



8:e Svenska Accessmötet 13-14 november 2025

Swedish Access Meeting,
November 13–14, 2025

**MuST: Multiple Single Canulation
Technique**

Ricardo Peralta

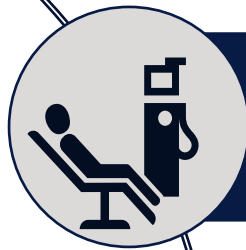
Background



BRS VASCULAR ACCESS
Special Interest Group



Clinical Practice Recommendations for Needling of Arteriovenous Fistula and Grafts for Haemodialysis



Incorrect techniques can lead to complications including stenosis and aneurysm development, infections, haematoma, pseudoaneurysm, bleeding and pain.



Ensuring a good technique will reduce such complications and prolong the life-span of the AV access.



In the first Patient Reported Experience Measure (PREM) in the UK, **needling was identified as one of 3 issues of concern for renal patients**

Background - Area cannulation technique - Recommendations

ESVS (2018)

This technique is less used **and is not recommended**

KDOQI (2019)

... the Working Group agreed on a cautious approach in approaching the patient's lifeline with the decision to **prefer the RL** cannulation technique

Spanish CG (2017)

... Therefore, this method should be avoided whenever possible. However, the current situation in the **"real world"** is **disappointing**

VASBI/BRS (2018/2019)

Recommendation I

Area puncture needling technique **should be avoided** wherever possible, and we recommend the use of RL or BH needling technique on all AVF and grafts, whenever it is possible

Background - Area cannulation technique - Recommendations

□ G. Kronung, MD, Chirurgische Universitätsklinik, 5300 Bonn, German Federal Republic

Plastic Deformation of Cimino Fistula by Repeated Puncture

Repeated puncture of Cimino fistula can be called a plastic vascular operation in installments, leading to aneurysmatic and stenotic deformation. Knowledge of the different puncture techniques and their morphologic consequences means that the stenotic deformations can be avoided and the aneurysmatic effect used to gain optimal response to correct the fistula vein. Each nephrologist performing dialysis has an important, protective duty for the long-term function of the Cimino fistulas of his patients.

DESCRIPTION OF PRINCIPLE

Each fistula puncture causes a small tissue displacement, filled by a thrombus after removal of cannula. The organization of the thrombus results in a small tissue increase, which causes a plastic elongation of the front side of the vessel wall and the covering skin in the puncture area. This elongation () leads to an aneurysmatic dilatation of the center of the puncture area, whereas the border often tends to a stenotic folding (1) of the vessel wall (Figure 1).

Moreover, repeated punctures destroy the contractile and elastic elements of the vessel wall. Replacement scar tissue is less resistant to chronic burden of the increased blood pressure. Additionally, after the law of Bernoulli:

load); and stenoses become more stenotic independent of further punctures (decreased pressure load, intima proliferation). The vicious circle initiated in this way can lead to the loss of fistula function by progressive dilatation (rarely) or progressive stenosis (often).

Varying parameters for the degree of dilatation are:

- Number of punctures per area unit,
- Kind of cannulas (anticoring),
- Puncture technique (especially the angle between cannula and skin during insertion),
- Blood coagulation,
- Blood pressure in the fistula vein,
- Degree and duration of compression after cannula removal,
- Individual disposition.

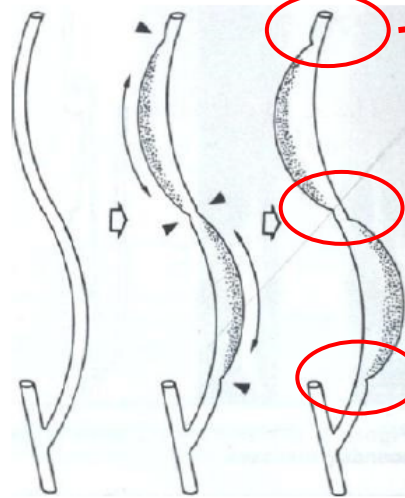


Figure 1: Arterial and venous puncture area with typical central dilatation and bounding stenoses.



Picture source: NephroCare Portugal SA database

Background - Buttonhole technique - Recommendations

ESVS (2018)

Recommendation 42

In patients with a **short cannulation segment** the use of the buttonhole technique should be considered over other techniques.

KDOQI (2019)

Guideline 11.3

KDOQI considers it reasonable to limit AV access buttonhole cannulation only to **special circumstances** given the associated increased risks of infection and related adverse consequences.

Spanish CG (2017)

R 3.3.6

Se recomienda reservar la técnica de punción en ojal (buttonhole) como método de punción para las fístulas arteriovenosas nativas **tortuosas, profundas** y/o con un tramo venoso de longitud muy limitado

BRS/VASBI (2018)

We recommend the use of RL or BH needling technique on all AVF and grafts, **whenever it is possible**.

