Port-a-caths in cancer patients

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Abstract **We report on 91 patients with cancer who underwent the insertion of 89 venous and 4 hepatic arterial, implanted vascular ports (Port-a-caths) for periods of up to 33 months (total 1 525 patient-months). There were 1 fatal, 9 serious and 8 minor complications in 18 patients which are described and discussed. In this series, complications were more common in younger patients, and infection was rare.**

Port-a-caths are extremely useful for vascular access, and have a low complication rate. However, the occasional occurrence of serious and even fatal complications suggests that the decision to insert a device should be judiciously weighed.

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Most cytostatic agents require reliable venous access for administration. This may be difficult to obtain, especially in patients who are elderly or obese. Central vascular lines circumvent this problem. The larger lumen also allows the easy administration of intravenous drugs, blood products or parenteral nutrition, while blood may also be withdrawn for analysis. Since the usual plastic indwelling catheters used for acute problems are not durable, Silastic catheters are commonly inserted for longer term use (Broviac and Hickman lines); these protrude through the skin and the loose external ends are capped when not in use.

More recently, long-indwelling right atrial Silastic catheters have been attached to an implanted subcutaneous stainless steel or titanium port which can be frequently accessed percutaneously through a self-sealing silicone plug (Port-a-cath and others). We have been using Port-a-caths since January 1984 in patients with poor vascular access. Fatal septicaemia related to infection of the Port-a-cath tunnel in one patient and other serious complications in other patients prompted us to review the results in our own patients. This report of our experience with subclavian venous and hepatic arterial Port-a-caths in a community hospital and oncology programme illustrates the benefits and risks in patients with solid tumours.

Material and methods

We retrospectively reviewed the charts of 91 cancer patients over the age of 16 registered with the Northeastern Ontario Regional Cancer Centre who underwent the insertion of an implanted port and vascular line between 1 January 1984 and 1 January 1990 to assess the complications of the insertion and use of this device. Patients ranged in age from 18 to 76 (median 58 years, mean 53 years). Patients with acute leukaemia, with percutaneous catheters without ports and those with catheters inserted at other institutions were excluded from analysis. Most of our patients received a subclavian venous Port-a-cath (Pharmacia (Canada) Inc.) and this report deals predominantly with these devices. The unassembled venous Port-a-caths used in these patients had the following specifications: titanium port, 25,4 mm base, 13,5 mm height, septum 11,4 mm in diameter; weight 16 g; catheter external diameter 2,8 mm and internal diameter 1,0 mm. Specifications are slightly different for arterial catheters and may have changed for newer models.

Indications for a central venous line were variable, largely because of the subjective difficulty of experienced oncology nurses in finding veins for the administration of cytostatic therapy. Two patients received central venous lines for parenteral nutrition, 2 for prolonged pain control by intravenous morphine infusion and 1 for rehydration. All central venous lines were placed by percutaneous puncture into a subclavian vein under local anaesthesia, usually on an outpatient basis, so that the distal end lay at the junction of the superior vena cava and right atrium, or slightly within the right atrial cavity. Hepatic arterial Port-a-caths were surgically inserted under general anaesthesia for chemotherapy in 4 patients with hepatic metastases. Most (83 of 93) were inserted by only two surgeons using standard techniques.[1,2] A detailed description of the techniques is available from the manufacturers. Whenever possible, insertion of an indwelling line was postponed until recovery from episodes of neutropenia, thrombocytopenia or active infection. A chest radiograph was done in all cases before and after insertion.

Use of the ports was begun as early as the same day as the insertion. Venous ports were flushed with 10 ml 0,9% saline and heparinised with 6 ml of 100 U/ml heparin after each use or every 4 weeks when not in active use. Arterial ports were flushed with 10 ml 0,9% saline and heparinised with 6 ml of 1 000 U/ml heparin weekly or after each use. Some patients failed to comply with regular monthly heparinisation. Special aseptic precautions were taken throughout. In the case of patients receiving daily injections, an 18 cm extension tube was often left in place and capped for reuse the next day. Only Huber 22-gauge right-angle needles were used for access, as these do not core out the septum.[2]

Various intravenous cytostatics were given intermittently to 41 men and 50 women with cancer (excluding acute leukaemia). Most cytostatic therapy was administered by infusion over 1 - 2 hours. Nine patients received a continuous intravenous infusion of cytostatics for periods of up to 5 days. Ports *in situ* were also used as required for antimicrobial agents, blood products or parenteral nutrition. The hepatic arterial ports were used only for the continuous infusion of fluoro-uracil (3 patients) or adriamycin (1 patient).

