Case Report

Iatrogenic Hemothorax and its Treatment — Case Report
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Abstract

Introduction Subclavian vein cannulation is associated with a number of complications. Hemothorax occurs in approximately 2% of cases. Immediate surgical revision of the chest cavity is indicated in case of large blood loss or insufficient circulation. The management of hemorrhage in the pleural apex is extremely demanding due to its bad accessibility and conventional surgical procedures are often insufficient. In such situations the local application of topical hemostats can be used instead.

Case report The report presents a 36-year-old patient with a massive, left hemothorax developing after subclavian vein catheterization. Surgical review detected a source of bleeding in the superior thoracic aperture area that could not be stopped with conventional surgical procedures. As a result, TachoSil and Arista preparations were applied with good effects.

Key words: central venous catheter, hemothorax, topical hemostats

Introduction Subclavian vein cannulation is associated with a number of the lung complications and generally presents a greater risk than internal jugular vein cannulation. The incidence of the lung complications associated with subclavian vein cannulation ranges from 0 to 21%. The relevance of these complications depends on the surgeon's practical experience and on the level of difficulty inserting a catheter in a specific patient. The surgeons who completed over 50 central vein cannulations exhibit 50%-less risk of the occurrence of complications than those with less experience. The most frequent mechanical complications related to catheter insertion or removal into/from the subclavian vein include, apart from minor hemorrhage and local hematoma in the site of puncture, cannulation of the subclavian artery (19%), catheter malposition (6.5%) (most often into the vena jugularis interna), pneumothorax (6%), damage to the plexus brachialis, pulmonary embolism, etc. Hemothorax occurs in about 2% of patients. A survey of early and late complication is provided in Table 1. The risk of hemorrhage during central venous catheter insertion is substantially increased by coagulopathy. Careful choice of the site of puncture and of an appropriate method can reduce hemorrhagic complications to a minimum. Because the subclavian artery and the subclavian vein cannot be accessed for direct compression, the subclavian approach is least suitable in patients with the risk of hemorrhage.

Depending on the amount of blood, a hemothorax can be classified as small (less than 350 ml of blood), moderate and large (more than 1,000 - 1,500 ml of blood). The selection of the optimum treatment does not consider only the size of a hemothorax but also the rapidity of its occurrence. Single-time puncture and aspiration usually suffice to manage smaller hemorrhage. Large hemorrhage, however, has to be secured with a chest drain. If the pleural cavity absorbs more than half of circulating blood, lethal hypovolemia with the irreversible stage of hemorrhagic shock is imminent. Review of the thoracic cavity by thoracotomy is indicated when initial blood loss exceeds 1,000 - 1,500 ml and hemorrhage into a drain of more than 200 ml/hour persists or increases or when insufficient circulation...
Table 1 Complications of subclavian vein catheterization

<table>
<thead>
<tr>
<th>Early complications</th>
<th>Late complications</th>
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<tbody>
<tr>
<td>1 Catheter malposition</td>
<td>1 Thrombosis</td>
</tr>
<tr>
<td>2 Wrong catheter insertion in artery</td>
<td>2 Thrombophlebitis</td>
</tr>
<tr>
<td>3 Hemothorax</td>
<td>3 Thromboembolism</td>
</tr>
<tr>
<td>4 Pneumothorax</td>
<td>4 Hydrothorax</td>
</tr>
<tr>
<td>5 Nerve/nerves damage</td>
<td>5 Air embolism</td>
</tr>
<tr>
<td>6 Embolization of catheter or its part</td>
<td>6 Local infection (site of insertion)</td>
</tr>
<tr>
<td>7 Cardiac dysrhythmia</td>
<td>7 Catheter sepsis</td>
</tr>
<tr>
<td>8 Air embolism</td>
<td></td>
</tr>
<tr>
<td>9 Vein wall/heart damage or perforation</td>
<td></td>
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(signs are observed\(^7,8\). Smaller hemorrhage can be clarified and possibly also managed by videothoracoscopy\(^7\).

Case Report
This is a presentation of a 36-year-old man with extensive hemothorax. The man was transferred from the cardiologic department to the surgical clinic of the Pardubice Regional Hospital with the diagnosis of an acute left-sided hemothorax.

