Complications and risk factors on midline catheters' follow-up about non-ICU patients: study protocol for a multicentre observational study (the midDATA study)

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ABSTRACT

Introduction The midline catheter (MC) is an increasingly popular device used commonly for patients with difficult venous access or those who require infusion for more than 6 days. Little is known about complications such as infection, thrombosis or occlusion for inpatient and home care patient. This protocol presents the follow-up of non-intensive care unit patients with an MC. The aim is to identify complications and search for risk factors associated with these complications.

Method and analysis A prospective observational design is used for the follow-up of 2000 patients from 13 centres in France. Each practitioner (inserting clinician, anaesthetist nurse, hospital nurse and home nurse) will fill out a logbook to report each care made (eg, number of saline flushes, dress maintenance) on the MC and if any complications occurred. The incidence of complications (ie, infections, thrombosis or occlusions) will be expressed by the total number of events per 1000 catheter days. The period of recruitment began in December 2019 for a duration of 2 years. An extension of the inclusion period of 1 year was obtained.

Ethics and dissemination This study received the approval of the Committee for the Protection of Persons of Nord Ouest IV (No EudraCT/ID-RCB : 2019-A02406-51). It was registered at clinical trials (NCT04131088). It is planned to communicate results at conferences and in a peer-reviewed journal.

Trial registration number NCT04131088.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ midDATA will be the first European prospective observational study of complications on a cohort of 2000 patients from 13 centres.
⇒ Continuity of the follow-up for home care patients who are discharged from hospital.
⇒ Limitations due to the follow-up of home care patients and the challenge of identifying complications.

BACKGROUND

The midline catheter (MC) is a venous access device inserted in a deep peripheral vein of the arm. Its tip should not exceed the axillary vein.[1 2] It requires a vein's location by Doppler ultrasound, which means that it can only be inserted by trained professionals authorised to use it.[3 4] MCs are prescribed for patients with either difficult intravenous access or who need more than 6 days of venous access for either (1) non-vesicant or non-irritant or (2) pH between 5 and 9 or (3) osmolarity less than 900 mOsm/L.[5 6] MCs are made of polyurethane or silicone, single or two lumens, in sizes ranging from 3 to 5 French and lengths from 8 to 20 cm. In most procedures, a Seldinger or a modified Seldinger technique is used for the MC's insertion, secured by a securement device and an integrated extension line, which allows the MC to remain fitted for a duration of 28 days when used with the appropriate maintenance protocol as described by European recommendations on the proper indication and use of peripheral venous access devices consensus.[2] For the last decade, MCs have found a place as an alternative between the peripherally inserted central catheter (PICCs) and central venous catheters (CVC), and their use is increasing.[7 8] Indeed, they are appropriate to antibiotherapy (non-CVC exclusive) of less than 4 weeks in surgical wards or to patients with an Adult-Difficult Intravascular Access-score ≥4 in medicine wards.[9 10]

Using MCs on patients may expose them to infections, thrombosis and occlusions for major causes, as well as leaks, dislodgements and intravascular infiltrations for minor ones. However, the rate of complications (composite of infection, thrombosis and occlusion) is estimated to be between 3.45% and 10%.[11 12] At first glance, MCs infection

rate seems low (0.28/1000 catheter days).[13] However, there is little evidence of these lower rates, but also of thrombosis (3.3/1000 catheter days) and occlusions due to the quality of the studies, which are primarily retrospective cohort studies.[14–16]

Although MCs are peripheral catheters, they often dwell for longer than 7 days, and therefore, follow-up protocols (eg, dressing changes) more closely reflect CVC protocols. Most studies describe MCs in intensive care units (ICUs), where medical and nurse staff are familiar with CVC maintenance and are focused on follow-up.[17] On the other hand, most MCs are inserted for patients in general wards (surgical or medical), where nurses use more peripheral intravenous catheters and are less aware of CVC protocols. The creation of vascular access units has seemingly increased[18 19] to respond partly to this patient population, likely to be cared for at home with the device. The maintenance of MCs needs more cooperation between hospitals and home caregivers, mostly home care nurses, for the continuity of care and to improve quality.[20] There is also a need to collect more data on care and follow-up during hospitalised and particularly homecare patients as epidemiological data about MCs on their use patterns and complications of home patients is scarce.[21]

The aim of midDATA study is (A) to assess the incidence rate of midline complications defined by an infection or a thrombosis or an occlusion, (B) to evaluate protocols used by hospitals and home healthcare providers and (C) to identify risk factors associated with infection, thrombosis and occlusion.

