POLISH HYPERBARIC RESEARCH 4(61)2017
Journal of Polish Hyperbaric Medicine and Technology Society

HYPERBARIC OXYGEN THERAPY IN TREATING A POORLY HEALING WOUND FOLLOWING CARDIAC SURGERY IN A PATIENT WITH CONGENITAL CONNECTIVE TISSUE DEFECT – CASE REPORT

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ABSTRACT

We hereby present the case of a female patient with recurrent aortic aneurysms. In order to treat aneurysms of the ascending aorta, aortic arch and aneurysms of the aortic arch branches, the debranching procedure was used. Following the surgery, a deep sternal wound infection occurred characterised by impaired healing. The infection was treated with targeted antibiotic therapy and hyperbaric oxygen therapy.
Keywords: deep sternal wound infection, DSWI, aortic aneurysm, debranching, hyperbaric oxygen therapy.

ARTICLE INFO

PolHypRes 2017 Vol. 61 Issue 4 pp. 25 - 32
ISSN: 1734-7009 **eISSN:** 2084-0535
DOI: 10.1515/phr-2017-0019
Pages: 8, figures: 4, tables: 0
page www of the periodical: www.phr.net.pl

Publisher
Polish Hyperbaric Medicine and Technology Society

Casuistic article (case desription)

Submission date02.11.2017r.
Acceptance for print: 19.12.2017r.

INTRODUCTION

Given the more rapid development of cardiac surgery and the referring of increasingly complicated cases to surgery, the number of complications, including post-operative wound infections, also increases [1]. Sternal wound infections are among the most common complications in cardiac surgery, and their frequency is estimated at approximately 0.5 – 5% [2,3,4]. Among patients with a sternum infection, perioperative mortality is greater than 10 and reaches up to 47% compared to patients without an infection in the wound [4]. Deep Sternal Wound Infection (DSWI) is among the most severe complications in cardiac surgery and is characterised by high mortality and significantly impairs the quality of life of patients after surgery. Standard DSWI treatment include: targeted antibiotic therapy, surgical treatment of the wound, and the use of Negative Pressure Wound Therapy (NPWT). In extremely complicated cases where the above measures are not effective, additional therapeutic options are needed. Hyperbaric oxygen therapy may be one of them [5].

Below we present the case report of a 33-year-old female patient, operated on twice due to aneurysms of the large arteries, in whom impaired post-operative wound healing occurred. In order to cure the wound infection, the patient was treated with combined targeted antibiotic therapy and oxygen therapy using a hyperbaric chamber.

CASE DESCRIPTION

A 33-year-old female patient was admitted to the Department of Cardiovascular Surgery and Transplantology, in the John Paul II Hospital of the Jagiellonian University of Krakow for a planned reoperation of the dissecting aneurysm, DeBakey type II, and aneurysms of the aortic arch. The diagnosis was made based on the result of a computed tomography examination, which the patient had had performed annually due to the history of a previously diagnosed aneurysm (Fig. 1). The patient reported chest pains (grade II according to the Canadian Cardiovascular Society scale) and a worsened exercise tolerance experienced for several months (grade II according to the New York Heart Association scale), which accelerated the decision to perform the surgery.

Fig. 1. Reconstruction of the aortic image based on computed tomography of the chest and abdomen prior to surgery.

The woman was operated on at the local hospital six years earlier due to acute dissection of the descending aorta on the 14th day after giving birth. The patient initially underwent rescue percutaneous implantation of a stent graft into the descending aorta and aortic arch. Next, due to the lack of clinical improvement and the presence of leakage into the aneurysm caverns along with reduced flow in the mesenteric arteries, the decision was made to place the second stent graft in the abdominal aorta, insertion of the stent into the mesenteric artery and angioplasty of the right renal artery. After stabilisation of the clinical condition, the patient was transported back to the gynaecology and obstetrics ward. During hospitalisation at the gynaecology and obstetrics ward, prolonged healing of the wound of the cut from the caesarean section was noted. An annual check-up in the form of computed tomography was recommended to assess the function of the stent graft and detect early possible disease progression.

The patient's interview additionally showed a history of ophthalmic diseases (lens dislocation, retinal degeneration), multiple dislocations of the knee and ankle joints and excessive mobility of the joints. In addition, due to the young age of the patient and the diagnosis of recurrent aneurysms of the large arteries, a congenital defect of the connective tissue was suspected. Differential diagnosis included the Ehlers-Danlos syndrome (EDS) type IV, Loeys-Dietz syndrome and Marfan syndrome. Type IV EDS accounts for 5-10% of all cases of this syndrome, the inheritance is autosomal dominant and is manifested by an increased tendency to break or delaminate large and medium calibre arteries, translucent skin with visible subcutaneous vessels, facial dysmorphia (acrogeria), subcutaneous haemorrhage and an increased frequency of gastrointestinal perforation and uterine rupture during pregnancy [6,7].

Loeys-Dietz syndrome is characterised by the presence of aortic aneurysms, cleft palate and

hypertelorism, it is usually diagnosed in childhood [8,9]. The characteristic features of Marfan syndrome, occurring with the frequency of about 5-10 cases per 10 000 persons, include: slim, tall figure, long fingers (arachnodactyly), the presence of aortic aneurysms, ophthalmologic disorders (lens dislocation, myopia, retinal degeneration), excessive mobility in the joints and chest deformities [10,11]. Due to the presence of common features and the lack of unambiguous evidence for the presence of a particular syndrome, it was decided to refer the patient to the genetic centre for further diagnosis as well as examination following treatment completion at the cardiac surgery department.

PROCEDURE

Due to the history of numerous aneurysms and widening of both the aorta root, ascending aorta, and common left carotid artery, a decision was made to perform the procedure of debranching consisting in the reconstruction of the ascending aorta with part of the aortic arch using vascular prostheses.