The patient had been treated for hypertension from 2003. He received low molecular weight heparin for atrial flutter. He was admitted to the cardiologic department to undergo an electro-physiological examination and radiofrequency ablation (RFA) of the myocard for persistent symptomatic atrial flutter. During the procedure the left subclavian vein and the right femoralis vein were cannulized. In the evening the same day the patient began complain-

of chest pain. The patient was sent for chest X-ray which did not show, at that time, any signs of pneumothorax or any other pathology. On the following day the patient reported continuing chest pain and difficulty breathing. He was sent for a check-up chest X-ray which detected a non-homogeneous opacity of the left lower lung field that exhibited expansive behavior and pushed the cardiac shadow to the right (Fig. 1). A thorax CT scan was indicated for suspected left-sided hemothorax and the patient was transferred to the ICU of the surgical clinic, Pardubice.

During his admission to the surgical ICU the patient was fully conscious, pale, with spontaneous ventilation, and without obvious dyspnea at rest. Breath sounds heard on auscultation were attenuated or even non-audible over the whole left hemithorax. BP 130/80, P 110-130/min. Blood count: RBC 3.68 \(10^\text{12}/\text{l}\), Hb 11.6g/100 ml, Ht 33%. Irregular cardiac activity. \(O_2\) saturation measured with a pulse ox-
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![Chest X-ray after surgical treatment](image)

Fig. 3 Chest X-ray after surgical treat-

meter: 98%. Other physical examination were normal. The patient complained of persistent breathing difficulties. The CT scan (Fig. 2) proved the presence of massive left-sided hemothorax (fluid density about 42 HU - blood). Blood filled most of the left hemithorax and compressed the left lung. The residual air-filled area of the left lung was imaged mediately. The mediastinal structures were moved to the right. Neither pneumothorax nor the signs of hemopericardium were detected. Right-sided fluidothorax was not present.

A marked decrease in hematological values and clinical signs of circulatory instability appeared as early as during the first hour after transfer to ICU. Originally intended chest drainage was abandoned and urgent surgical revision of the left hemithorax was indicated instead.

With the patient lying on his right side and being under general anesthesia, the left pleural cavity was opened by posterolateral thoracotomy in 5th intercostal space. 4,000 ml of liquid blood and blood coagulates was removed at once from the left hemithorax. Review of the pleural cavity detected the presence of blood in the tissue in the site of the left brachiocephalic vein and of the left subclavian vein. Bright red blood was running out of a small hole in the pleura. After resecting the parietal pleura in the pleural apex and after isolating major veins and the artery in the superior thoracic aperture area the bleeding nearly stopped. Apart from the above-described small bleeding opening there was no other proven source of bleeding in the pleural cavity. The whole area under the left clavicle was filled with TachoSil (collagen sponge). The defect created by the resection of the pleura was applied with the Arista tissue adhesive. After the treatment, the hemostasis in this area was sufficient. Another chest drain was inserted into the left pleural cavity.

During the procedure that took nearly 2 hours, 1,000 ml of crystalloids, 1,000 ml of colloids, 4 erythrocyte mass units and 4 plasma units were administered. The patient’s blood pressure and circulation were compensated and catecholamine support was not required.

After the procedure the patient remained in the care of ICU. His blood pressure and circulation were stable and ventilation was spontaneous. Breath sounds were audible on both sides and were accompanied with additional acoustic phenomena on the left. The chest drain removed 300 ml of hemorrhagic liquid during the first 8 hours following the procedure and another 350 ml of the same liquid during the subsequent 9 hours. The drain removed a total of 1500 ml of the liquid and was extracted after 53 hours. A control chest X-ray image taken after drain removal displayed an unfolded left lung with insignificant residual fluidothorax at the left costophrenic angle (Fig. 3). A control red blood count continued to exhibit markedly decreased values as late as the 3rd post-operative day (RBC 252.10^6/l, Hb 8.0g/100 ml, and Ht 22%). However, no blood preparations were administered after the procedure. During hospitalization the patient continued to receive one subcutaneous application of an LWMH prophylactic dose a day. He was also administered analgesics, mucolytics, and breathing rehabilitation. On the 3rd post-operative day the patient’s general condition was satisfactory, his cardiopulmonary function was compensated, and the patient was transferred back to the cardiologic department in good status. There was performed hematology examination. There was not confirmed coagulation disorder. During hospitalisation there was seen sinus rhythm, RFA was successful. On postoperative day 11 there was seen minimal amount of fluid in left hemithorax. Patient was dismissed home.

