis. In this study, adult patients underwent cardiac surgery after anesthesia and complete cardiovascular monitoring, a unit of autologous blood (450 ml) and blood weighing 5-8 kg mL/kg were taken and blood was taken for each ml. The patient was injected with 3 ml of crystalloid (Ringer). Their complications, including arrhythmias such as atrial fibrillation rhythm, abnormal ventricular rate, and unstable hemodynamics, were then assessed and recorded during blood sampling and up to half an hour later and was injected after surgery.

Data analysis: Then the information sent to these cardiac surgery patients to the autologous blood transfusion ward in Tabriz in 2019 was analyzed with 18 SPSS. Frequency tables, central indices and dispersion indices were used to analyze the data. This study was performed to evaluate the possibility of performing one of the autologous methods (acute dilution of blood with normal pressure) in different patients with heart surgery and its complications in these patients.

Ethical considerations: This study was conducted after approval by the ethics committee of Tabriz University of Medical Sciences. Then the informed consent was completed by the participants and their information was used.

Results

Complications during autologous ANH blood sampling (collecting the patient's own blood shortly after anesthesia and replacement with crystalloid and hemodilution) were evaluated in 308 heart surgery patients in 2019. Results were reported as mean ±standard deviation. These patients had a minimum of 14 and a maximum of 81 years with a mean age of 54.34±10.91 years.

Among all patients, 296 (96.1%) were male and 12 (3.9%) were female.

Their weight was reported to be between 42 and 102 kg with an average weight of 72.58±10.82 kg. The hemoglobin of these patients was between 13-21 g/dL (15.07±1.25) and their hematocrit was between 39-66 (46.18±3.75). In 278 (90.3%) patients, radial artery was used for blood collection and in 30 (9.7%) patients, venous blood was collected(Figure 3).

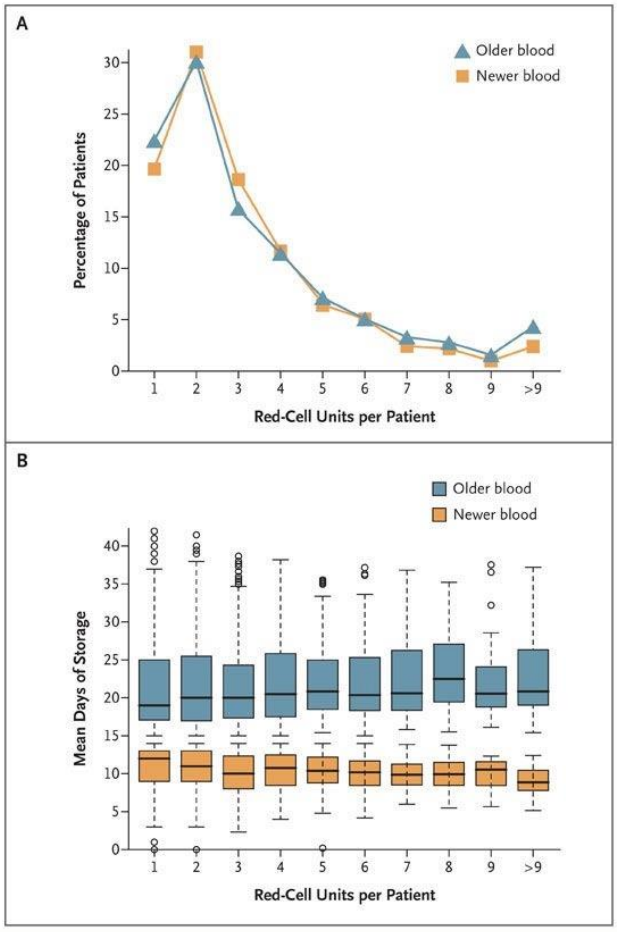

Figure 3: Blood Transfusion Complication In Cardiac Surgery

The type of operation of these patients was heart surgery from which an autologous blood sample was taken. In 266 (86.4%) patients had coronary artery bypass graft, in 20 (6.6%) patients had a heart valve replacement including aorta and mitral. In 3 (0.9%) patients, mitral and aortic valve replacement was performed simultaneously (MVR+AVR) and in 10 (3.2%) patients, coronary artery transplantation was observed with mitral and aortic valve replacement(Figure 4).