Complications were classified as serious (fatal, life-threatening or resulting in symptomatic problems requiring hospital admission or an invasive procedure), or minor (all others, e.g. haematomas not requiring therapeutic intervention, extravasation without tissue damage). Patients with more than one complication were classified according to the most serious one. The mean ages of those with and without complications were compared using the standard error of difference between means.[3]

The minimum direct costs of insertion and each access are shown in Canadian dollars according to the current price and fee schedules in Ontario.

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TABLE I.
Patients with serious Port-a-cath-related complications

Patient	Age	Sex	Complication(s)	Outcome
1	55	M	Major pneumothorax; septicaemia (with neutropenia)	Resolved with intercostal drainage; sudden death 5 weeks after insertion considered unrelated
2	59	M	Major pneumothorax	Resolved with intercostal drainage
3	41	M	Major pneumothorax	Resolved with intercostal drainage
4	46	M	Wound infection; *Staphylococcus aureus* cultured; loop in right subclavian vein possibly unrelated	Patient died with multiple metastatic abscesses
5	31	M	Infection in wound and tunnel; fever (preceded by occlusion — minor complication)	Infection resolved with catheter removal; prior occlusion relieved with streptokinase
6	61	M	Wound infection and dehiscence; *S. aureus*	Infection resolved with catheter removal
7	21	M	Thrombophlebitis	Recovery; catheter removal
8	26	F	Catheter fracture and embolisation; kink seen	Removal transvenously with difficulty
9	27	M	Catheter fracture and embolisation; no kink noted	Removal transvenously with difficulty
10	20	F	Catheter partially retained at removal	Required open surgical removal

TABLE II.
Patients with minor Port-a-cath-related complications

Patient	Age	Sex	Complication(s)	Outcome
11	35	F	Hepatic artery thrombosis (hepatic arterial catheter)	Catheter removed; no deleterious sequelae
12	33	F	Sterile granuloma	Catheter removed at patient's request
13	48	F	Small pneumothorax; occlusion	Resolved; catheter removed
14	72	M	Minor haematoma	Resolved
15	39	F	Kink at first rib	Catheter removed and replaced on opposite side
16	49	F	Extravasation of fluoro-uracil from hepatic arterial line on two occasions	No sequelae
17	48	M	Migration of catheter tip to right ipsilateral internal jugular vein	*In situ* — no sequelae
18	72	M	Large haematoma in chest wall (mild bleeding tendency)	Resolved gradually

Results

Serious complications (1 of which proved fatal) occurred in 10 patients (11%) (Table I) and minor complications in another 8 (9%) (Table II).

Difficulties in percutaneous insertion were fairly common and there were 6 occasions where this initially failed. In each case except one, a Port-a-cath was successfully inserted in the contralateral subclavian vein. Four patients had an immediate pneumothorax and intercostal drainage was required in 3 of them.

Infection occurred in 3 patients after 3 - 16 months of use. All 3 had wound infections and one had an extension to the catheter tunnel. In 2 cases, *Staphylococcus aureus* was cultured from the pus. The infections settled in 2 of the 3 patients with antibiotics and catheter removal. The fatal infection occurred in a 46-year-old man with non-small-cell lung cancer who had a Port-a-cath inserted without difficulty. He first showed signs of soft-tissue infection overlying the port 3 months after insertion, and it was accompanied by fever and neutropenia. After a brief resolution on antibiotics, the infection recurred and progressed despite intensive antibiotic treatment. A chest radiograph showed a complete loop of the catheter in the right subclavian vein (Fig. 1), but no obstruction was noted. His cancer progressed concurrently and he died with an empyema and loculated pleural abscesses a month after his third admission. Despite multiple culture specimens, *S. aureus* was cultured on only a single occasion from pus at the port site. The catheter was removed just before the patient's death.

