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Short report

Spontaneous fracture of implanted central venous catheters in cancer patients: report of two cases and retrospective analysis of the 'pinch-off sign' as a risk factor

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Spontaneous fracture of central venous catheters (CVC) has been reported. It results from repeated compression of the extravasal part of the CVC between the clavicle and the first rib. The so called pinch-off sign (POS) of the CVC as visible on a chest radiograph has been described as a warning for this complication. Fracture of CVC in patients receiving chemotherapy results in extravasation of the drug which may have serious consequences. We describe the spontaneous fracture of a CVC in two cancer patients. Subsequently we retrospectively analyzed chest radiographs for the POS of 77 cancer patients who received chemotherapy through a CVC and correlated these results with the occurrence of complications related to CVC compression. In 77 patients a total of 97 CVC were implanted for a median duration of 7 months. Four CVC (4%) showed a grade 2 POS (change in course of CVC with luminal narrowing) on a chest radiograph. In three of these (75%) a compression-related complication occurred versus no compression-related complications in 93 CVC showing a POS of grade 1 (change in course of CVC without narrowing) or 0 (no change in course of CVC). The grade of POS on a chest radiograph may vary with the position of the patient, but all grade 2 POS were visible in the upright position. We recommend a chest radiograph in the upright position after placement of a CVC for grading of the POS. CVC showing a grade 2 POS should be removed or at least checked by a chest radiograph before the start of each chemotherapy infusion. To prevent CVC compression, CVC should be implanted in a lateral position.

Key words: Central venous catheters, chemotherapy, extravasation of chemotherapy, fracture, pinch-off sign.

Introduction

Implanted central venous catheters or ports (CVC) placed via the subclavian vein are being used with

increased frequency for the continuous i.v. delivery of drugs such as chemotherapeutics or for parenteral alimentation. The main complications as reported in the literature are thrombosis, infection, catheter migration and occlusion.¹⁻⁴ Spontaneous fracture of a CVC with embolization of the distal part is a rare complication. When a CVC is inserted in a medial position, the CVC will pass the thoracic outlet outside the vessel.⁵ Repeated compression of the extravasal part of the CVC at the thoracic outlet between the clavicle and the first rib, associated with normal arm and shoulder use (Figure 1), is thought to be the cause of catheter fracture.⁵ The so-called 'pinch-off sign' (POS) of the catheter on a chest radiograph has been mentioned as a warning for this complication.⁵ To date 17 cases of CVC fracture and one case of CVC fragmentation have been reported in the literature,⁵⁻¹² all occurring in cancer patients receiving chemotherapy. In all but one case the CVC were retrieved percutaneously and no serious complications due to catheter emboli were reported in these patients. However, since most patients with fractured CVC were asymptomatic, in cancer patients receiving chemotherapeutics there is a serious threat of extravasation which may have devastating local effects depending on the nature of the chemotherapeutic agent. We recently observed a spontaneous fracture of a CVC in two cancer patients. Both had a positive POS on a previous chest radiograph. Subsequently we retrospectively analyzed the chest radiographs of 77 colorectal cancer patients who had received chemotherapy through an implanted CVC. We scored the POS according to Hinke *et al.*¹⁰ and correlated the results with the occurrence of complications related to catheter compression.

