Analysis of Pathological Situations and Confrontation of Wounds Caused from the Entrance of Missiles in the Thoracic Cavity

Alexandropoulou Christina–Athanasia
Undergraduate Student, Department of Nursing,
Technological Educational Institute of Patras, Patras, Greece

Dr. Panagiotopoulos Elias
Lecturer of Ballistic (P.D. 407/80), Department of Mathematics and Science of Engineer,
Hellenic Military Academy, Vari, Attiki, Athens

ABSTRACT

The aim of the present inquiring work is the study of the missile's effect of different caliber diameter and velocity, which enters in the thoracic cavity of the human body. The direct diagnosis and confrontation of wounds in the thorax are considered very important, while the wounds of the thoracic cavity can probably lead to instantaneous death or serious pathological situations, like blockage of windpipes, pneumothorax, bloodthorax, collection of pus in the pleura's cavity, lesion and dysfunctions at the area of heart, which are potentially dangerous in the future. The results of the study showed that the importance of wounds of thoracic cavity depends on the missile's characteristics, which enters in the thoracic cavity, and on the characteristics of thorax's tissues that are affected.

Keywords: blockage of windpipes, characteristics of missile's entrance, collection of blood in the cavity of pericardium, lesion, pneumothorax, thoracic cavity.

Introduction

In the modern field of battle, the wounds usually result from explosive mechanisms (artillery, mortars and mines) and in a smaller percentage they result from missiles of high and/or of low speed of proportional caliber diameter. The importance of these wounds depends on the systems of the human body, which are offended, as well as on the characteristics of missiles that offend them (Ordog G.J. et. al., 1988). Consequently, the Traumatic Ballistic is an important field of science of ballistic, which studies the damages in the human body that result from missiles and modern arms of battle that enter into this (Alexandropoulou C.E. et. al., 2009). The present work examines the types of wounds and analyzes the pathological situations, which can probably be caused in the thoracic cavity by the entrance of missiles (Picture I). The wounds of the thoracic cavity are of major importance and they have occasionally occupied enough scientists, while in the antiquity they were considered lethal. Of course, in our season this perception is not true, while with the progress of medical technology in combination with the direct and correct confrontation of thorax's wounds, the life of wounded person can be saved and the prognosis of wound can be excellent.

Picture I: Wounds at the thorax of the human body caused from missiles with high speed and small caliber diameter

Historical retrospection

The fractures of ribs are known from the season of Hippocrates (5th B.C. century), who considered the haemoptysis as complication. He therapeutic proposed the bandaging of thorax with linens fabrics, a practice that constituted the base of wound's confrontation for centuries (Ntolatzas Th., 1992). Later, Ambroise Pare, the most famous surgeon of 16th century, faced the subcutaneous emphysema with multiple incisions of skin and subcutaneous tissue. In 1740, Daniel Hoffman described the clinical picture of wounded person with paradoxical mobility of thoracic wall and in 1807 Andrew Halliday presented his knowledge about pneumothorax (Tountas K, 1977).

The first successful correction of traumatic cardiac rupture is attributed to the German Von Rehn. The same year, Paget declared that the surgery had reached its limits and the correction of heart's wounds was impossible. Dupuytren and Larrey had already attempted similar interventions without success and the year 1709 Boerhaave declared that the heart's wounds are always lethal (Ntolatzas Th., 1992). Giovanni Battista Morgagni is the first scientist who described the pulmonary rupture and in 1833 J. Jobert distinguished three degrees of importance of pulmonary rupture. Up to the end of 19th century, there were enough cases of closed wounds of thorax. G.J. Guthrie, English military surgeon of wars, described the complications of closed wounds of thorax (pleurisy, pneumonia, abscess e.t.c.) and Paget, at his first English book about surgical situations of thorax, refers that the lung's wounds can be attributed to the energy of lesion and not only to the fractures of ribs (Nteros Mr et. al., 1999).

The studies of E. Graham and R. Bell, the period of Ist world war, helped at the complete comprehension of physiology of pneumothorax and of value of closed channelling of pus with pipe. Up to the 2nd world war, this simple method was used very little. Moreover, the peeling of lung was established therapeutic, for the cases in which the simple channelling with pipe failed and led to the stay of residual collection. The frequency of collection pus in the lungs at the thoracic wounds during the 2nd world war and during the war of Korea was 25-30%. With the above practice, the frequency of collection pus in the lungs was limited to 6% during the war of Viet-Nam (Ann H. Ross, 1995).