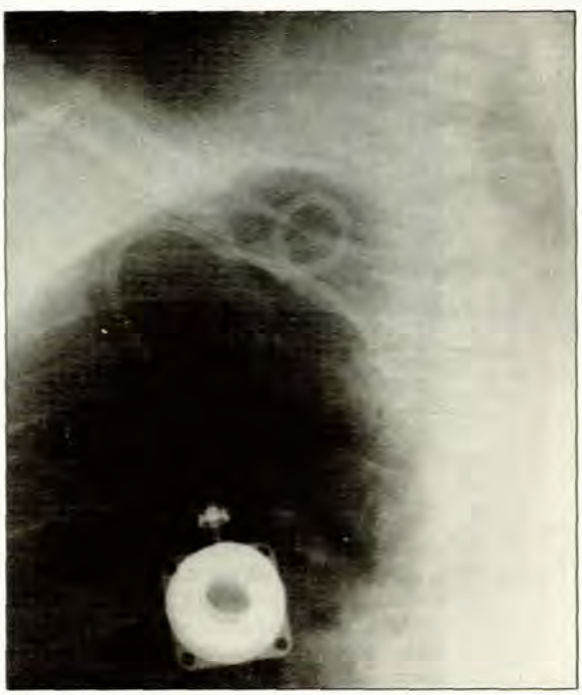

FIG. 1.
Radiograph of patient 4 showing a complete loop of the catheter in the right subclavian vein. This patient eventually died from infection of the port and metastatic abscesses caused by *S. aureus*. The loop may be incidental.

A 26-year-old woman and a 27-year-old man had embolisation of the distal catheter segment which fractured in the region of the first rib (Fig. 2), 6 and 13 months respectively after insertion. The distal catheter segments were removed transvenously by cardiologists, without sequelae. This was, however, a painstakingly prolonged and difficult procedure in each case. Only one removed catheter was available for inspection and this showed an oval segment at the site of rupture due to extrinsic compression. A small kink (pinch-off sign[4]) was subsequently noted in one catheter overlying the first rib on the plain postero-anterior chest film. Furthermore, nurses had noted some positional resistance to flow in this patient. Our experience in the first of 2 patients led us to remove an intact catheter 3½ months after insertion from a 39-year-old woman showing kinking with resistance to flow (Fig. 3). The removed catheter appeared normal on inspection. Another catheter was successfully placed on the contralateral side. These 3 patients have been described briefly elsewhere.[5]

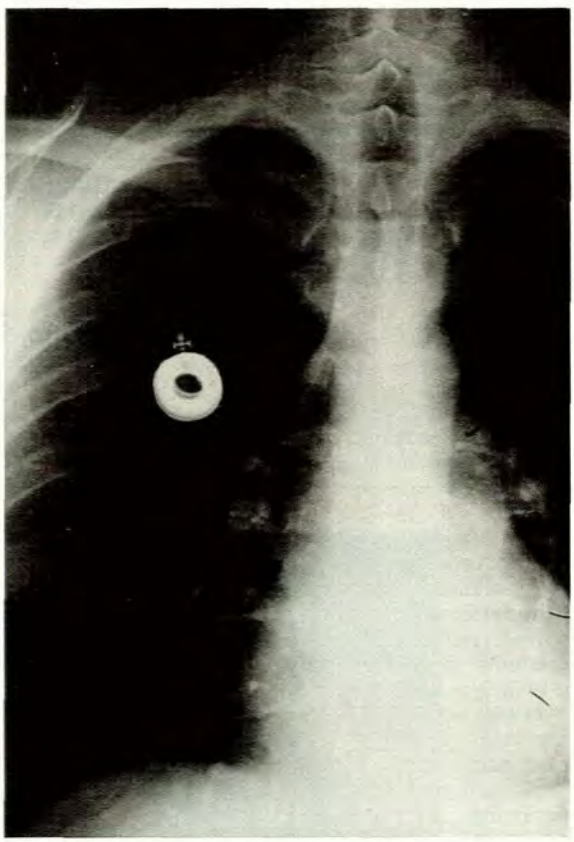

FIG. 2.
Radiograph of patient 9 showing the fracture site at the junction of the medial aspect of the first rib and the clavicle. The embolic distal segment can be seen in the lower right of the picture.

One patient developed significant axillary vein thrombosis which resolved with anticoagulation and removal of the catheter. Another with a hepatic arterial line had thrombosis of the artery without sequelae.

Minor complications including transient and superficial wound infection, wound dehiscence, large haematomas, hepatic artery thrombosis and extravasation of fluoro-uracil occurred in 8 patients (Table II). One patient experienced migration of the distal catheter up the right internal jugular vein (Fig. 4). Two catheters became blocked but patency was restored in one using streptokinase; the other catheter was removed.