Background - Buttonhole technique - The reality

Original Investigation

AJKD

Risk of Vascular Access Infection Associated With Buttonhole Cannulation of Fistulas: Data From the National Healthcare Safety Network

Meghan Lyman, Duc B. Nguyen, Alicia Shugart, Heidi Gruhler, Christi Lines, and Priti R. Patel

Rationale & Objective: Compared with conventional (rope-ladder cannulation [RLC]) methods, use of buttonhole cannulation (BHC) to access arteriovenous fistulas (AVFs) may be associated with increased risk for bloodstream infection and other vascular access–related infection. We used national surveillance data to evaluate the infection burden and risk among in-center hemodialysis patients with AVFs using BHC.

Study Design: Descriptive analysis of infections and related events and retrospective observational cohort study using National Healthcare Safety Network (NHSN) surveillance data.

Setting & Participants: US patients receiving hemodialysis treated in outpatient dialysis centers.

Predictors: AVF cannulation methods, dialysis facility characteristics, and infection control practices.

Outcomes: Access-related bloodstream infection; local access-site infection; intravenous (IV) antimicrobial start.

Analytic Approach: Description of frequency and rate of infections; adjusted relative risk (aRR) for infection with BHC versus RLC estimated using Poisson regression.

Results: During 2013 to 2014, there were 2,466 access-related bloodstream infections, 3,169 local access-site infections, and 13,726 IV antimicrobial starts among patients accessed using BHC. *Staphylococcus aureus* was the most common pathogen, present in half (52%) of the BHC access–related bloodstream infections. Hospitalization was frequent among BHC access–related bloodstream infections (37%). In 2014, 9% (n = 271,980) of all AVF patient-months reported to NHSN were associated with BHC. After adjusting for facility characteristics and practices, BHC was associated with significantly higher risk for access-related bloodstream infection (aRR, 2.6; 95% CI, 2.4-2.8) and local access-site infection (aRR, 1.5; 95% CI, 1.4-1.6) than RLC, but was not associated with increased risk for IV antimicrobial start.

Limitations: Data for facility practices were self-reported and not patient specific.

Conclusions: BHC was associated with higher risk for vascular access–related infection than RLC among in-center hemodialysis patients. Decisions regarding the use of BHC in dialysis centers should take into account the higher risk for infection. Studies are needed to evaluate infection control measures that may reduce infections related to BHC.

Complete author and article information provided before references.

Correspondence to
M. Lyman (yeo4@cdc.gov)

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ajkd.2019.11.006

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National Kidney Foundation,
Inc.

- This is a retrospective observational study that compared BH with RL from the National Healthcare Safety Network (CDC)

- Involved: n = 271.980 patients with AVF

Concluded:

- **BH was associated with:**
- Significantly higher risk of access-related bloodstream infections. (*Staphylococcus aureus* 52% versus 32%); (aRR, **2.6**; 95% CI, 2.4-2.8).
- Local access infections (aRR, 1.5; 95% CI, 1.4-1.6)
- Hospitalization was frequent among patients with BH

Background - Buttonhole technique - The reality

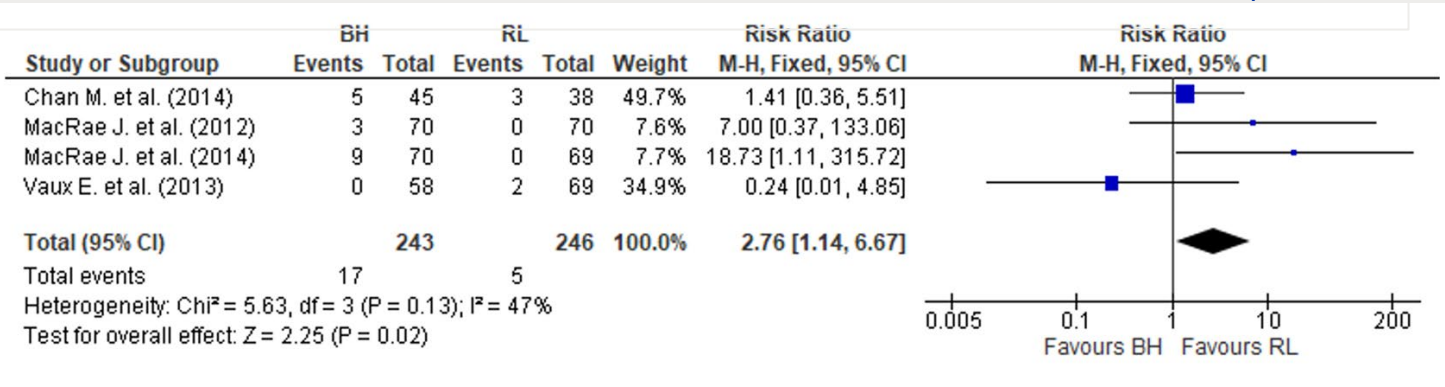


Systematic Review

Cannulation Technique of Vascular Access in Hemodialysis and the Impact on the Arteriovenous Fistula Survival: Systematic Review and Meta-Analysis