After performing classic sternotomy, the pericardial sac was opened. An ascending aorta aneurysm with a diameter of approximately 6 cm and aortic arch aneurysm with a diameter of approximately 5 cm were revealed in the surgical field. Next the aortic arch was dissected along with the branches departing from it. The arterial line was connected to the right axillary artery and descending aorta, the venous line to the right atrium and the superior vena cava. A cold crystalline solution of cardioplegin in the amount of 2000 ml was used for cardiac arrest during the operation. In order to protect the brain against ischaemic damage, selective brain perfusion was applied for 47 min.

The patient had the ascending aorta and arch removed, as well as an alloplasty performed using a Vascutek prosthesis with a diameter of 24 mm by first stitching the prosthesis proximally to the aortic ring. Next, two smaller ones, 8 mm in diameter, were stitched into the prosthesis, constituting a bridge between the aortic prosthesis and the brachiocephalic artery and the left common carotid artery. The consecutive step was to remove the arch and aneurysmal part of the brachiocephalic artery and the left common carotid artery and begin selective brain perfusion through a cannula inserted through the right axillary artery. The aortic prosthesis was joined with the remaining non-dissected aortic arch fragment and the prostheses were joined with the brachiocephalic artery and the left common carotid artery.

After the performance of all anastomoses and appropriate reperfusion, the tightness of connections was checked, extracorporeal circulation was stopped, vascular cannulas were removed and protamine sulphate was administered to reverse the action of heparin. The total time of extracorporeal circulation was 182 minutes. Subsequently, drains for both pleural cavities and pericardial sac were positioned and the chest was closed according to a standard procedure.

POSTOPERATIVE PERIOD

The patient was transferred to the Intensive Care Unit. In the short post-operative period, due to cardiorespiratory failure, the patient required administration of inotropic drugs. On the 9th day, the patient required a retoracotomy due to instability of the sternum and the presence of a haematoma in the pleural cavity.

During the mediastinal revision, additional bleeding from the right intercostal artery was noted and dressed. After 5 days of retorakotomy, the patient was transferred to the postoperative ward. On the 19th day after the operation a serum leakage was observed from the upper pole of the wound and the formation of three fistulas. Swabs were collected for microbiological cultures and ceftriaxone at a dose of 2 g per day was empirically included into treatment. After 3 days, strains of methicillin-resistant staphylococci were grown – in accordance with the antibiogram vancomycin, piperacillin with tazobactam and cotrimoxazole treatment were included. On the 35th day after the surgery a silver dressing was put on. After 24 days of multi-drug, targeted antibiotic therapy, no significant improvement was achieved.

A decision was made to consult the patient with regard to the application of oxygen therapy in a hyperbaric chamber. Treatment with oxygen in the hyperbaric chamber was started immediately after patient qualification by the Burns and Plastic Surgery, Centre of Malopolska, Ludwik Rydygier Memorial Hospital in Krakow.

HYPERBARIC OXYGEN TREATMENT

The patient was qualified for treatment in a multiplace hyperbaric chamber Hipertech Zyron 12 in a scheme of 20 sessions conducted from Monday to Friday, once a day, for 4 weeks. Patients in this chamber are immersed in the environment of the atmospheric air and breathe through masks with 100% oxygen. A single session lasts 92 minutes. During the first 10 minutes, the pressure is raised to 2.5 atm. The patients then breathe 100% oxygen through the masks in series 3 sessions, each 20 minutes long, separated by two 5-minute intervals of breathing with atmospheric air. These breaks are intended to prevent oxygen poisoning. The last 12 minutes of the session is devoted to a gradual reduction of pressure.

The stages of wound healing are shown in photographs (Fig. 2,3,4). After the therapy was completed, the fistulas were closed and the wound healed. The patient was discharged from the post-operative ward of the centre after 56 days of hospitalisation. She continued treatment in an outpatient hyperbaric chamber until the completion of a full cycle of 20 sessions. No complications of hyperbaric oxygen treatment were observed.

Fig. 2 Postoperative wound of the sternum before the inclusion of hyperbaric oxygen therapy.

Fig. 3 Postoperative wound of the sternum during hyperbaric oxygen therapy.

Fig. 4 Postoperative wound of the sternum following hyperbaric oxygen therapy.

DISCUSSION

Thoracic aortic aneurysms are a relatively common disorder in the general population, affecting approximately 10 out of 10,000 people a year [12]. The cases of patients with connective tissue disorders as in the described case are even more common [13]. Treatment of recurrent and multiple aneurysms of large arteries constitute a challenge for modern surgery. These operations are associated with a particularly high risk of complications due to the long duration of the procedure, prolonged use of extracorporeal circulation and associated peripheral ischaemia.

One of the most serious complications is infection in the post-operative wound. Due to the constantly increasing antibiotic resistance of hospital pathogens it is necessary to look for new methods of treatment.

In recent years, NPWT therapy has been widely used in cardiac surgery, which accelerates the approximation of wound margins, effectively removes pus and serous fluid from infected wounds and reduces oedema, which in turn significantly improves the healing process [14]. In cases of particularly resistant infections, hyperbaric oxygen therapy is effective as it uses the antibacterial effect of oxygen, acceleration of angiogenesis and vasculogenesis in conditions of high oxygen availability in the tissue, as well as vasoconstriction followed by oedema reduction [15].

In the described case, the 20 sessions in the hyperbaric chamber led to a complete fistula closure and healing of the wound. No complications related to the applied method were observed. Therapy with the use of hyperbaric oxygen is expensive, however it shortens the time of hospitalisation and the use of expensive antibiotics, which in the final analysis may prove to be beneficial.

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