

The Use of Midline Catheters

Brief Summary

Midline catheters are peripheral venous access devices between 3 to 10 inches in length (8 to 25 cm). Modern versions of this device are typically 8 inches (20 cm) long. Midlines are usually placed in an upper arm vein such as the brachial or cephalic and the tip ends below the level of the axillary line. Midline catheters are longer than peripheral IV catheters which are generally 1 to 3 inches long and shorter than peripherally inserted central catheters (PICC) which extend into the vena cava. This device provides an alternative to short peripheral IVs for certain treatments. While the exact length of dwell time is unknown, Midlines are routinely used for one to six weeks. Since the tip of these catheters does not extend beyond the axillary line, there are limitations as to the type of infusate that can be used and the rate at which that infusate can be delivered. In general, infusates that are between pH 5 and 9 or have an osmolarity less than 500 mOsm are appropriate for infusion through a Midline (O'Grady 2002). Importantly, since the catheter does not reach the central veins, Midlines can be placed without a chest X-ray to confirm placement. For certain applications, Midline catheters provide a stable, cost-effective, intermediate to long term peripheral venous access that is appropriate for acute, subacute, and home care settings.

Longer than a short peripheral IV

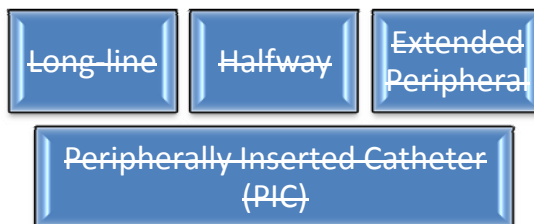
- Peripheral Venous Access
- Between 3 to 10 inches long (8 to 25 cm)
- Most are 8 inches (20 cm)

Shorter than a PICC

- Does not provide central vein access
- Terminus rests below the axillary line

Midline catheter terminology

Midline catheters have been referred to by various names in the literature including long-line, halfway, midline, extended peripheral, and peripherally inserted catheter or PIC (Intravenous Nursing Society 1997).



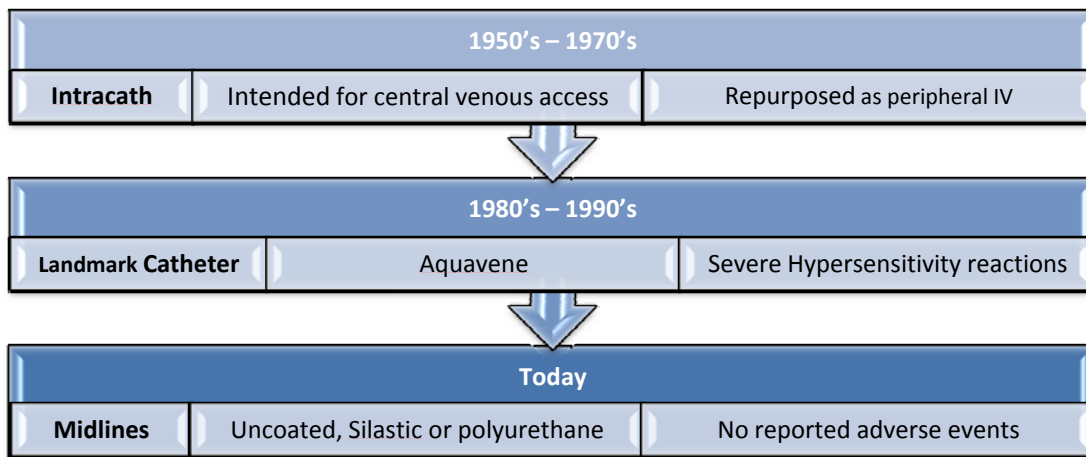
The term PIC is particularly troubling because it can easily be confused with PICC—a markedly different venous access device. Some have argued for alternate names (Gilbert DN 1997), however these catheters are marketed under the name Midline and are most widely known as that name.