Ricardo Peralta ^{1,2,*}, Luís Sousa ^{3,4} and António Filipe Cristovão ¹

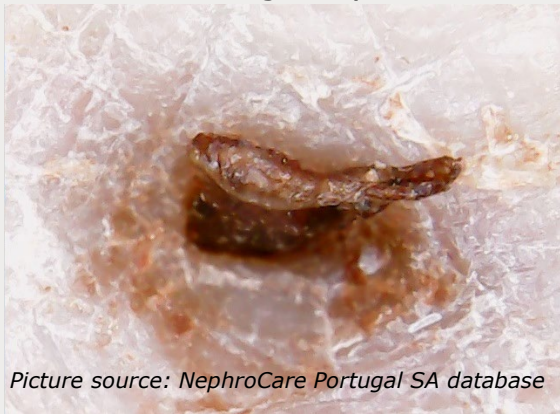
Result of the number of interventions in the AVF between the buttonhole and the rope ladder



Peralta, R. et al. "Cannulation Technique of Vascular Access in Hemodialysis and the Impact on the Arteriovenous Fistula Survival: Systematic Review and Meta-Analysis." *Journal of Clinical Medicine* 12.18 (2023): 5946.

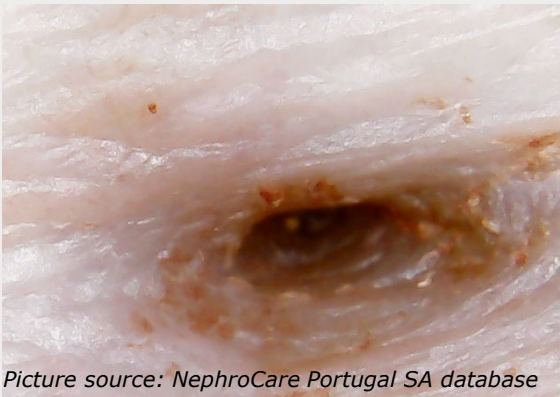
Buttonhole technique

Pictures enlarged by 500x



Picture source: NephroCare Portugal SA database

Tunnel with scab



Picture source: NephroCare Portugal SA database

Tunnel without scab

Photos author: Rui Sousa

- The test showed homogeneity between studies, and using the fixed effects model ($p > 0.1$ and $I^2 = 47\%$)
- A significant difference was observed in the incidence of bacteraemia associated with BH (RR, **2.76** (95% CI 1.14 - 6.67) $p = 0.02$).

Background - Rope-ladder cannulation - Recommendations

ESVS (2018)

Recommendation 43

The rope ladder technique should be used for cannulation of **arteriovenous grafts**

KDOQI (2019)

Guideline 11.2

KDOQI recommends rope ladder cannulation as the preferred cannulation technique **for AVFs**.

Spanish CG (2017)

R 3.3.5

Se recomienda utilizar la técnica de punción escalonada como método de punción preferente de la **fístula arteriovenosa** nativa

BRS/VASBI (2018)

Recommendation F.1

3. We recommend either rope ladder or buttonhole technique is chosen for AV fistulae and rope ladder for AV grafts.

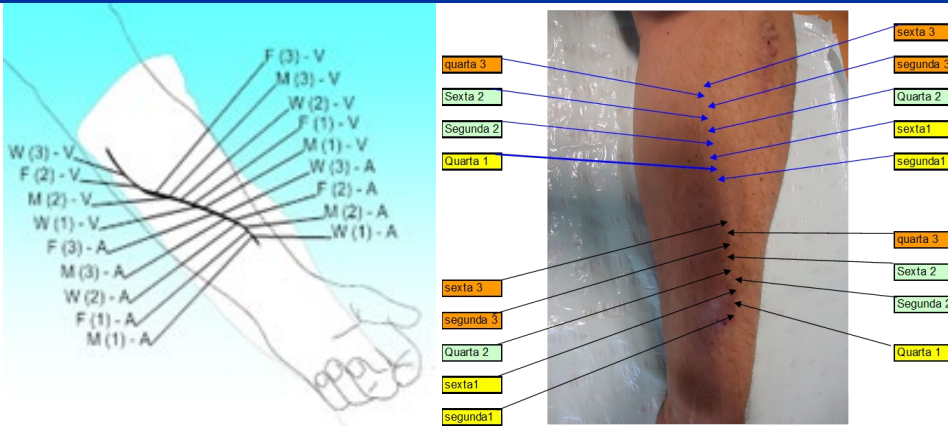
Background - Rope-ladder cannulation - Recommendations

Buttonhole needling of haemodialysis arteriovenous fistulae results in less complications and interventions compared to the rope-ladder technique

