escape route for the fluid. One would predict such a mechanism would take time to develop; it is only speculative that three to four hours would be sufficient. It should be noted that our patient was placed flat simultaneously with the onset of secretions without improvement, but it is likely that severe pulmonary edema was already established, as evidenced by the high hematocrit (46 per cent).

A single cause of pulmonary edema is rare, and it is probable that a combination of events was responsible in our patient. Indeed, many operations have been performed in this hospital with the patients in similar Trendelenburg position, without incident. However, the more common causes of pulmonary edema (i.e., pre-existing heart disease, anesthetic overdose, arrhythmia, increased blood pressure, tachycardia, hypoxia, negative airway pressure and fluid overload) can be eliminated or minimized in our case. Essentially we are left to consider the presence of elevated central venous pressure, an outpouring of frothy yellow tracheal fluid, and roentgenographic evidence of pulmonary edema, and to conclude that the steep head-down position combined with the elevated central venous pressure may have provoked the development of pulmonary edema.

REFERENCES


Transient Phrenic-nerve Paralysis Following Subclavian Venipuncture

I. W. P. OBEI, M.B., F.G.P.(S.A.) *

Percutaneous puncture of the subclavian vein, used in emergencies for monitoring of central venous pressure, recently has been used for the passage of permanent transvenous pacemaker catheters. The purpose of this communication is to document a hitherto unreported complication of subclavian venipuncture.

REPORT OF A CASE

A 65-year-old white woman sustained a series of episodes of Stokes-Adams syncope on the day of her admission to the Johannesburg Hospital. The electrocardiogram showed that the rhythm varied between 2:1 and complete A-V block. S-T and T wave changes were indicative of a recent anterior subendocardial myocardial infarction. Serial serum enzyme determination confirmed this diagnosis. The patient was treated by demand pacing with a temporary transvenous electrode passed via an antecubital vein but, in spite of steroids, heart block remained, and after three weeks permanent pacemaking was decided upon.

The skin and deeper tissues were infiltrated with 5 ml of 2 per cent lidocaine 1 inch below the midpoint of the clavicle to a depth of about 1½ inches. The skin was punctured with a Seldinger needle which was directed medially and cephalad towards the superior aspect of the sternoclavicular joint to enter the left subclavian vein. The guide wire passed with ease into the superior vena cava. Further manipulation was abandoned because within a few minutes the patient became dyspnée and cyanotic. Roentgenogram of the chest revealed that the heart and mediastinum

* C.S.I.R. Cardio-Pulmonary Research Unit and Cardiovascular Research Unit, Department of Medicine, University of the Witwatersrand, and the Cardiac Clinic, Johannesburg Hospital, Johannesburg, South Africa.
were displaced to the right and the left leaf of the diaphragm was raised (Fig. 1). Fluoroscopy showed paradoxical movement of the left leaf of the diaphragm. There was no pneumothorax. The patient recovered within three hours, and the next day the diaphragm was mobile and the radiologic appearance, including the fluoroscopic appearance, was normal (Fig. 1). Permanent transvenous pacing was later instituted.

**Discussion**

A frequently documented complication of transcatheter subclavian venipuncture is pneumothorax. This may be associated with subcutaneous emphysema and can prove fatal. Flannagan et al. report a case of fatal air embolism in a hypovolemic patient. Smith et al. reported brachial plexus injuries and massive hematoma formation. On the left side, damage to the thoracic duct has been caused and pleural effusion has followed transfusion of blood and clear fluid through a catheter which had perforated the subclavian vein.

Considering that the phrenic nerve runs on the scalenus anterior muscle, immediately behind the subclavian vein at the point of puncture, it is surprising that phrenic-nerve paralysis has not been reported before. The rapid clinical and radiologic recovery of diaphragmatic movement implies that the phrenic nerve was blocked by the local anesthetic rather than injured by the needle. Though transient, this complication could be hazardous to the seriously-ill patient. The danger to the phrenic nerve would not be obliterated by using the supraclavicular approach, which is claimed by Yoffa to be less hazardous than the infraclavicular approach. The addition of yet another complication of subclavian venipuncture has influenced us to restrict its use to cases in which more accessible veins are not available.

The author is grateful to Mr. P. Marchand for his assistance in the preparation of this manuscript and to the Superintendent of the Johannesburg Hospital for permission to publish this case.

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