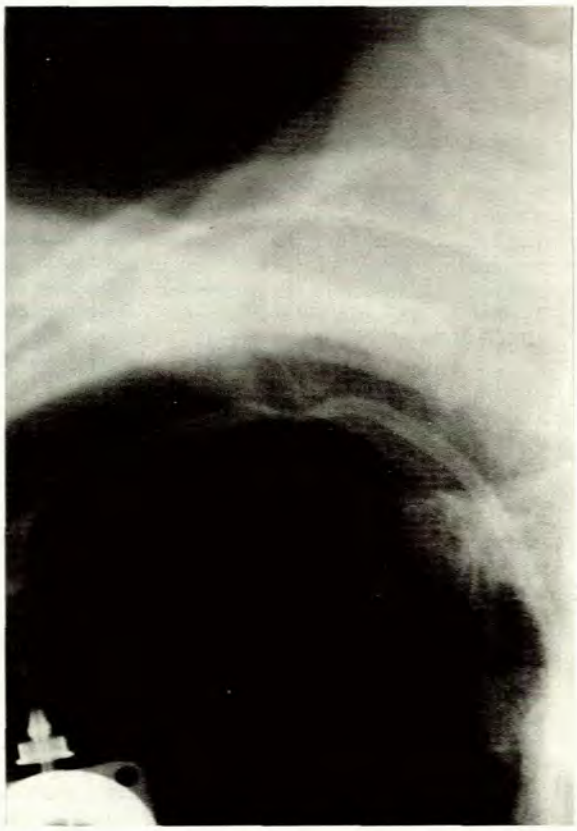

FIG. 3.
The 'pinch-off' sign at the junction of the first rib and clavicle (patient 15).

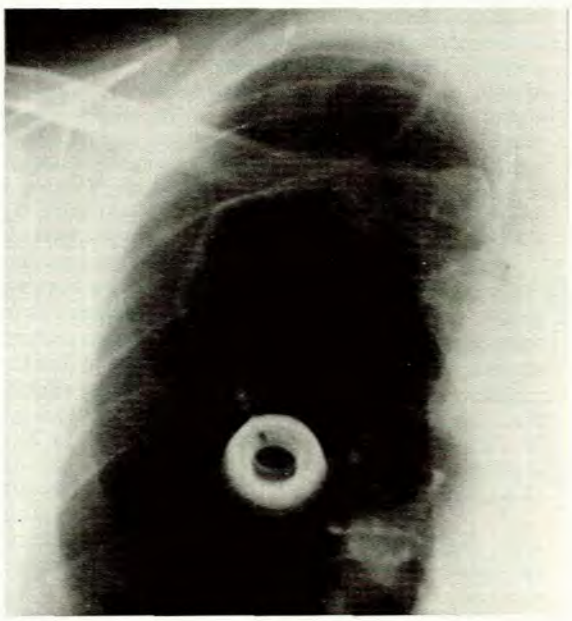

FIG. 4.
Migration of the catheter end to the right internal jugular vein (patient 17).

Most patients had venesections done through peripheral veins in order to minimise complications. Our nurses estimated that difficulty in obtaining blood return through the Port-a-cath despite easy infusion at the time of chemotherapy occurs in about 10% of patients (exact figures unknown).

The mean age of those with a complication of any severity and those with serious complications is compared with those without (Table III). The mean age of patients with complications was significantly lower than that of those without complications.

TABLE III.
Age comparisons of patients with or without any complications and serious complications

	No. of patients	Mean age	*P*-value
Any complications	18	43,5 ± 16,1	
With			$P < 0,002$
Without	73	56,3 ± 13,2	
Serious complications	10	38,7 ± 15,8	
With			$P < 0,001$
Without	81	55,6 ± 13,5	

The means were compared using the 'standard error of the difference between means'.[2]

The minimal direct cost of the Port-a-cath, surgical fee, theatre time and control radiographs is approximately Canadian $868,00 (Table IV). The minimum direct cost for each access is approximately Canadian $7,20. (Canadian $1,00 = US $0,85 and = R2,14 at the time of writing.)

Discussion

Some type of complication is reported in over 30% of patients with Port-a-caths; catheter removal is required in 6 - 30% of cases.[2-4,6-15]

A pneumothorax, occasionally requiring intercostal drainage, may result from perforation of the apex of the lung at the time of insertion but this appears to be uncommon[7] and occurred in only 4 of our patients. Other structures in the supraclavicular fossa including the subclavian artery, may rarely be damaged, usually without sequelae.[6]