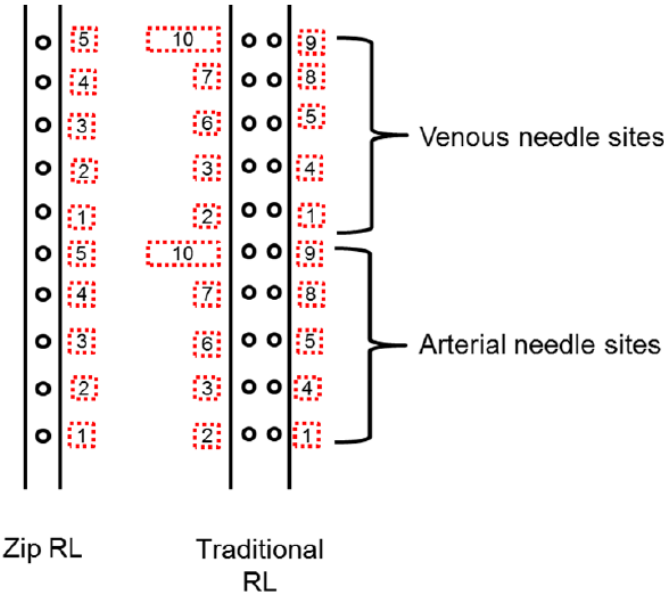
Magda M. van Loon¹, Tony Goovaerts², Alfons G. H. Kessels³, Frank M. van der Sande⁴ and Jan H. M. Tordoir¹

Nephrol Dial Transplant (2010) 25: 225–230

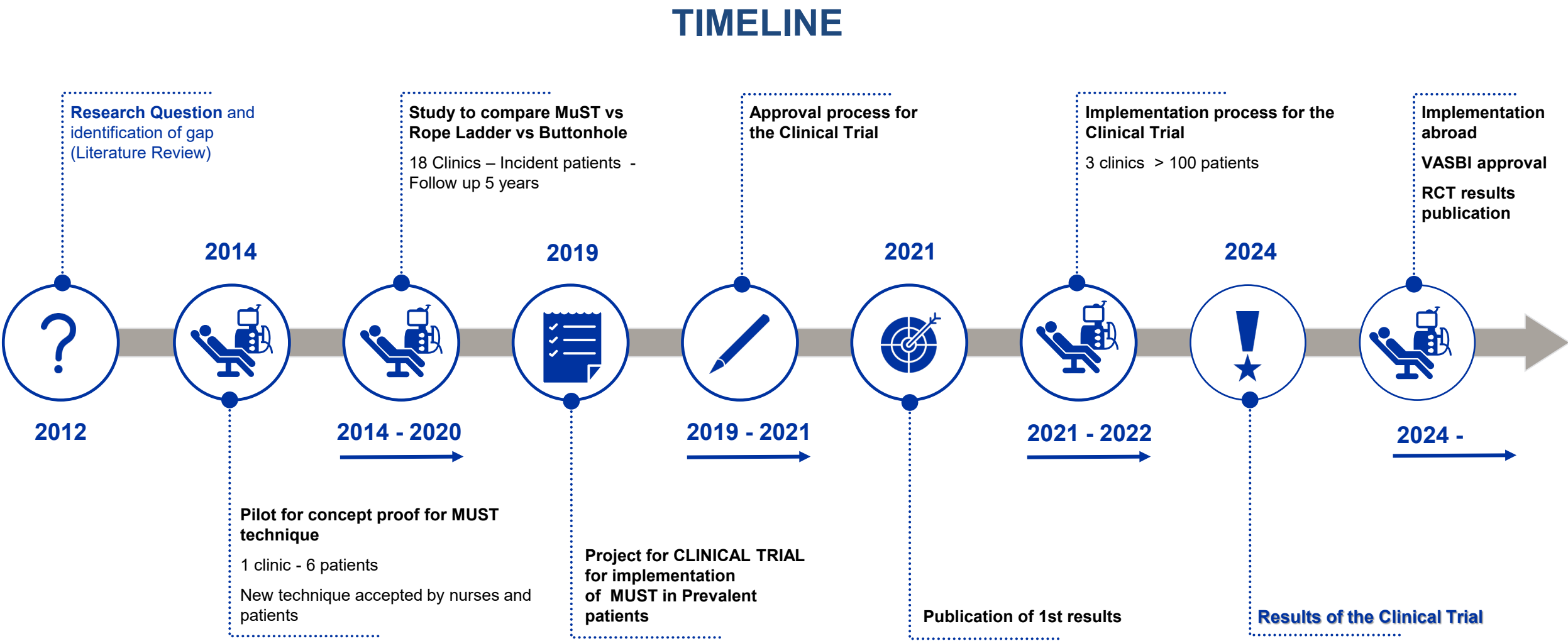
The result of using the rope-ladder technique is only a small dilatation effect over a greater length [5]. We observed a significant number of aneurysms in patients exhibiting the rope-ladder technique. This finding suggests that, although the protocol prescribes the use of the rope-ladder method, the dialysis staff in daily practice may use the area technique.