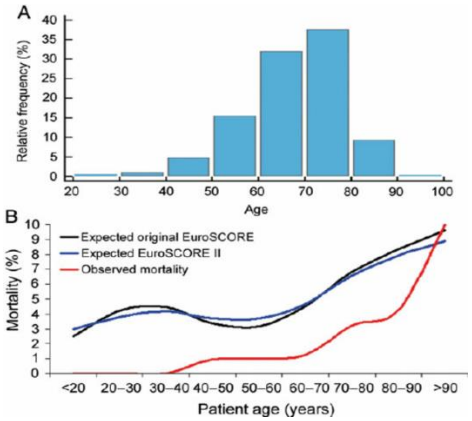

Figure 4: Blood Transfusion complication Rate in ICU after Cardiac Surgery

In 7 (2.3%) patients with congenital heart abnormalities (including tetralogy repair, fallopian tube defect, duodenal defect) and in 2 (0.6%) patients with Bental surgery in ascending aortic aneurysm (aortic valve replacement, Aortic root, ascending aorta, and repositioning of coronary arteries into grafts were performed. None of the patients reported cardiac arrhythmias or hemodynamic instability during blood sampling and up to half an hour after.

Discussion

This study showed that autologous (ANH) method can be used in different heart surgeries and patients tolerated this method well and in different heart surgeries [9-11] such as replacement of one valve such as mitral or aorta, simultaneous replacement of two mitral valves and Aorta, simultaneous replacement of mitral and tricuspid valves, coronary artery bypass graft and simultaneous aortic valve replacement by coronary artery graft, simultaneous mitral valve and coronary artery bypass graft replacement, and even aortic valve replacement and ascending aortic root and coronary artery bypass grafting [7] The autologous ANH method was used and the patients tolerated this method well and no arrhythmias such as atrial fibrillation rhythm and abnormal ventricular beat and unstable hemodynamics were seen in them and the patients did not suffer from acute complications [8].

ANH is a proven method of reducing the need for blood transfusions in heart surgery. Although the extent to which ANH reduces the use of blood products and its consequences are not yet generally agreed upon by physicians, in a study, researchers stated that less blood products when using the method [9]. ANH autologous is consumed. In this autologous procedure, some red blood cell mass is taken and replaced with colloid or crystalloid or a combination of both, and less blood is lost due to the patient's blood being diluted on the surgical site [12-14]. This method is fully approved by the Association of Anesthesiologists. Autologous ANH blood can be used to prevent the transmission of infectious diseases and hemolytic reactions [15-17]. Cardiac surgery is responsible for approximately 20% of allogeneic blood transfusions. However, with the understanding of transfusion physiology and the reduction of blood transfusion threshold and the use of antifibrinolytics and autologous blood transfusion in heart surgery, a reduction in this rate has been observed [10].

In a study at a very large hospital in the United States, this autologous procedure was performed on patients with coronary artery bypass graft surgery, and blood consumption was lower in this group than in the control group [11]. In a study, researchers found that heart valve patients were less tolerant of other autologous procedures than other patients, but patients tolerated the autologous ANH method well by changing the mitral valve (with hemoglobin 10.3±4.3 g/dl) [18-20]. Some studies have reported this autologous method as contraindication in aortic valve stenosis due to decreased cardiovascular reserve with myocardial hypertrophy. However, researchers have shown that this autologous procedure can also be performed safely in aortic stenosis if the heart is functioning properly [12]. In a postoperative ANH study on CABG patients, their hemodynamic status was assessed. Within five minutes, the heart rate did not increase, but twenty minutes later, it decreased. In both groups, five patients needed an intra-aortic pump balloon for hemodynamic support, but in the present study, there was no report of an intra-aortic pump balloon requirement [13].