**Discussion**

A supraclavicular approach or transclavicular approach with clavicle resection or luxation can be
employed to manage hemorrhage in case of subclavian vein injury. Hemorrhage can also be managed with thoracotomy whose application proves beneficial for the securing of present hemothorax. Alternatively, the site of the puncture can be treated from a sternotomy. A prerequisite for successful hemostasis is the preparation of all major veins and clarification of their anatomic interrelations. We were not successful to identify exactly the site of bleeding not only due to difficult approach but also because the bleeding stopped after preparation of main vessel trunks. This fact developed based on vasoconstriction of vessel wall. Based on this we assume that the vessel injury was small and the source of bleeding was on the back wall of the subclavicular vein developed during inducing the catheter. If hemostasis cannot be achieved by a conventional surgical method (i.e. ligation or electrocoagulation), a preparation from the range of local hemostatics can be used as a reliable alternative. The hemostasis affect blood coagulation at various levels and support the formation of blood coagulates\(^{90}\). They are made from a synthetic or organic base material such as collagen (TachoSil, Tissucol Kit), gelatin sponge (Spongostan) or oxidized regenerated cellulose (Surgicel, Traumacel)\(^{12-13}\).

We use broad spectrum of hemostycts to control bleeding on our department. Product TachoSil we used first time. TachoSil manufactured by Nycomed is based on collagen sponge derived from horse collagen. Sponge surface is coated with a layer of human fibrinogen and thrombin. On contact with blood or other body fluids these coagulation factors are activated thus creating a fibrin coagulate that firmly joins the basic matrix with adjacent tissues in several minutes. It is used not only during the bleeding that cannot be stopped by other surgical methods but also in bleeding that is not possible to identify. Due to good adhesivity it enables to perform good wash of the wound even by big amount of water. This product is well tolerated by the human body and is fully absorbable in 12 weeks of a procedure\(^{11,15}\).

Another preparation applied in a pulverized form was Arista manufactured by Medafor. It is made of organic polysaccharide extracted from potato starch. Its hemostatic function is that of a molecular filter that contains serum that makes its dry volume enlarge up to fifteen times. Concentrated blood elements form a gel matrix that decelerates blood flow in a certain area, thus contributing to its enhanced coagulation regardless of the patient's hemocoagulation characteristics. It is absorbable. Because absorption sets in immediately and is complete in 24-48 hours, the risk of infection is not increased. However, in view of the risk of fatal thrombosis this preparation must not be applied directly in vessels and must not be used for massive hemorrhage treatment\(^{10}\).

Application of local hemostatics reduces the necessity to administer transfusion preparation both prior to and after surgery. Hemostatics promote the reduced occurrence of post-operative bleeding complications. The use of local hemostycts has become widespread in all fields of surgery, mainly in the management of diffusion parenchyma-related bleeding or in case of smaller bleeding in badly accessible areas. Chest surgery often uses these preparations in case of visceral or parietal pleura injuries. The contribution of these preparations to the reduced occurrence of adhesions was proven. Usage of the local hemostycts expanded to all surgical disciplines, especially to neurosurgery, thoracic, vascular and abdominal surgery. Their usage is advantageous especially in bleeding control in diffuse parenchymatous bleeding, in leakage from anastomosis of big vessels or in bleeding control from small source but with difficult approach. Product TachoSil can be used as a prevention of fistulas for example after pancreatic resections, to occlude bronchopleural fistulas in lung abscesses. It can be also used to stop air outflow from lung injury or after elective lung procedures. It was shown also his influence on development of postoperative adhesions. In neurosurgery is used to stop cerebrospinal fluid leakage through dura\(^{11,17,18}\).

**Conclusion**

Hemothorax does not belong to the most frequent complications associated with the cannulation of the subclavian vein yet its occurrence is not exactly rare and has to be considered whenever clinical signs of circulatory instability or respiratory insufficiency appear. Treatment is based on immediate surgery, revision of pleural cavity and consequent bleeding control. In smaller lesions transthoracic approach is possible, in more severe lesions, the quick preparation of vein from of supra or transclav...
icular approach is needed. Control of bleeding in apex is always extremely demanding and the visualization of all the structures in this area facilitates the choice of a reasonable, safe treatment procedure. From this casuistics is apparent that usage of local hemostytics in our case, TachoSil and Arista, can be simple but very effective treatment without further trauma of vessel wall.

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