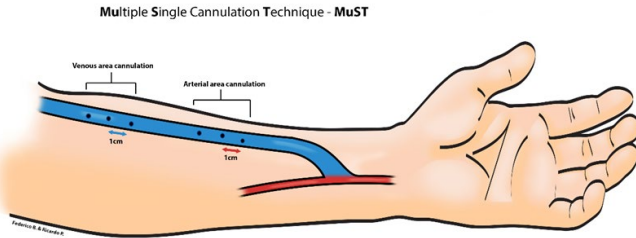
Picture source: NephroCare Portugal SA database



MuST implementation timeline



MuST – Multiple Single Cannulation Technique



Picture source: Picture from the author and Nephrology Nursing Journal, 48(2), 169-176



Picture source: Picture from the author and Arch Nephrol Ren Stud. 2021;1(1):28-33.

- This CT consists of rotating the same six specific cannulation sites, three arterial and three venous, through the three treatment days of each week.
- Two areas of arterial and venous cannulation were created, with three cannulation points each at least 1 cm apart.



Picture source: Picture from the author and Hemodialysis International. 2022;26:4-12

How to implement MuST



Picture source: Picture from the author of the presentation



Picture source: Picture from the author of the presentation



Picture source: Picture from the author of the presentation

- Experienced nurses or physicians should select patients according to inclusion criteria.
- Straight paths of at least 3 cm length should be chosen for each cannulation area, both arterial and venous.

How to implement MuST



- Areas with aneurysms should be avoided; however, spots at the bottom of aneurysms with greater tissue integrity may be chosen.

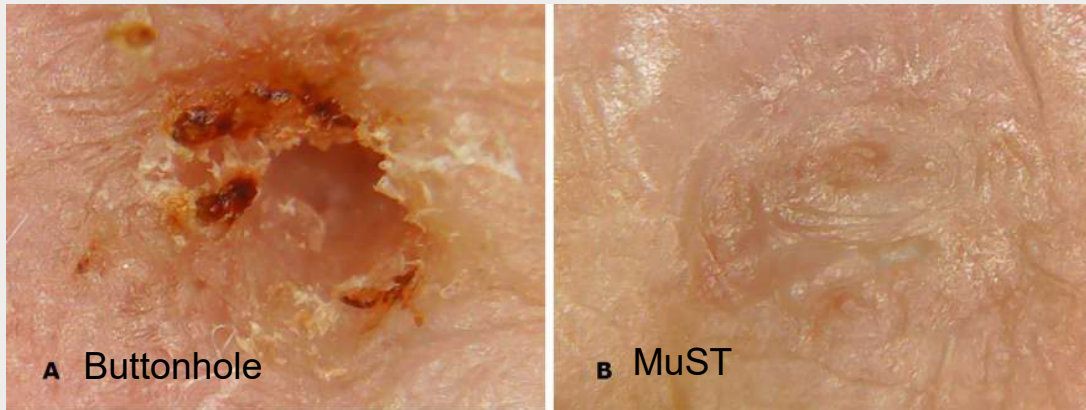
How to implement MuST

- Select and identify cannulation spots with a pen until their location is easily visible due to skin depigmentation.
- The distance between each cannulation spot must be symmetrical and above 1 cm.
- Generally, after 8 to 12 consecutive cannulations at the same site, a fibrotic and depigmented tissue develops and subsequently identifies the exact spot.



Pictures source: Picture from the author of the presentation

Successful and Safe Cannulation Technique



Picture source: Picture from the author and Arch Nephrol Ren Stud. 2021;1(1):28-33.