The last years, the American College of Surgeons developed a system of confrontation of wounds, which is known as Advanced Trauma Life Support (ATLS). The purpose of this system is the recognition and effective confrontation of wounds, which threaten the life of wounded person, aiming at the precocious stabilisation. This confrontation is known as Initial Estimate and it includes the total of essential energies, from the point of wound up to the centre, which will offer the final treatment. The First degree and Secondary Estimate are essential steps. With the First degree Estimate, the dangerous for the life lesions are recognized and faced, the situation of the wounded person is stabilised and the possibility of benefit of final treatment is determined. The secondary Estimate is, in fact, the detailed clinical examination that intends to reveal the total of lesions. The failing of benefit of final treatment is followed by secure evacuation of stabilised wounded person at the nearest and more suitable centre, which has the possibility to offer services of high level (Murphy G., 1980).

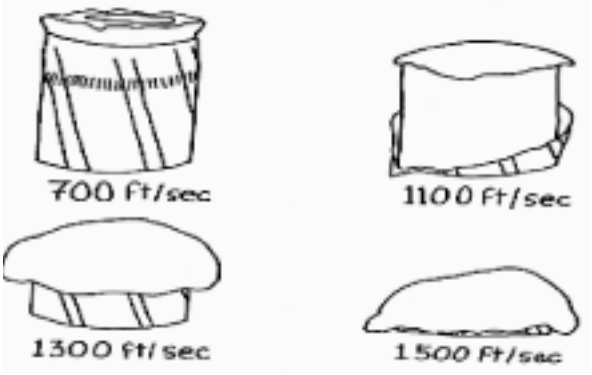
Effect of missile

In the previous sections, it was reported that the importance of wounds depends not only on the systems of the human organism that are affected, but also on the characteristics of missile that offend them. The missile's spinning momentum has big relation with the way that the damage is caused, when the missile strikes the thoracic cavity. A missile of small caliber diameter, which is moved with high speed, begins to palpitate fast while it enters in the tissues, forcing more tissues to be moved. With this way, the bigger part of missile's kinetic energy is transmitted in the thorax. A heavier missile of bigger caliber diameter transports more kinetic energy in the thorax, even from bigger distance (Picture 2). But, the missile can probability puncture so much the thorax and as a result to penetrate the thoracic cavity with the rest of the kinetic energy. In addition, a missile with low kinetic energy can cause important damage at the thorax, if it is drawn to transport all its energy on the target. Essential condition, however, is the near distance of the shot (Coe J.I., 1982).

Moreover, the missile's planning determines significantly the wound's importance. The convention of Hagen and consecutively Geneva prohibit the use of explosive missiles in war time. This is the reason, why the military missiles are metal casing. In our days, the missiles have casing of copper, because the missiles begin to be made red-hot by the heat, which is produced in speeds bigger than 2000 ft/s (approximately 60 m/s). A missile, which is sharp and small in diameter, (Picture 3) can penetrate the thoracic cavity and cause damage equal with a knife or a lance. The missile's tip, drawn in order to destroy human tissues, should have a "brake", so as to transport all the kinetic energy at the target (Peter's C.E., 1997).

In addition, the missile's speed plays an important role. The speed that ought to have a missile in order to penetrate the skin is 163 ft/s (almost 50 m/s) and in order to penetrate a bone is 213 ft/s (at about 65 m/s). Both values are low enough (Definis Gojan vic M., 1995) to cause damage at the thorax, but in combination with other

factors, which were analyzed in the previous units, can possible cause instantaneous death or various serious pathological situations, which are potentially dangerous in the future and require direct and correct confrontation. The most significant of these are analyzed extensively in the following sections.



Picture 2: Indicative speed values for various missile bodies. As long as bigger is missile's speed, so much bigger is its kinetic energy.

Picture 3: Various types of missiles with differently geometric characteristics and proportional caliber diameter.