METHOD AND ANALYSIS

Study design

This is a prospective multicentre, observational study. It involves 13 French hospitals.

Enrolment

The inclusion began in December 2019 for an initial period of 2 years, with an extension of an additional year obtained in October 2021.

A total of 2000 patients aged over 18 years and not hospitalised in ICUs will be enrolled if they require an MC and are willing and able to provide consent.

Non-inclusion criteria are as follows:

- ICU admission.
- Contraindication for MCs (arm with: arteriovenous fistula, lymph node excision or radiotherapy, skin infection or surgical history close to MC implantation site, hemiplegia).
- Pregnant women.
- Patients under justice protection.

Thirteen French university and non-university public hospitals will be involved in the study: (Blois Public Hospital, La Roche sur Yon Public Hospital, Le Mans Public Hospital, Lyon University Hospital, Morlaix Public Hospital, Nantes University Hospital, Nord Deux Sèvres Public Hospital, Quimper Public Hospital, Rodez Public Hospital, Saint-Malo Public Hospital, Thonon Public Hospital, Toulouse University Hospital, Vannes Public Hospital) (table 1).

Sample size

In 2018, the authors identified 408 MC placements in our institution. Over a 24-month inclusion period, approximately 2000 patients were eligible for study inclusion. According to two recent studies,[10 12] the rate of complications such as infection, thrombosis or occlusion varies from 2% to 10%. With the inclusion of 2000 patients, the team was able to estimate the incidence of complications with an accuracy ranging from 0.6% to 1.3%. In addition, researchers expect between 40 and 200 events, which would make it possible to search for risk factors associated with these complications. Regarding home care patients, in our institution, researchers estimated that nearly 20% of the follow-up would be patients discharged from hospital.

Procedure

In all participating centres, all MC insertions will be performed by an anaesthetist nurse or an anaesthetist. They have the choice of the device's length and diameter (eg, undefined long peripheral cannulas (6–15 cm long) or MC), of the local antiseptic used, of the securement device and of the securing dressing. Each hospital uses its own devices and processes for routine care. At each insertion, all these characteristics will be collected for the electronic case report form (online supplemental figure 1S). All centres comply with the French guidelines on infection prevention.[22] The follow-up starts from the insertion procedure's beginning until the catheter's removal. A monitoring logbook will follow the patient and will be used to collect the data (online supplemental figure 2S). The logbook is kept by the nurse in a general ward and by the patient (or next of kin) when discharged from the hospital. Each practitioner (eg, nurses, physicians, health caregivers) will record the data related to the MC maintenance in the monitoring logbook. At the removal of the MC, the monitoring logbook will be sent to the research department of each hospital to implement a centralised electronic case report form. If an MC is removed for any reason (complications or other issues), and if there are less than 10 days between removal and a second insertion, this second MC will be followed up by a second monitoring logbook. Otherwise, the follow-up stops. When discharged from hospital, if the MC is still in place, the monitoring logbook follows the patient for home care providers, and at the MC removal, it is returned by post to the research department. The protocol drop-out is defined when patients are transferred to an ICU, the follow-up is stopped, but data will be kept until ICU admission.

Table 1 Characteristics of centres and their MCs insertion protocol

Hospital	Total no of beds*	Year of first midline	No of MCs per year	Insertion practitioner	Length of midline (cm)	Diameter (G or Fr)
Blois Public Hospital	440	2013	130	AN	20	4,5
La Roche-sur-Yon Public Hospital	869	2015	910	A/AN	8 (wo/IEL), 6,8, 20,	2, 3, 4, 5†
Le Mans Public Hospital	958	2017	700	AN	20, 15	3,4,5
Lyon University Hospital (southern site)	1078	2018	500	AN/A/N	20	4
Morlaix Public Hospital	249	2018	295	AN	20	4
Nantes University Hospital	1712	2015	800	AN/A/AR	12	4
Nord deux Sèvres Public Hospital	176	2017	75	AN	Adjusted to patient	4
Quimper Public Hospital	580	2011	1000	AN	20	4
Rodez Public Hospital	406	2018	400	AN / A	20	3, 4, 5†
Saint-Malo Public Hospital	462	2016	206	AN/A/AR	20	4
Thonon Public Hospital	285	2013	317	AN/N	10 (wo/IEL), 20	18, 4
Toulouse University Hospital	2493	2018	1300	AN	20	3, 4
Vannes Public Hospital	725	2013	400	AN	20	4

*Combined surgical medicine and obstetric.
†Two lumens.
A, anaesthetist; AN, anaesthetist nurse; AR, anaesthetist resident; MCs, midline catheters; N, nurse; wo/IEL, without integrated extension line.