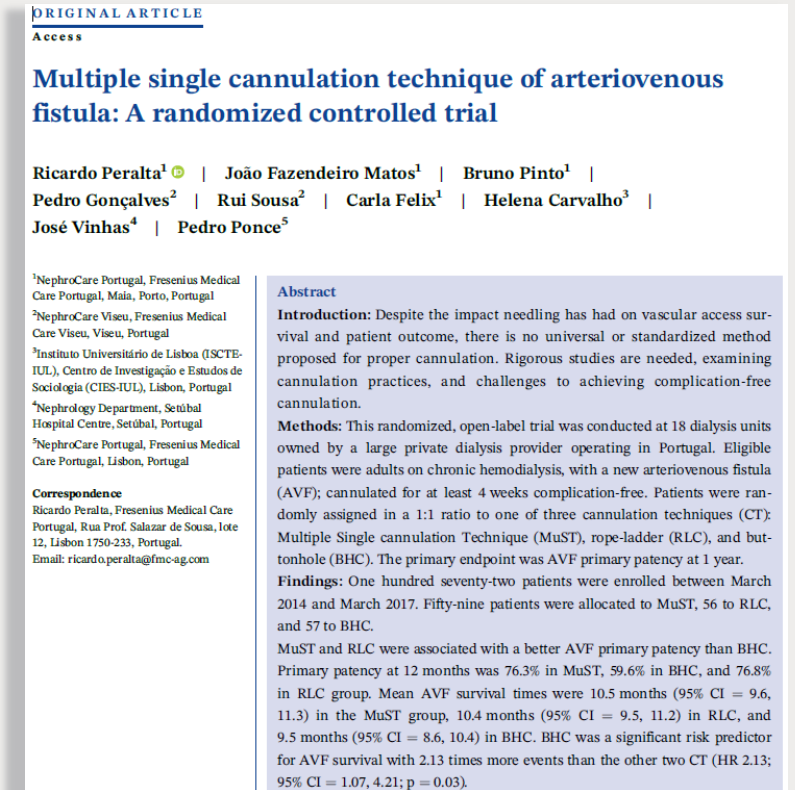
- **Blunt needles are not required**, and a fibrotic tunnel track formation is not expected to occur, because the last site cannulated will heal in a week.
- It is **not necessary** to have the **same nurse** performing the first cannulations.
- **No additional care** is required than the recommended care for RL cannulation.
- In the presence of **peri-needle bleeding** during treatment, **new cannulation sites** can be implemented.