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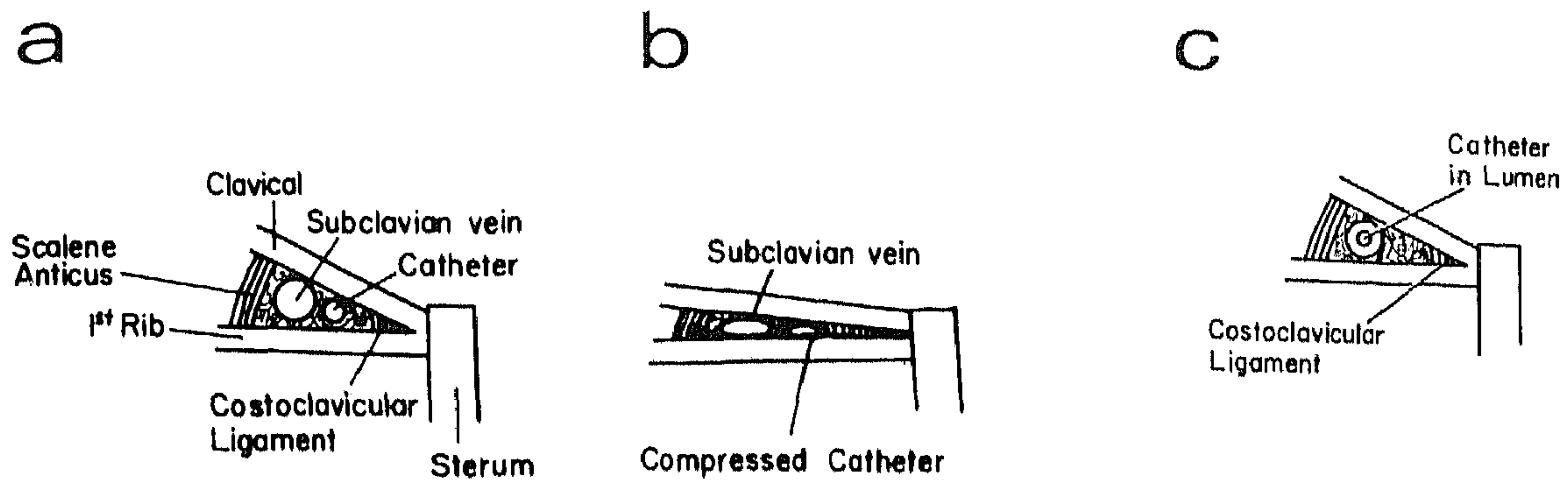


Figure 1. When the catheter passes the thoracic outlet outside the lumen of the subclavian vein due to a medial insertion (a), the catheter is compressed when the clavicular–first rib angle narrows (b). When the catheter enters the axillary vein lateral to the thoracic outlet, it passes the clavicular–first rib angle in a more lateral position where the angle is wider and is less likely to be affected by pincher action (c). Reprinted from Aitken and Minton,⁵ with permission.

Case reports

Patient 1

A 41 year old male with lung metastases and pleural carcinomatosis from an adenocarcinoma of the rectum. He was treated ambulatory with methotrexate 40 mg/m² i.v. push followed by 5-fluorouracil 60 mg/kg continuous i.v. infusion over 48 h, given weekly for 4 weeks and every 2 weeks thereafter, for which a Port-A-Cath (Pharmacia, Woerden, The Netherlands) was implanted. Chest radiographs taken after CVC implantation showed a grade 1 POS (see Patients and methods) of the catheter in the supine position and grade 2 in the upright position. At the end of the fourth cycle he presented with a painless infraclavicular s.c. swelling at the site of the Port-A-Cath. A chest radiograph showed fracture of the catheter with the distal part positioned in the right atrium (Figure 2). Both parts of the Port-A-Cath were removed, the distal part via a percutaneous right femoral vein approach using a snare. He experienced no serious sequelae from the extravasated chemotherapy. Several days later a second Port-A-Cath was implanted in the left subclavian vein which functioned well until the patient died of progressive disease 2 months later.

Patient 2

A 22 year old male with stage IV Hodgkin's disease for which he received chemotherapy with mechlorethamine, vincristine, procarbazine, prednisone, doxorubicin, bleomycin and vinblastine (MOPP/ABV). A Port-A-Cath was implanted because of

recurrent severe phlebitis. One month later it was impossible to draw blood from the catheter and flushing was painful below the clavicle. A chest radiograph showed fracture of the catheter with embolization of the distal part in the pulmonary artery. A previous chest radiograph had shown a grade 2 POS of the catheter. The catheter was removed according to the same method as was used in patient 1. His recovery was uneventful. Afterwards