Infection after successful insertion is reported as the most frequent complication, although this was not the case in our patients. It has been suggested that most bacteraemias and infections of the exit site can be treated with antibiotics alone, but that tunnel infections require removal of the catheter. Additionally, infections due to *Bacillus* spp. *Candida* spp., and JK *Corynebacterium* are considered difficult to eradicate without catheter removal.[6-11] Although the commonest organism reported is *S. epidermidis*, this was not identified in any of our patients; *S. aureus* was identified in 2 of 3 patients with infection. The long delay before evidence of infection (3 months in 2 of our patients, 16 months in another) suggests that it is more commonly acquired from circulating bacteria or from non-sterile punctures rather than at the time of insertion. Prophylactic vancomycin at the time of surgery and/or with each access may be used, where infections with Gram-positive organisms are relatively common, but our figures (3 infections in 93 catheters) show that low infection rates can be achieved without prophylactic antibiotics, and the value of vancomycin remains unproven. The rarity of infection in our patients may be due to the exclusion of patients with acute leukaemia, postponement of insertion while neutropenic, and the conscientious aseptic technique of trained oncology nurses.

Catheter occlusion is reported in up to 25% of catheters[1] but this occurred in only 2 of our patients. 'Persistent withdrawal occlusion' resulting in difficulty in blood withdrawal despite easy infusion is not uncommon (occurring but not documented in our patients).[12] This appears to be due to the valve-like action of a fibrous sheath developing around the venous portion of the catheter. Both complete and partial occlusion will usually be reversed by thrombolytic infusion. As this may be required on more than one occasion, urokinase is preferable to streptokinase.[12,13]

Venous thrombosis occurs quite frequently in some series and this too usually responds to thrombolytic agents[12,14] but rarely requires catheter removal.[1,8,15] It is uncertain if regular flushing with heparin, as was done in our patients, contributes to a lower rate of occlusion or thrombosis.[15]

Extravasation of cytostatics from Port-a-caths is an uncommon problem.[1,6,16] The dangers required special emphasis for those receiving outpatient infusions of cytostatics which may cause soft-tissue necrosis.

Another uncommon complication is disruption or fracture of the catheter at the passage between the first rib and clavicle.[4,6] It is interesting that our 2 patients, aged 26 and 27, in whom this occurred (Fig. 2), and a third aged 39 in whom kinking of the catheter suggested the risk of disruption (Fig. 3), were all younger than most of our patients (mean of the whole group 58 years, median 53 years) and were all fairly physically active in the period when dislodgement occurred.

Factors which potentially predispose to complications include the type of cancer, duration and severity of neutropenia, the patient's age and performance status, recent chemotherapy, use soon after insertion, experience and skill of the surgeon inserting the catheter, the type and size of the catheter and techniques of access.[1,7,11,17] None are proven. Surprisingly, complications, especially serious ones, were statistically more common in younger patients in this series. Possible explanations include the generally greater physical activity and mobility of younger patients, or a greater disregard for the presence of the devices. Our data were insufficient to analyse putative predisposing factors, but we hope to do this by prospective study. Although unproven, it seems prudent that, whenever possible, insertion should be delayed until recovery from neutropenia. Delaying the first use of the port after insertion is not clearly advantageous.

The insertion of a Port-a-cath is an expensive undertaking. In addition to the direct costs shown in Table IV, patients with complications will incur additional expenses for radiographs, bacterial cultures, antibiotics, surgery, hospitalisation and catheter removal. These costs are difficult to quantitate and are sometimes indistinguishable from the costs of treating the underlying cancer.

TABLE IV.
Direct costs in Canadian dollars of insertion and access of an uncomplicated Port-a-cath

	Canadian dollars (1989)
Insertion of venous Port-a-cath	
Port-a-cath	440,00
Theatre costs	184,00
Surgical fee	162,00
Radiographs before and after insertion	82,00
Approximate minimal cost*	868,00
Access	
Sterile gloves	1,30
Extension tube	1,50
Huber needle	2,20
Dressings and miscellaneous	2,20
Approximate minimal cost per access*	7,20

*See text for additional costs not quantified (Canadian $1 approximately US$ 0,85, R2,14).

The selection of an implantable venous port over peripheral venous access must necessarily be subjective and depends on the condition of the patient's veins, the skill, patience and experience of the therapist inserting peripheral catheters, and the patient's life expectancy and the strength of the indication. Many patients with poor veins prefer the certainty of venous access for therapy and blood sampling, to the anxiety accompanying multiple attempts to access peripheral veins. Despite the advantages of implanted devices, the cost is significant and the complications, though uncommon, may be serious. Every technique should be used to enhance the success of peripheral venous cannulation (warming the limb or hand, obtaining adequate proximal venous compression, etc.), before considering an implanted device.

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