The rate of blood transfusions associated with heart surgery in the United States reached a record high in 2010, with 34% of patients receiving blood products [21-23]. Patients undergoing complex surgeries (coronary artery

bypass grafting [CABG] plus repair or replacement) and complex surgery (CABG only) may have symptoms such as anemia. In addition, most patients undergoing CABG alone have a history of myocardial infarction [24-26]. These features can increase the risk of problems and modifications. Proving the relationship between blood donation and death has been difficult, as most patients undergoing heart surgery are critically ill [27-29]. Despite advances in perioperative blood preservation, such as the use of cytoprotectants in cardiac surgery, blood transfusion rates remain high. Many previous studies have shown that the use of blood products, even in low-risk patients, can affect clinical outcomes [30-32]. Based on these data, we reviewed the literature to examine the 30-day and 1-year morbidity and mortality outcomes in patients converted to uncomplicated CABG procedures [33-35].

Ferrari et al. It has been reported that patients undergoing CABG with lower Hb levels are more likely to receive blood transfusions [36-38]. Bleeding time is long in people with diabetes and antiplatelet drugs are exacerbated. The same authors later recommended 7 g/dl as the threshold for blood transfusion in the new blood conservation guidelines of the Society of Thoracic Surgery and Society of Cardiovascular Anesthesiologists.

Almost all of our patients (95.9% had CPB surgery. This may be the reason why 83.4% of the patients had blood draw, referring to the Hb level in the valves (13.7 g/dl) preoperatively. CPB machines cause excessive blood loss due to clotting during and after surgery, which increases blood loss and can subsequently cause Hb levels to drop, leading to blood transfusions. Bleeding in CABG patients may also be caused by other factors that may affect the patient, such as pre-existing thrombocytopenia and platelet dysfunction; for example, a doctor prefers surgery; the pace of surgery and related procedures such as previous heart surgery; or drug use.

Gender is a significant predictor only if it interacts with other variables, as shown in other studies. Compared with male patients, female patients undergoing CABG had lower anterior hematocrit, were smaller, were older, and had more comorbidities. These conditions have been shown to be associated with red blood cell transfusions.

Univariate analysis showed that smoking prevented blood transfusion in primary CABG patients in this study. This finding is supported by previous research. Smoking causes polycythemia and hypercoagulability, which reduces the risk of bleeding in these patients. But other authors have a different point of view. These conflicting findings may be due to the non-standard definition of smoking among the authors of these studies. In this study, smoking was obtained from patient records from different physicians and there is no standard definition of smoking [39-41].

This study identified independent markers of red blood cell transplantation in primary elective CABG. More accurate predictive tools for CABG replacement may be obtained by conducting future studies with larger cohorts. This work should have a estimation and validation phase. The estimator should then be tested in different locations to ensure it is suitable for use [42].

Conclusion

According to the present study, none of the patients showed cardiac arrhythmia or hemodynamic instability during blood sampling and up to half an hour after it, so autologous ANH transfusion for cardiac surgery patients (coronary artery bypass graft and valve replacement) in this Research was a safe way. Therefore, it is suggested that in future studies, considering the control group, the complications

and the amount of allogeneic blood consumption in the two groups be compared.

References

[1]Abdollahi MH, Foruzan-Nia K, Behjati M, Bagheri B, Khanbabayi-Gol M, Dareshiri S and et al. The effect of preoperative intravenous paracetamol administration on postoperative fever in pediatrics cardiac surgery. Nigerian medical journal: journal of the Nigeria Medical Association. **2014**; 55(5): 379. [Google Scholar], [Publisher]

[2]Birmangi S, A Review of the Effect of Corona on the Human Brain – Short Review, Eurasian Journal of Chemical, Medicinal and Petroleum Research, **2022**, 1 (3), 80-87 [Crossref], [Google Scholar], [Publisher]

[3]Ebadian B, Fathi A, Khodadad S. Comparison of the effect of four different abutment screw torques on screw loosening in single implant-supported prosthesis after the application of mechanical loading. International Journal of Dentistry. **2021**;19;2021: 3595064.[Google Scholar], [Publisher]

[4]Eghdam-Zamiri R, Gol MK. Effects of ginger capsule on treatment of nausea and vomiting in patients receiving cisplatin undergoing mastectomy: a randomized clinical trial. The Iranian Journal of Obstetrics, Gynecology and Infertility. **2020**;22(11): 15-21. [Crossref], [Google Scholar], [Publisher]