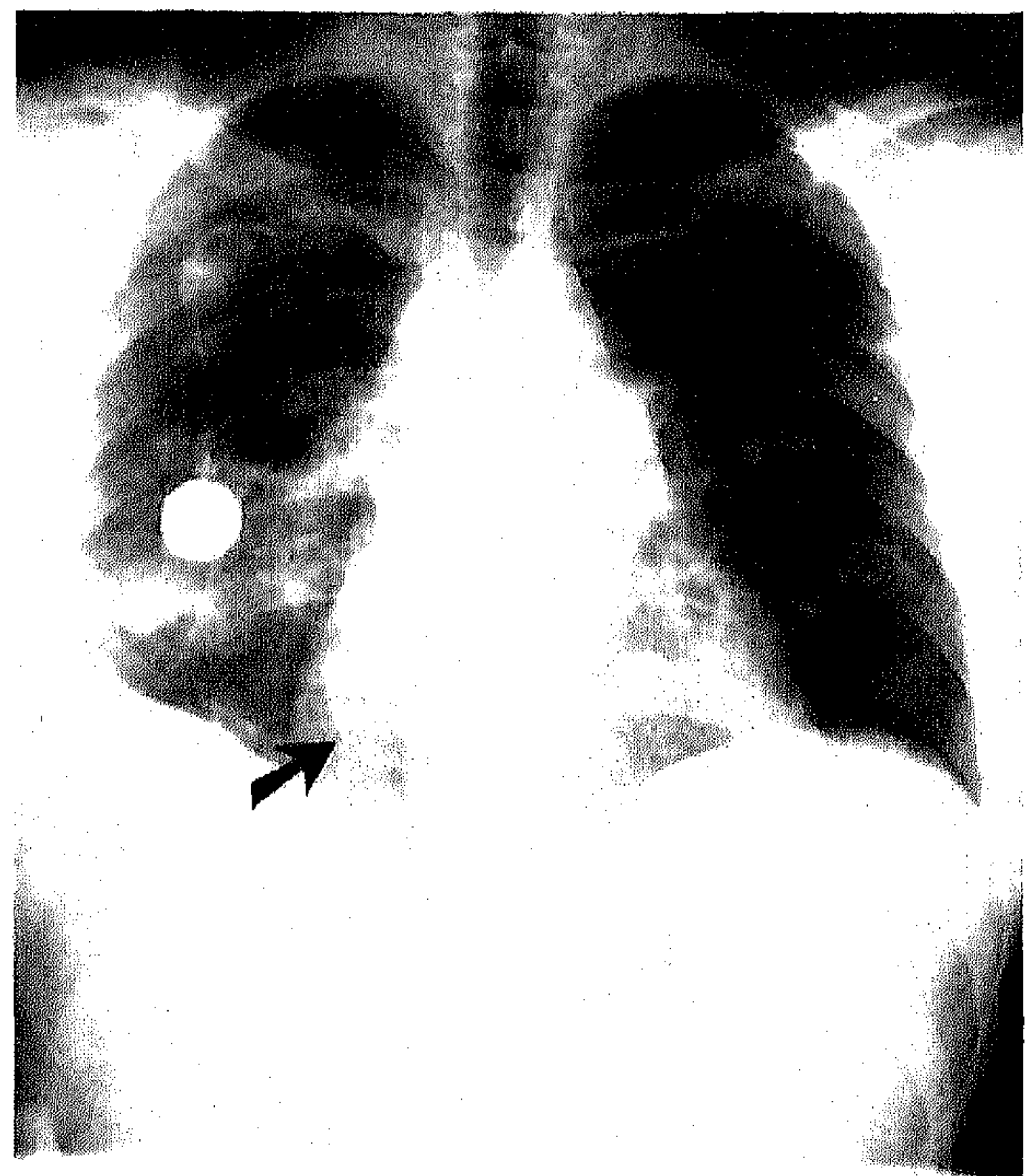


Figure 2. Chest X-ray of a patient with lung metastases of colorectal carcinoma who developed a spontaneous fracture of a Port-A-Cath device. The distal part is located in the right atrium (arrow).

he remembered that 1 week earlier he had experienced a mild pain in his right hemithorax and a dry cough, which both had resolved spontaneously. Further chemotherapy was administered by direct cannulation of the subclavian vein.

Patients and methods

We retrospectively analyzed the catheter positions on chest radiographs from 77 consecutive patients with advanced colorectal cancer who were treated according to four different chemotherapy protocols which all involved the use of 5-fluorouracil 60 mg/kg (2400 mg/m²) given by continuous i.v. infusion over 48 h, weekly for 4 weeks and once every 2 weeks thereafter. Patient 1 is included in this evaluation. At first we performed chest radiographs once, directly after CVC placement either in the supine or upright position. Later we performed chest radiographs immediately after CVC placement in the supine position, as well on the next day in the upright position for the detection of a delayed occurrence of a pneumothorax. The POS of the CVC was scored according to Hinke *et al.*:¹⁰ grade 0 = normal, grade 1 = change in course of catheter with no luminal narrowing and grade 2 = as 1 but with luminal narrowing.