Study endpoints

Primary outcome

The primary outcome will be a composite outcome of the incidence of complications related to the MC. Complications are defined as the occurrence of symptomatic infections confirmed with culture or symptomatic thrombosis confirmed with Doppler ultrasound, or occlusion onset. The definition of the infection is based on the French 'Comité Technique des Infections Nosocomiales et des Infections Liées aux Soins' (Technical Comity of Nosocomial Infections and Medical Care-Related Infections),[23] which defines the Peripheral Catheter-Related Infection (PCRI) as (1) catheter-related bloodstream infections (CR-BSI). A CR-BSI is defined as a bloodstream infection occurring within 48 hours of the MC removal and (A) the MC blood culture≥10^3 Colony-Forming Unit (CFU) /mL with the same micro-organism involved or (B) the onset of pus on the insertion site without other infection site identified and, (2) PCRI is based on (A) the general PCRI is defined as the MC tip culture ≥10^3 CFU/mL and the total or partial regression of general infectious signs within the 48 hours of the MC removal, (B) the local PCRI is defined as the MC tip culture ≥10^3 CFU/mL if an MC infection is suspected or on the onset of pus on the MC insertion with positive culture on the MC insertion site (negative culture, without antibiotic treatment, exclude the case). Clinical signs at diagnosis are fever, redness or pus on the insertion site.

Thrombosis is defined by a blood clot at the end or around the catheter, which is in contact with the vein wall with a length >5 mm and confirmed with a Doppler ultrasound exam. Clinical signs at diagnosis are oedema, leaking on insertion site, pain, erythema, indurated cord and infection (eg, thrombophlebitis).

Occlusion is defined as a catheter obstruction with an intraluminal blood clot or a precipitated medication. A test entails an injection of 0.9% NaCl in the catheter made to demonstrate the catheter occlusion at removal (figures 1 and 2).

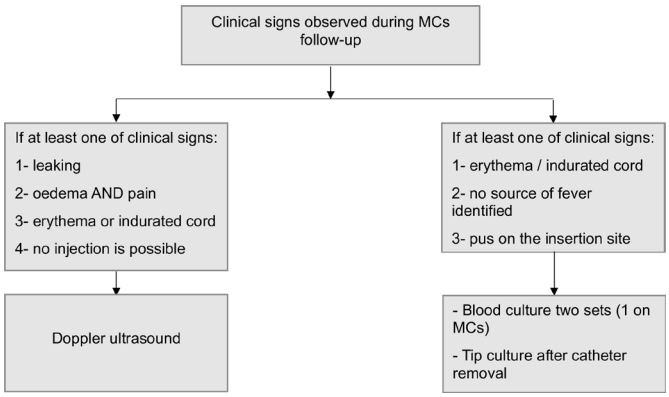

Figure 1 Algorithm for diagnosis exams of inpatients related to clinical signs onset. MCs, midline catheters.

Secondary outcomes

Secondary outcomes about protocols used will be the description of the catheter dwell days, the preparation of the patient's skin and the antiseptic used, the characteristics of the MC per the Seldinger technique, the diameter and the length of the catheter, whether single or double lumen, whether a sheath was used, whether scheduled catheter placement, whether other removal issues.

Risk factors associated with a complication during the course of care of the patient with the MC will be analysed:

Related to the patient: age, sex, the vein diameter (under tourniquet), documented infection during treatment, history of coagulation pathology and malignant haemopathies.

Related to use: the insertion indication, number of attempts, vein choice, the preparation of the patient's skin and the antiseptic used, the characteristics of the MC per the Seldinger technique, the diameter and the length of the catheter, whether single or double lumen, whether a sheath was used, whether scheduled catheter placement, the removal indication, whether the end of treatment, complications or other removal issues (eg, phlebitis, infiltration, dislodgment), catheter dwell time.

Related to hospitalisation: patient in the hospital or discharged.

Related to monitoring and care: number of flushes in positive pressure, number of dressing changes, antiseptic used, needle-free connectors used, number of blood sampling, kind of drug perfusions (eg, type of fluid, antibiotics, pain killers).

Patient and public involvement

No patients involved.