[5]Elmi A, Rouhani A, Irajian M, Iman MB, Tabrizi A. Comparison results of acromioclavicular dislocation treatment by screw with and without coracoclavicular ligamentous repair. Medical Journal of Tabriz University of Medical Sciences. **2017**; 39(2): 46-51. [Google Scholar], [Publisher]

[6]Esmaeilzadeh AA, et al., Correction: Recent advances on the electrochemical and optical biosensing strategies for monitoring microRNA-21: a review, Analytical Methods, **2023** [Crossref], [Google Scholar], [Publisher]

[7]Esmaeilzadeh AA, et al., Cytotoxic study of green synthesized pure and Ag-doped α-Fe2O3 nanoparticles on breast cancer (MCF-7) cell line, Nanomedicine Research Journal, **2022** 7 (4), 370-377 [Crossref], [Google Scholar], [Publisher]

[8]Esmaeilzadeh AA, et al., Recent advances on electrochemical and optical biosensing strategies for monitoring of microRNA-21: A review, Analytical Methods, **2022** 15 (1), 132-132 [Crossref], [Google Scholar], [Publisher]

[9]Esmaeilzadeh AA, et al., Study of Silybin in Plant Effective Substance for use in targeted liposomal nanoparticles in the treatment of liver cancer, Archives of Pharmacy Practice, **2020** 11 (1), 35 [Google Scholar], [Publisher]

[10] Esmaeilzadeh, AA, et al., Identify Biomarkers and Design Effective Multi-Target Drugs in Ovarian Cancer: Hit Network-Target Sets Model Optimizing, Biology, **2022**, 11 (12), 1851 [Crossref], [Google Scholar], [Publisher]

[11] Gheisari R, Doroodizadeh T, Estakhri F, Tadbir A, Soufdoost R, Mosaddad S. Association between blood groups and odontogenic lesions: a preliminary report. Journal of Stomatology. **2019**;72(6):269-73. [Crossref], [Google Scholar], [Publisher]

[12] Gheisari R, Resalati F, Mahmoudi S, Golkari A, Mosaddad SA. Do Different Modes of Delivering Postoperative Instructions to Patients Help Reduce the Side Effects of Tooth Extraction? A Randomized Clinical Trial. Journal of Oral and Maxillofacial Surgery. **2018**;76(8):1652.e1-.e7.[Crossref], [Google Scholar], [Publisher]

[13] Haghdoost M, Mousavi S, Gol MK, Montazer M. Frequency of Chlamydia trachomatis Infection in Spontaneous Abortion of Infertile Women During First Pregnancy Referred to Tabriz University of Medical Sciences by Nested PCR Method in 2015. International Journal of Women's Health and Reproduction Sciences. **2019**; 7(4): 526-30. [Google Scholar], [Publisher]

[14] Hasanpour Dehkordi A, Khaji L, Sakhaei Shahreza MH, Mashak Z, Safarpoor Dehkordi F, Safaee Y, Hosseinzadeh A, Alavi I, Ghasemi E, Rabiei-Faradonbeh M. One-year prevalence of antimicrobial susceptibility pattern of methicillin-resistant Staphylococcus aureus recovered from raw meat. Tropical Biomedicine. **2017**;34(2):396-404. [Crossref], [Google Scholar], [Publisher]

[15] Irajian M, Beheshtirooy A. Assessment of Frequency of Long Bone Osteomyelitis in Traumatic Patients Undergoing Orthopedic Surgery in Imam Reza (AS) Hospital-Tabriz. International Journal of Current Microbiology and Applied Sciences. **2016**;5(1): 818-825.[Google Scholar], [Publisher]

[16] Irajian M, Faridaalaee G. Establishing a field hospital; a report on a disaster maneuver. Iranian Journal of Emergency Medicine. **2016**;3(3): 115-118. [Crossref], [Google Scholar], [Publisher]

[17] Khaji L, Shahreza MH. SCCmec types in methicillin-resistant Staphylococcus aureus strains of various types of milk. Electronic Journal of Biology. **2016**;13:1. [Google Scholar], [Publisher]