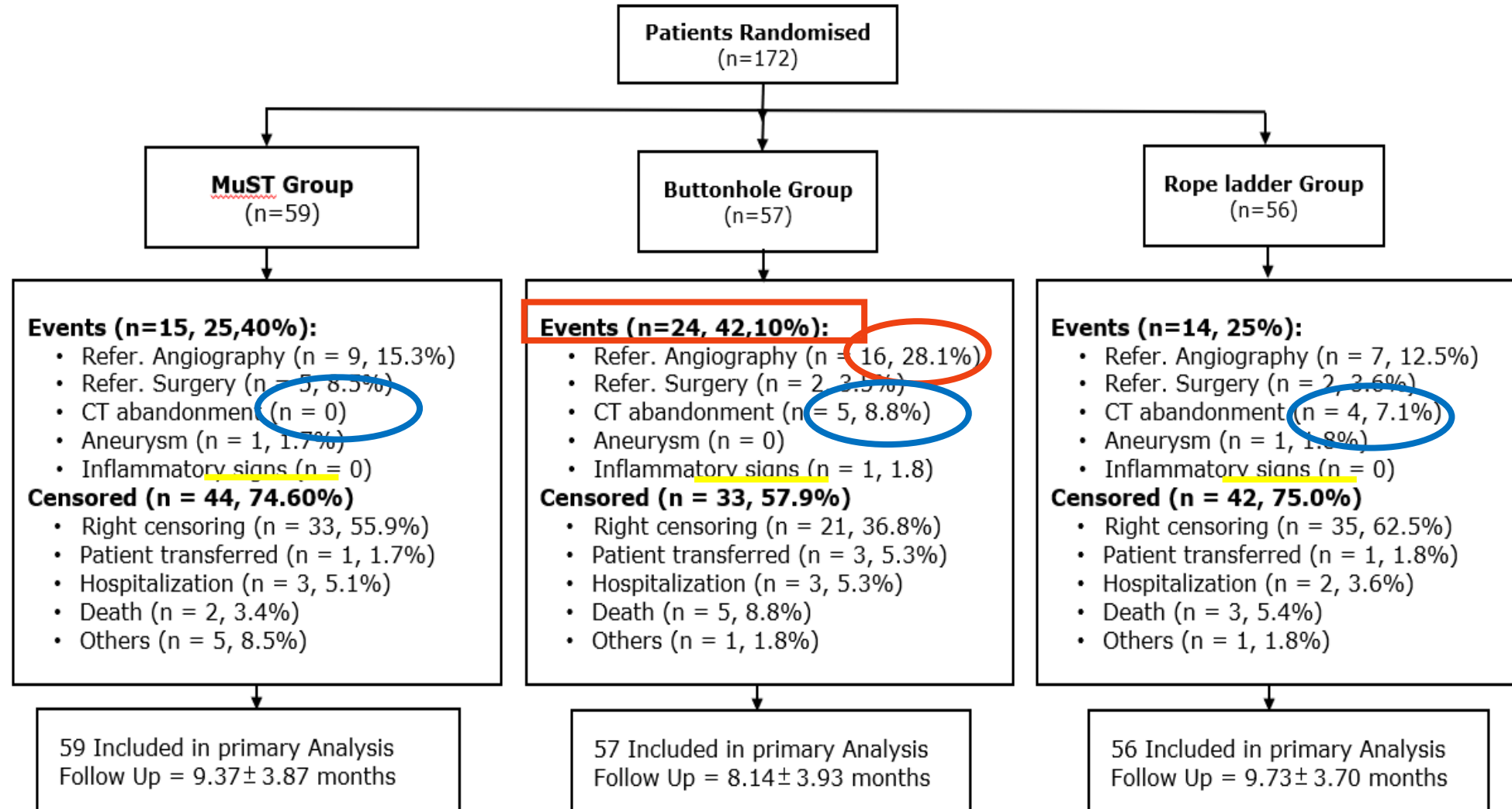
Picture source: Picture from the author

MuST Study I – INCIDENT Patients

- Randomised open-label trial was conducted at 18 dialysis units
- The study consisted of two phases:
 - 1st phase comprised a training of all the clinics' nursing teams;
 - 2nd phase patients were selected according to the inclusion criteria
- Eligible patients were adults on chronic haemodialysis, with a new arteriovenous fistula (AVF)
- Patients were randomly assigned in a 1:1 ratio to one of three cannulation techniques (CT): MuST, rope-ladder (RLC), and buttonhole (BHC).
- For MuST and RLC, individual diagrams of the AVF were created and attached to the patient's file
- Prior to cannulation, physical examination of the AVF was performed at every dialysis session
- All parameters were recorded in a specific vascular access database.
- Whenever a change in the physical or dynamic examination was identified, the patient was referred to the vascular access centre.

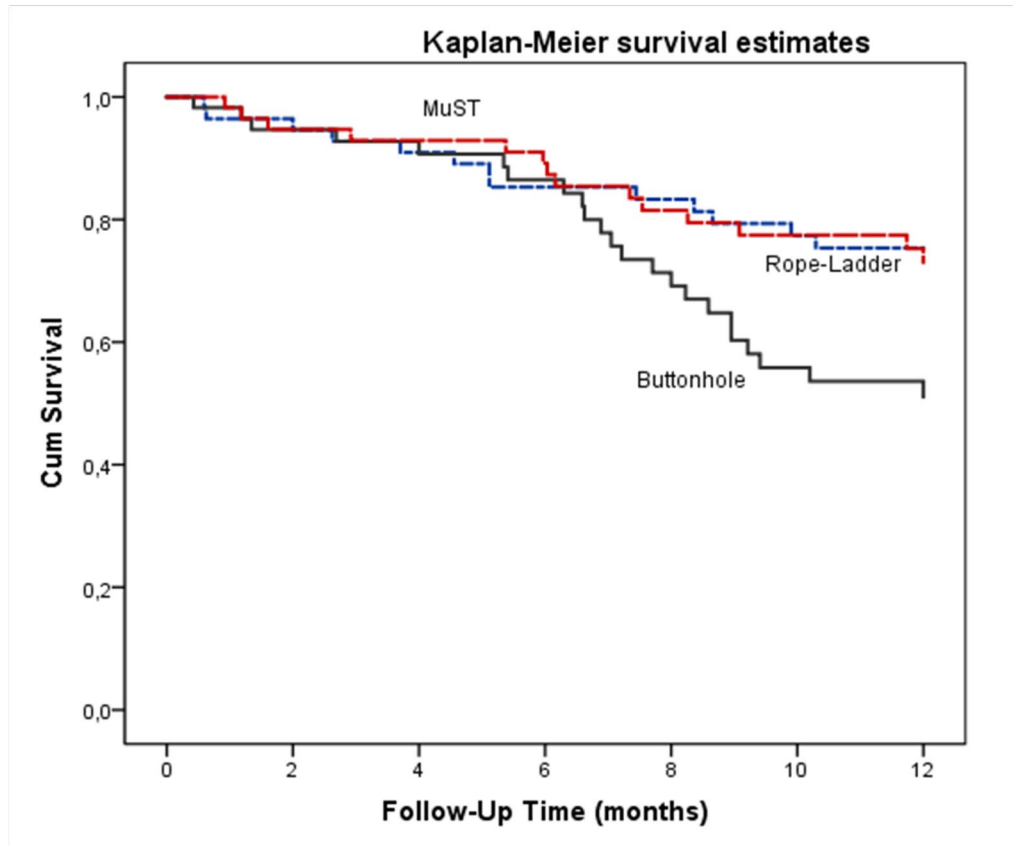


MuST Study I – INCIDENT Patients



MuST Study I - Results

AVF - Unassisted Patency



- The Kaplan-Meier analysis showed that AVF survival during the 1st 6 months in the 3 groups was overlapping.
- After the 6th month, the BH group survival curve decreased exponentially.
- AVF survival curve comparing the three groups of cannulation technique, MuST versus BH and versus RL. (log-rank test, $p = 0.033$).

MuST Study II – PREVALENT Patients

MuST Study II

The study was approved and sponsored by the Head Global Biomedical Evidence Generation, Fresenius Medical Care Deutschland GmbH.