Statistical analysis

The primary endpoint, the incidence (ie, the number of new cases divided by the population at risk, which is only catheterised patients) of complications, will be expressed by the total number of events per 1000 catheter days. A descriptive analysis will show the characteristics and the modalities of management of how the midline will be performed. Qualitative variables will be described in terms of numbers and percentages of each modality, and the quantitative variables by minimum, maximum, mean, and SD, or median and quartiles otherwise. The factors associated with the occurrence of complications will be analysed using a Cox proportional hazards model, considering the time of the complication's occurrence. The univariate analysis will be performed. And for factors associated with $p<0.20$, a multivariate analysis will be done to determine the factors independently associated with $p<0.05$. Only a univariate analysis will be done if the number of events is too low.

DISCUSSION

Strengths

MidDATA study is the first prospective multicentre observational study based on MC complications in Europe. Inclusions had begun in December 2019 for 2 years. After 29 months of enrolment, 1800 patients had been included. Due to the COVID-19 pandemic, an extension

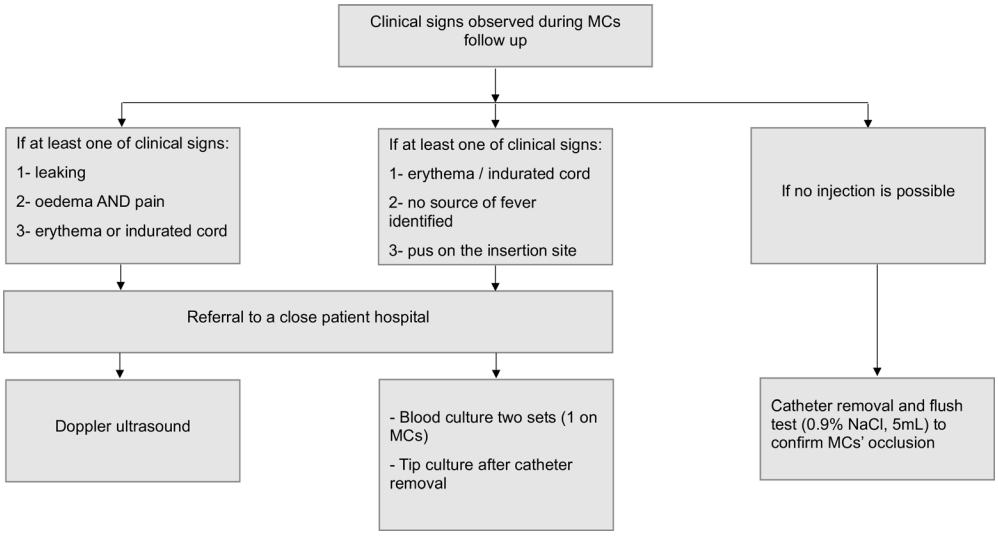

Figure 2 Algorithm for diagnosis exams of home patients related to clinical signs onset. MCs, midline catheters.

of the inclusion period by 1 year was obtained. At the end of the study, nearly 2000 patients will have been included and followed up. To the best of our knowledge, there are few prospective studies about MCs,[11 24–26] and most epidemiological data is based on only a few high-quality studies, which consist of randomised control trials but with small size samples.[8] Moreover, a highlight of this study is the inclusion and follow-up of home care patients. For this population, the COVID-19 pandemic may have modified MCs indication. In addition, multicentre data collected will provide invaluable insight into current practices and patient-centred approaches to their hospital pathway, maintenance protocols, and follow-up. The use of MCs evolved due to the safety of the device. Indeed incidence rate of infection and thrombosis seems lower than PICCs,[27 28] and MCs indications could be assessed with new considerations. Our study will provide knowledge about MCs insertion and maintenance that could highlight relevant issues and influence nurse practices. Further studies will be considered based on these results if factors are associated with complications.

Limitations

First, MCs are usually used for home patients, thus making the follow-up and estimating the rate of complications challenging.[29] Second, the estimation of thrombosis will be difficult for home patients (20% estimate) because it means they will have to be readmitted for ultrasound diagnosis, leading to the complication being underestimated.

ETHICS AND DISSEMINATION

The approval from the research ethics committee was obtained in October 2019 (comité de protection des personnes Nord Ouest IV), No EudraCT/ID-RCB : 2019-A02406-51. An update was made concerning primary and secondary outcomes in January 2023, and new approval was obtained in March 2023.

Clinical trial registration: The MidDATA study is registered with the American registry of trials, NCT04131088, date of registration: 18 October 2019, date of the first participant enrolled: December 2019 (https://clinicaltrials.gov/ct2/show/NCT04131088).

An oral and written information, and a non-opposition is sought before enrolment by the inserting practitioner.

Findings will be disseminated widely through peer-reviewed, scientific journals, and at national and international conferences in vascular access and public health.

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Competing interests None declared.

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