Results

The retrospective analysis included 77 patients in which 97 CVC were implanted: 91 Port-A-Cath devices and six Hickman catheters. Median age was 54 years (range 30–70). Median duration of implantation was 7 months (6 days–44 months). Chest radiographs were available from all patients after each catheter implantation: in 38 cases in the upright or supine position and in 59 cases in both positions. The results of POS grading in these cases are summarized in Table 1. Of the four patients with a POS grade 2 of their CVC (all Port-A-Cath devices), one remained without catheter-related complications during the 7 months of implantation, in one patient the catheter disconnected from the reservoir 11 months after implantation during infusion, in one patient there was only flow through the CVC in the supine position but not in the upright position (Figure 3) upon which the CVC was removed, and one patient had a CVC fracture (patient 1). In all other patients no complications occurred which could be related to catheter compression. When available, chest radiographs performed during follow-up were

also analyzed for the POS and in no patient was the POS grade increased compared with the initial grading.

Discussion

Including the two patients presented in this paper the total number of reported cases of fractured or fragmented implanted CVC is 20. Of note, the indication for catheter implantation in all these patients was the administration of chemotherapy. Most patients were asymptomatic, but some experienced chest discomfort,^{8,9} as did one of our patients. Removal of catheter emboli is strongly recommended since a 45% incidence of serious or fatal complications has been reported in 76 patients in whom a catheter embolus was left *in situ*.¹³ The most commonly used technique is percutaneous transvenous retrieval.^{13,14} When CVC fracture occurs during the infusion of chemotherapy, extravasation of the chemotherapeutic drug will ensue since the fracture occurs in the extravascular part of the catheter.⁵ This happened in our first patient who presented with a s.c. swelling at the end of a 48 h infusion of 5-fluorouracil and was prevented in our second patient due to the symptom of pain below the clavicle during flushing of the catheter prior to the start of infusion of chemotherapeutics. The POS has been mentioned as a warning for impending CVC fracture.⁵ We therefore retrospectively analyzed the position of the CVC as visualized on chest radiographs in 77 patients who were treated with chemotherapy for colorectal cancer and correlated these results with the occurrence of complications related to catheter compression. Several observations were made. First, the POS grade may vary with the position of the patient during the chest radiograph. This

Table 1. Grading of the POS in 97 CVC implanted in 77 patients as visible on chest radiographs

	Number of CVC (%)
Grade 0 in U and/or S	61 (63)
Grade 1 in U and/or S	23 (24)
Grade 1 in S, grade 0 in U	6 (6)
Grade 0 in S, grade 1 in U	3 (3)
Grade 1 in S, grade 2 in U	3 (3)
Grade 2 in U	1 (1)
Total	97 (100)

Chest radiographs were performed in 38 patients in the upright (U) or supine (S) position and in 59 patients in both positions. POS grading: 0 = no change in course of CVC at the thoracic outlet, 1 = change in course without luminal narrowing, 2 = change in course with luminal narrowing.