Further confusing the matter is the existence of mid-clavicular catheters. Mid-clavicular catheters must be differentiated from midline catheters, the former being longer and extending into the subclavian or brachiocephalic veins with final tip placement anticipated at the midpoint of the clavicle. The use of

mid-clavicular catheters is controversial and not supported by the (Intravenous Nursing Society 1997) or the Association for Vascular Access (NAVAN 1998) due to increased mural thrombus formation and venous dissection. Mid-clavicular catheters are not considered Midlines or PICCs.

The history of Midlines

The Midline catheter has had a difficult history, a fact that likely hampers its widespread use today. The first Midline catheter-like devices were produced by the Deseret Pharmaceutical Company in the late 1950s under the name Intracath. These rigid devices were originally marketed and intended to be inserted directly into the subclavian vein for central venous access. By the 1970s nurses were using the devices in veins of the upper arm as an alternative to short peripheral IVs since they needed less frequent changing. Unfortunately the rigidity of this device led to relatively frequent infiltrations and mechanical phlebitis (Cook 2007).



In the 1980s Menlo Care produced a device called the Landmark catheter that was rigid at the time of insertion and then softened as it was remained in the vasculature. The catheter material termed Aquavene was later found to cause severe hypersensitivity reactions in approximately five percent of patients (Maki 1995) and was pulled from this market. Despite the fact that severe reactions were specific to the Aquavene material, use of Midline catheters mostly fell out of favor. Current midline catheters are constructed of silicone and similar pliable materials and inserted using a modified Seldinger technique. Limited studies on modern devices show them to be safe and effective and to date there have been no reports of adverse reactions based on materials or catheter design (Anderson 2004).

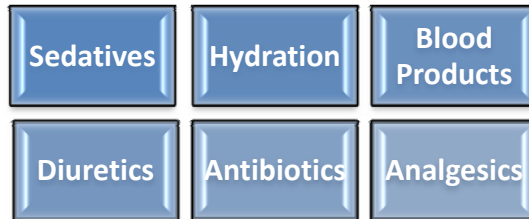
Safety of Midline catheters

Modern Midline devices confer several advantages over short peripheral IV access. One important advantage of Midline catheters is that they can be left in place for extended periods of time. Short peripheral IVs should be changed every 72 to 96 hours to minimize phlebitis and infection (O'Grady 2002) while Midlines are usually left in place at least seven days and often longer. Midlines are associated with less risk of phlebitis than short peripheral IVs (Mermel, Parenteau and Tow 1995). Part of the reason for decreased risk of phlebitis with Midline catheter use is that the diameter of the vein at

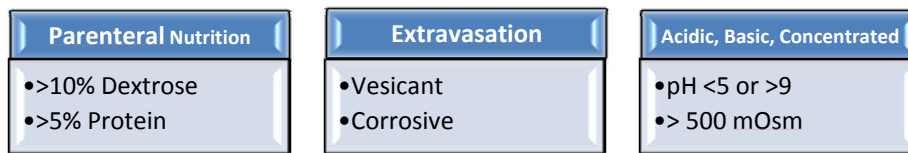
the terminus of the catheter is larger than it would be in the mid and distal arm. Thus chemical and mechanical phlebitis is reduced.

Midline Infusates

Infusates that are appropriate for short peripheral IV infusion are also appropriate for Midline infusion, in general.



However, since upper arm veins run deeper than veins used for insertion and likely targets for short peripheral IV catheters, complications from the infusion may not be recognized until a severe reaction has occurred. Therefore, certain medications that are likely to be damaging to the vein generally should not be infused through Midline catheters.



These medications include vancomycin, nafcillin, Primaxin, Phenergan (promethazine), and Dilantin (phenytoin) as well as any agent that is hyperosmolar (> 500 mOsm) or very acidic or basic (Cook 2007).