Blockage of windpipes

It is evinced with voice's alteration, dyspnoea, which can possibly be accompanied with cyanosis, weakness of function of thoracic wall, intense anxiety of wounded person, use of complementary respiratory muscles, as well as with the presence of hematomas or wounds at the neck (Gardika K.D., 2005). The effort of maintenance of practicable of windpipe with simple ways, like the breathing of air into the windpipes and the placement of mouthpharygnal windpipe are short-lived solutions and do not protect the windpipe. The nurse ought to place artificial windpipe for the facilitation of breathing of wounded person. If the blockage last for big time interval, it is possible to befall heart failure due to deficiency of oxygen. If the blockage is raised and the wounded person has not pulse, the support of respiratory and circulatory system should begin immediately (Makos K. et. al., 2003).

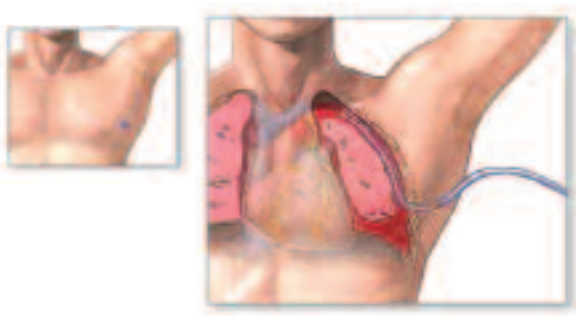
Pneumothorax

It is evinced with the collection of air in the cavity of pleura. The pneumothorax is named open, when via the aperture the air enters in the cavity of pleura and comes out with the respiratory movements. On the contrary, the pneumothorax is named closed when the air ceases to enter and come out. The air is gradually absorbed and the cavity is disappeared. The most dangerous is the pneumothorax under strain, at which the mechanism of valve is presented. Therefore, the air enters in the cavity of pleura, but it is unable to come out. As a result, a big quantity of air is collected, which causes movement of middle-thorax, bending of big veins with intense respiratory and circulatory deficiency (Athanasopoulou P. et. al., 2004).

The pneumothorax is evinced with strong pain of thorax, dyspnoea, cyanosis, anxiety and distress. At pneumothorax of severe level, particularly under strain, the pressure into the thorax amounts fast and the return of blood via the veins is impeded. As a result, the heart-blood is reduced. If the air is not removed, it is possible to befall death due to respiratory and circulatory deficiency. At pneumothorax of small level, it is recommended rest and fighting of pain. In every case of severe level pneumothorax, it is necessary the entrance of catheter in the cavity of pleura, while the other tip of pipe is placed in the bottom of container that contains water (apparatus billow). The lung begins to function within 12-14 hours. After the complete function the catheter remains for 2-3 days. The insistence of pneumothorax indicates bronchopleuritic fistula and the patient should be subjected to thorax's incision and sewing of fistula. The patients, who present relapsing pneumothorax, should be subjected to rib's incision, at which the pleura's wall is removed (Sachini - Kardasi A. et. al., 1993).

Bloodthorax

The bloodthorax is the collection of blood in the pleura's cavity. It is not recognized by a special point, but by the general points of bleeding. Apart from the general points of bleeding, the bloodthorax is recognized by the lowering of respiratory whispering during the auscultation and from the obtuseness during the percussion. The treatment consists the blood's channelling via the apparatus billow (Picture 4), which aims at the correct function of lung and at the restoration of circulating volume of blood. At severe level bloodthorax, namely continuing bleeding 200 ml/hour for the next 3-4 hours, the thorax's incision is necessary (Rachmanidou M. et. al., 2000).



Picture 4: Blood's channelling via the apparatus Billow

Collection of pus in the pleura's cavity

It is evinced with high fever with ague, pain at the thorax, perspiration and cough. The puncture gives purulent liquid and there are points of pleuritic liquid. When the pus is extended, there are intense weakness and swelling at the fingers. In infrequent cases there is inflammatory swelling of soft molecules, while the pus comes out to the skin with fistula from the pleura and the intercostals intervals. The treatment consists permanent channelling of pus with flexible pipe with the condition that the pus remains for long time interval. If the pus is rendered chronic, the peeling of lung should be held, in which the sac of pus is removed (Malgarinou M.A et. al., 2005).