[18] Mahmoodpoor A, Hamishehkar H, Fattahi V, Sanaie S, Arora P, Nader ND. Urinary versus plasma neutrophil gelatinase-associated lipocalin (NGAL) as a predictor of mortality for acute kidney injury in intensive care unit patients. Journal of Clinical Anesthesia.**2018**; 14: 12-17.[Crossref], [Google Scholar], [Publisher]

[19] Mahmoodpoor A, Hamishehkar H, Shadvar K, Sanaie S, Iranpour A, Fattahi V. Validity of bedside blood glucose measurement in critically ill patients with intensive insulin therapy. Indian Journal of Critical Care Medicine.**2016**; 20(11): 653. [Crossref], [Google Scholar], [Publisher]

[20] Margy S, A Review of the Effect of Brain imaging- Short Review, Eurasian Journal of Chemical, Medicinal and Petroleum Research, **2022**, 1 (3), 88-99 [Google Scholar], [Publisher]

[21] Mashak Z, Jafariaskari S, Alavi I, Sakhaei Shahreza M, Safarpoor Dehkordi F. Phenotypic and genotypic assessment of antibiotic resistance and genotyping of vacA, cagA, iceA, oipA, cagE, and babA2 alleles of Helicobacter pylori bacteria isolated from raw meat. Infection and Drug Resistance. **2020** 29:257-72. [Crossref], [Google Scholar], [Publisher]

[22] Mobaraki-Asl N, Ghavami Z, Gol MK. Development and validation of a cultural competence questionnaire for health promotion of Iranian midwives. Journal of education and health promotion. **2019**;8:179. [Crossref], [Google Scholar], [Publisher]

[23] Mokhtari Ardekani AB, et al., miR-122 dysregulation is associated with type 2 diabetes mellitus-induced dyslipidemia and hyperglycemia independently of its rs17669 variant, BioMed Research International, **2022**, Article ID 5744008, [Crossref], [Google Scholar], [Publisher]

[24] Mosharraf R, Molaei P, Fathi A, Isler S. Investigating the Effect of Nonrigid Connectors on the Success of Tooth-and-Implant-Supported Fixed Partial Prostheses in Maxillary Anterior Region: A Finite Element Analysis (FEA). International Journal of Dentistry. **2021**; 12;2021: 5977994.[Crossref], [Google Scholar], [Publisher]

[25] Movassagi R, Montazer M, Mahmoodpoor A, Fattahi V, Iranpour A, Sanaie S. Comparison of pressure vs. volume-controlled ventilation on oxygenation parameters of obese patients undergoing laparoscopic cholecystectomy. Pakistan journal of medical sciences.**2017**; 33(5): 1117 .[Crossref], [Google Scholar], [Publisher]

[26] Nazari B, Amani L, Ghaderi L, Gol MK. Effects of probiotics on prevalence of ventilator-associated pneumonia in multitrauma patients hospitalized in neurosurgical intensive care unit: a randomized clinical trial. Trauma Monthly.**2020**; 25(6): 262-268. [Crossref], [Google Scholar], [Publisher]

[27] Ranjbar R, Safarpoor Dehkordi F, Sakhaei Shahreza MH, Rahimi E. Prevalence, identification of virulence factors, O-serogroups and antibiotic resistance properties of Shiga-toxin producing Escherichia coli strains isolated from raw milk and traditional dairy products. Antimicrobial Resistance & Infection Control. **2018**;7(1):1-1. [Crossref], [Google Scholar], [Publisher]

[28] Ranjbar R, Shahreza MH, Rahimi E, Jonaidi-Jafari N. Methicillin-resistant Staphylococcus aureus isolates from Iranian restaurant food samples: Panton-Valentine Leukocidin, SCCmec phenotypes and antimicrobial resistance. Tropical Journal of Pharmaceutical Research. **2017** 7;16(8):1939-49. [Crossref], [Google Scholar], [Publisher]

[29] Ranjbar R, Shahreza MH. Prevalence, antibiotic-resistance properties and enterotoxin gene profile of Bacillus cereus strains isolated from milk-based baby foods. Tropical Journal of Pharmaceutical Research. **2017** 7;16(8):1931-7. [Crossref], [Google Scholar], [Publisher]