Midlines are associated with a rate of bloodstream infection between 0.3 and 0.8 per 1,000 catheter days (Mermel, Parenteau and Tow 1995) (Tokars, et al. 1999), a rate that is less than that reported for central venous lines and even PICC lines (Safdar and Maki 2005). Unlike central and PICC lines, the tip of a midline catheter is meant to end in a peripheral vein and their placement does not need to be verified by X-ray. Thus midlines avoid many of the cardiac problems that can occur with lines that terminate centrally such as heart arrhythmias (Bivins and Callahan 2000).

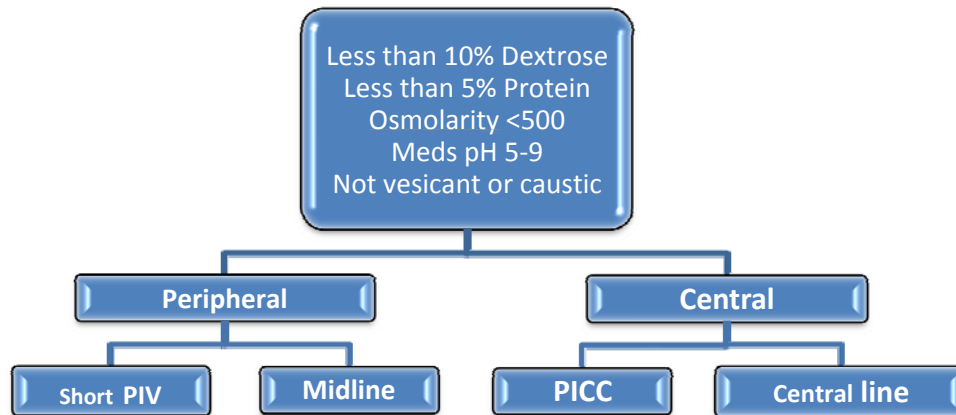
Early versions of catheters containing a polyurethane-elastomeric hydrogel were associated with severe hypersensitivity reactions (Mermel, Parenteau and Tow 1995). However, the Midline catheters that are currently available are uncoated and there have been no published adverse events related to these materials (Anderson 2004).

Thrombosis remains a concern for all forms of venous access. Like PICC lines, Midline catheters are constructed of either silicone rubber or polyurethane. When these two materials are compared in PICC catheters, silicone rubber is associated with a decreased risk of thrombosis (Cortelezzi, Moia and Falanga 2005), yet studies looking at Midline catheters have not yet been reported. In one study of PICC lines of various lengths, the rate of catheter-related thrombosis increases from 21 percent when the catheter terminus is in the superior vena cava to 60 percent if it lies in the axillary, subclavian, or

innominate veins (Kearns, Coleman and Wehner 1996). Other studies show similar rates of thrombosis regardless of terminus site (Thiagarajan, et al. 1998). It is currently recommended that Midline catheters terminate in below the axillary line to minimize the risk of thrombosis (Gorski and Czaplewski 2004).

When to use Midline catheters

Despite their lack of popularity, especially when compared to robust PICC line use in the United States and



other countries, Midline catheters serve a useful purpose in acute, subacute, and home healthcare settings in particular circumstances. **According to the Infusion Nurses Society's standards of practice (2006) Midline catheters are appropriate for all intravenous fluids that would normally be administered through a short peripheral IV. The same report cautions against using a Midline to infuse any solution containing greater than 10 percent dextrose or 5 percent protein, or any vesicant or caustic solution.** Since the midline catheter terminus is in a vein of wider diameter than most short peripheral IVs, there is a more rapid and greater dilution of infusate. Faster dilution provides greater patient comfort during infusion. While previous guidelines recommended that Midlines were not to be routinely used for blood draws (Infusion Nurses Society 2000) occasional blood draws are made through Midline catheters and may become more common as studies are done on this topic.

Short peripheral IV lines require routine replacement and are generally not used as outpatient vascular access (Anderson 2004). In the absence of a complication, a Midline can be inserted early in the patient's stay and left in place for the duration of the patient's hospital stay. As an additional advantage, Midline catheter access can remain for a period of time after patient discharge. Recent work suggests that midlines may be permitted to dwell *in situ* for up to 296 days (Griffiths and Philpot 2005).