Crushing or closed lesions of thorax

The simple fracture of one or two ribs is a painful damage, which limits the cough and the respiratory movements. If the fractures of ribs are multiple, the paradoxical breathing is created. Therefore, the steady osseous prop of thorax is suppressed. The part of thorax that lost its osseous prop, during the inhalation, pressed from the atmospheric pressure, recedes and the parenchyma's air, which is found under this part, is moved to the remainder parenchyma of the same lung and to the other lung. On the contrary, during the exhalation, the air from the other lung and the remainder parenchyma of the same lung is moved to the parenchyma, which is found under the offended part (Hefts D., 1991). The confrontation includes stabilization of thorax with the hands, application of pressing bandage, turning to the suffering semi-thorax, tracheotomy or placement of endotracheal intubation, connection with mechanic respirator for the correct function of lungs and administration of sufficient quantity of oxygen (Tountas K., 1988).

Collection of blood in the cavity of pericardium

The collection of blood in the cavity of pericardium impedes the fulfilment of heart's cavities and its function. The blood stems from the heart's wound, the coronary vessels or the aorta. It is evinced with dyspnoea, palpitation and shock's points. The known triad of Beck, which consists in distention of neck's veins, increase of cardiac tones and fall of arterial pressure, can set the diagnosis of blood's collection in the cavity of pericardium. The parallel increase of central venous pressure in combination with closed wound of thorax is also clues of blood's collection in the cavity of pericardium (Rachmanidou M. et. al, 2000). The nurse in collaboration with the doctor ought to realise pericardium's puncture and channelling of pericardium's cavity, which constitute saving interventions (Gourgouli E. et. al., 2005).

Rupture of trachea and big bronchuses

This lesion has as a result the massive escape of air that is added up in the pleura's cavity. The haemoptysis, the continuing escape of air from channelling semi-thorax and the incomplete pulmonary function are clues that require further examination. The bronchoscopy is a method, which is preferred, and reveals rupture, if there is, at distance 2.5 cm from the mainly bone of sternum and particularly right (Gardika K.D., 2005). The therapy requires surgical treatment, under the condition that the initial stabilisation of wounded person, with channelling of semi-thorax, which is recommended unconditionally, has been preceded (Susan C. deWit, 2009).

Heart's fracture

The closed lesion of heart can lead to myocardium's fracture, valve's dysfunction or rupture of heart's cavities. In the last case, the blood is collected in the pericardium's cavity, which was analyzed in the previous sections. In the other cases, there are not special points. The arrhythmias, the hypotension, the pain at the thorax and the dyspnoea are clues of heart's fracture. The measurement of level of cardiac enzymes is useful, as also useful is the observation of wounded person with electro-cardiogram at least the first 24 hour/day after the wound (Nteros K. et. al., 1999).

Aortic lesion

The rupture of thoracic aorta is lethal. Only the wounded people with incomplete ruptures of thoracic aorta's wall, which are located near its arterial ligament, survive. The diagnosis is placed with the aorta's check-up. Alternative, the helical calculating tomography with infusion of suitable substances can be used, which if it does not show the presence of blood, the presence of aortic lesion is excluded. The revelation of aortic lesion and its suspicion are essential elements for the salvation of wounded person. The therapy requires surgical treatment (Tountas K., 1977).

Conclusions

According to the analysis, which was held in the previous sections, it is obvious that the importance of wounds of thoracic cavity depends on the missile's characteristics that enters in the thoracic cavity and on the characteristics of thorax's tissues that are affected. Each scientist in the sector of health ought to know the way in which the missile enters the thoracic cavity and the type of wound that it is possible to be caused on the basis of the characteristics of missile body, so as to be able to face the wound immediately and effectively.

The thorax's wounds are particularly threatening for the life of wounded person and need direct diagnosis and confrontation with simple means, like administration of oxygen, insurance of windpipe, channelling with apparatus Billow, support of breathing, retention of bleeding, replacement of blood and others, depending on every case. It is remarkable that if the wounds of thoracic cavity are not faced immediately and effectively, it is possible to lead to instantaneous death due to the continuing bleeding and damage of tissues or they can cause serious pathological situations, which are potentially dangerous in the future, like the blockage of windpipes, pneumothorax and others.

In the present work, we examined the most serious pathological situations that are caused by the missile's entrance in the thoracic cavity. However, there are and others pathological situations, less dangerous and threatening for the life of the wounded person, like the fractures of scapula, sternum and collar-bone. In every case, the medical and nursing intervention is essential, which aims at the promotion of health and prevention of complications that are possible to be caused at the person due to the wounds of the thoracic cavity that are caused by missiles motions.

Conclusions

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