[30] Saliminasab M, Jabbari H, Farahmand H, Asadi M, Soleimani M, Fathi A. Study of antibacterial performance of synthesized silver nanoparticles on Streptococcus mutans bacteria. Nanomedicine Research Journal. **2022** 1; 7(4): 391-6.[Google Scholar], [Publisher]

[31] Sarejloo SH, et al., Neutrophil-to-Lymphocyte Ratio and Early Neurological Deterioration in Stroke Patients: A Systematic Review and Meta-Analysis, **2022**, Article ID 8656864 [Crossref], [Google Scholar], [Publisher]

[32] Shahreza MH, Rahimi E, Momtaz H. Shiga-toxigenic Escherichia coli in ready-to-eat food staffs: Prevalence and distribution of putative virulence factors. Microbiology Research. **2017** 22;8(2):7244. [Crossref], [Google Scholar], [Publisher]

[33] Shahreza MS, Dehkordi NG, Nassar MF, Al-Saedi RM. Genotyping of Campylobacter jejuni isolates from raw meat of animal species. Academic Journal of Health Sciences: Medicina balear. 2022;47(4):52-7. [Crossref], [Google Scholar], [Publisher]

[34] Shahreza MS, Dehkordi NG, Nassar MF, Al-Saedi RM. Virulence characters and linotyping of Pseudomonas aeruginosa isolated from meat and assessment of the antimicrobial effects of Zataria multiflora against isolates. Academic Journal of Health Sciencies: Medicina Balear. **2022**. 37(4): 11-16. [Google Scholar], [Publisher]

[35] Shahreza MS. Ready To Eat Food Samples As Reservoirs Of Shiga Toxigenic Escherichia Coli. Journal of Pharmaceutical Negative Results. 2022 31:9761-6. [Crossref], [Google Scholar], [Publisher]

[36] Shahreza, M. H. S., & Soltani, A. Genotyping and antibiotic resistance of methicillin-resistant staphylococcus aureus strains isolated from raw and frozen meat samples and assessment of the antimicrobial effects of origanum vulgare against MRSA isolates. International Journal of Health Sciences, **2022**, 6(S6), 4840–4852. [Google Scholar], [Publisher]

[37] Shahreza, M. S., & Afshari, H. Ribotyping and assessment of toxigenic genes of clostridium difficile strains isolated from raw meat. International Journal of Health Sciences, **2022**, 6(S6), 4853–4863. [Crossref], [Google Scholar], [Publisher]

[38] Tahmasebi E, Alam M, Yazdanian M, Tebyanian H, Yazdanian A, Seifalian A, et al. Current biocompatible materials in oral regeneration: a comprehensive overview of composite materials. Journal of Materials Research and Technology. **2020**;9(5):11731-55. [Crossref], [Google Scholar], [Publisher]

[39] Torkan S, Shahreza MH. VacA, CagA, IceA and OipA genotype status of Helicobacter pylori isolated from biopsy samples from Iranian dogs. Tropical Journal of Pharmaceutical Research. **2016** 4;15(2):377-84. [Crossref], [Google Scholar], [Publisher]

[40] Tosan F, Rahnama N, Sakhaei D, Fathi AH, Yari A. Effects of doping metal nanoparticles in hydroxyapatite in Improving the physical and chemical properties of dental implants. Nanomedicine Research Journal. **2021**;1;6(4):327-36. [Crossref], [Google Scholar], [Publisher]

[41] Yahaghi E, Khamesipour F, Mashayekhi F, Safarpoor Dehkordi F, Sakhaei MH, Masoudimanesh M, Khameneie MK. Helicobacter pylori in vegetables and salads: genotyping and antimicrobial resistance properties. BioMed Research International. **2014** 12;2014: 757941. [Crossref], [Google Scholar], [Publisher]

[42] Yazdanian M, Rahmani A, Tahmasebi E, Tebyanian H, Yazdanian A, Mosaddad SA. Current and Advanced Nanomaterials in Dentistry as Regeneration Agents: An Update. Mini Reviews in Medicinal Chemistry. **2021**;21(7):899-918. [Crossref], [Google Scholar], [Publisher]