A midline catheter should be considered when the projected hospital stay is going to be longer than four days. This recommendation is based on the fact that a short peripheral IV will need to be changed every 72-96 hours (O'Grady 2002). Two or three catheters will be used during a hospital stay of 8 to 10 days and Midline insertion and management costs approximately the same as three short peripheral IVs. (Anderson 2004). This type of venous access also provides the option of continuing intravenous therapy upon discharge.

A recent review of the topic suggests that Midlines are of limited usefulness because they cost the same as PICC lines but do not provide access to a central vein (Cheung, et al. 2009). While the cost of materials might be similar between Midlines and PICCs, PICC line placement requires at least one chest X-ray to confirm placement which increases the overall cost of the procedure considerably (Horattas, et al. 2001). Midline catheters are not a substitute for central venous access, however.

Midline catheters would not be appropriate, either in inpatient or outpatient settings, for the infusion of certain medications, concentrated parenteral nutrition, vesicant chemotherapy, or hyperosmolar solutions. Nevertheless there are times in which protracted intravenous infusion may be the only indication for a patient to be admitted or remain in the hospital. Thus, Midline placement should be considered at the beginning of a hospital stay to cover the duration of a patient’s stay in the hospital, but also to accelerate discharge to a subacute or home setting. Midline venous access would eliminate the need for repeated IV placement during the hospital stay and serve as a bridge to outpatient care.

There are various examples in which Midline catheters would be useful. Patients with end stage but stable congestive heart failure (CHF) often require intermittent intravenous boluses of furosemide. In fact, many inpatient admissions for CHF exacerbation could be shortened or avoided in highly motivated individuals with reliable peripheral venous access. Depending on the infective microorganism and its antibiotic susceptibilities, patients with certain infections could be effectively treated as an outpatient through a Midline. Cellulitis, bacterial arthritis, endocarditis, and certain other infections could be treated initially in the hospital through a Midline catheter and antibiotic treatment could continue in a subacute or outpatient setting through the same device. Select patients presenting in an office setting occasionally require hospital admission for IV medications alone. Since Midline placement does not require a chest X-ray to verify placement, the catheter could be inserted in the physician’s office and, with home health nursing support, hospitalization could be avoided entirely.

	Short PIV	Midline	PICC	Central line
Type of venous access	Peripheral	Peripheral	Central	Central
Discharged home with VAD <i>in situ</i>	No	Yes	Yes	No
Poor venous access	Difficult	Helpful	Helpful	N/A
Contrast CT (low pressure, flow)	Yes	Yes	Yes	Unusual
Vesicant Chemotherapy	No	No	Possible	Possible
End Stage Renal Disease	Concern that devices may compromise access			OK

Midlines have putative inpatient indications as well. As mentioned previously, for any hospital stay that is projected to last longer than 4 to 5 days, a Midline catheter would be preferable to multiple short peripheral IVs placed throughout a patient’s stay. This is especially true in patients with difficult peripheral venous access. While virtually all patients in an intensive care setting have central venous line

placement, it is sometimes necessary to administer agents into a peripheral vein in the ICU. Considering that the average length of an ICU stay is between 3 and 7 days (Knaus, et al. 1993) followed by several days in a step-down or similar unit, having a constant, stable, intermediate term peripheral venous device is reasonable, presuming the infusant does not require centralized placement.

Conclusions

Midlines should be considered as an alternative peripheral venous access. Unlike PICC lines, Midline catheters offer peripheral, not central venous access. Midlines should be considered early in treatment instead of serial short peripheral IVs. These devices permit the infusion of most or all infusates that are appropriate for short peripheral IVs with the added advantage that Midlines can dwell much longer, at least of six weeks and perhaps for months (Griffiths and Philpot 2005). Any cost-benefit analysis of Midlines must include the fact that a chest X-ray and specialist interpretation is not needed to confirm placement. Midlines are a cost-effective peripheral venous access that can be used successfully in acute, subacute, and home settings.

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