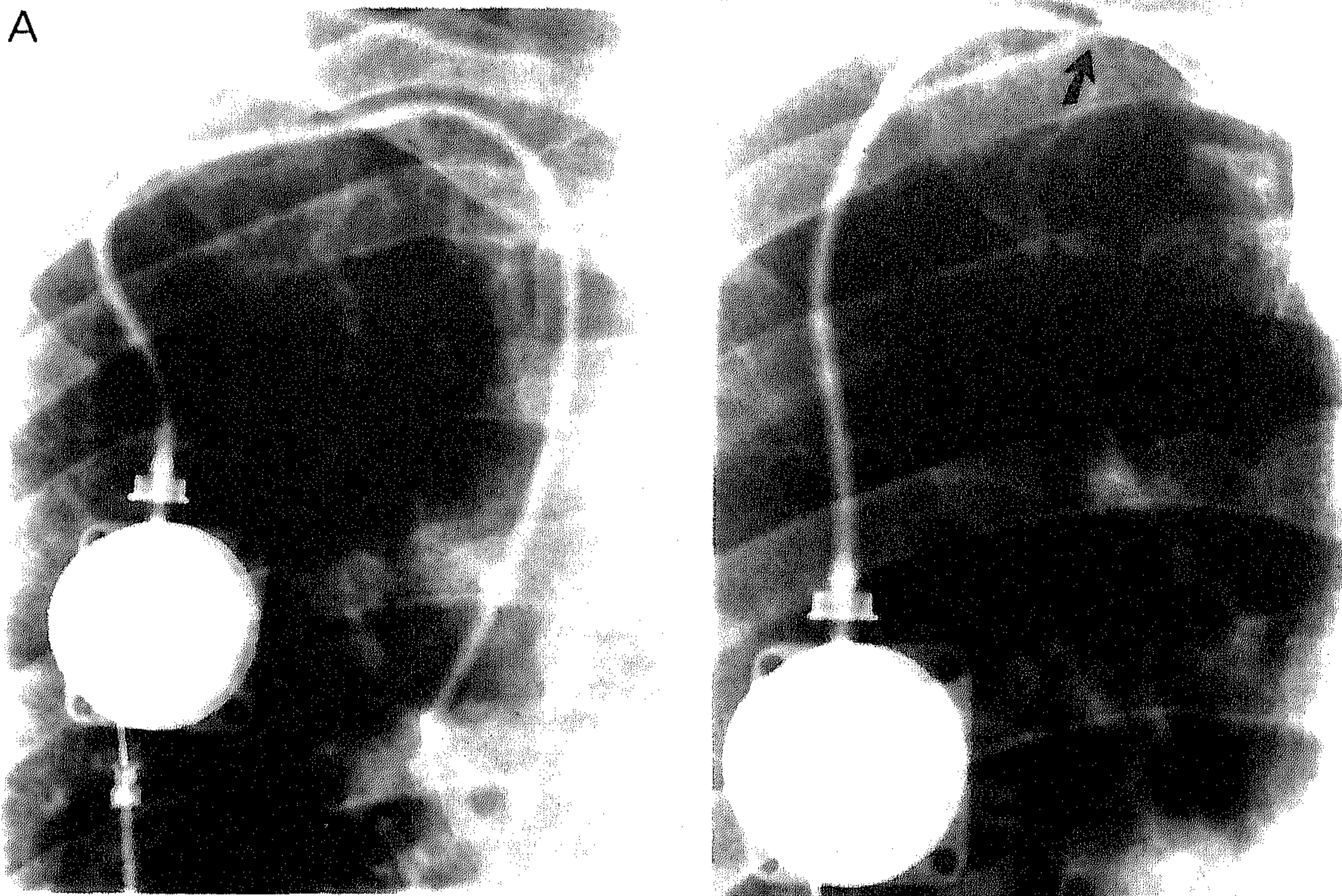


Figure 3. Catheter filled with contrast fluid showing no luminal narrowing in the supine position (A), but luminal narrowing (arrow) occurs in the upright position (B). In the upright position no flow was possible through the catheter.

may be explained by the fact that the space at the thoracic outlet between the clavicle and the first rib will depend on the degree of shoulder rotation of the patient, which is different during a chest radiograph performed in the supine compared with the upright position, and which will also vary with the mobility of the shoulder joint in each patient. Second, no patient with a maximum POS of grade 1 as visible on a chest radiograph either in the supine or the upright position, performed shortly after CVC implantation, presented with complications related to catheter compression during follow-up. Third, patients with a grade 2 POS have a high risk for complications related to catheter compression: in our series this occurred in three out of four patients (75%). The disconnection of the catheter from the port in one patient is likely to have resulted from increased pressure in the proximal part of the catheter caused by catheter compression. Based on these observations we can make the following recommendations. The position of a CVC should be carefully analyzed on a chest radiograph after the implantation, not only for the position of the catheter tip and the presence of a pneumothorax but also for the POS. Our data are in support of a chest radiograph in the upright position since all POS

grade 2 were visible in this position. In general, a chest radiograph in a position in which the thoracic outlet space is maximally compromised, i.e. in upright military position, seems preferable. CVC showing a POS grade 2 should be removed or should at least be checked by a chest radiograph before the start of each infusion. To prevent this complication, CVC should be implanted in a lateral position so that they pass the thoracic outlet inside rather than outside the lumen of the subclavian vein.

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