- The aims of the MuST Study are to:
 - Determine the **AVF survival and complications rate** of patients submitted to MuST compared to those submitted to RL.
 - Analyze the **intensity of pain perceived by the patient** with each cannulation technique under study.
- Trial registration: ClinicalTrials.gov identifier **NCT05081648** registered on 18 October 2021.
- Publication the Study protocol on BMC Nephrology: <https://rdcu.be/cP7rM>

NIH U.S. National Library of Medicine
ClinicalTrials.gov

Home > Search Results > Study Record Detail

Trial record 1 of 1 for: NCT05081648

Previous Study | Return to List | Next Study

Must Cannulation Technique of Vascular Access in Patients Undergoing Haemodialysis: Contributions for a Safe Nursing Intervention (MuST)

ClinicalTrials.gov Identifier: NCT05081648

Recruitment Status: Recruiting
First Posted: October 18, 2021
Last Update Posted: February 7, 2022
See [Contacts and Locations](#)

Sponsor:
Fresenius Medical Care Deutschland GmbH

Collaborators:
University of Lisbon
Lisbon Nursing School

Peralta et al. *BMC Nephrology* (2022) 23:218
<https://doi.org/10.1186/s12882-022-02842-3>

BMC Nephrology

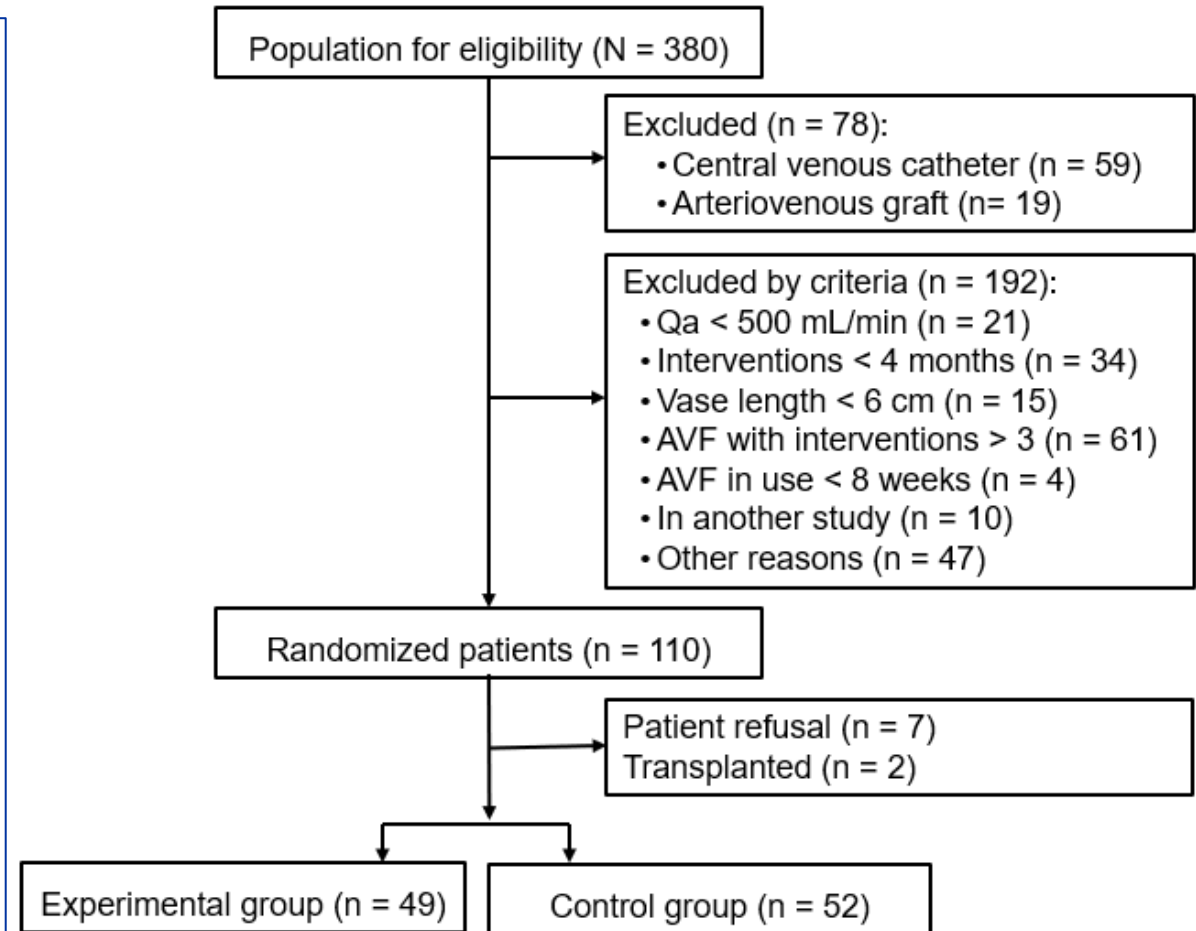
STUDY PROTOCOL **Open Access**

A randomised control trial protocol of MuST for vascular access cannulation in hemodialysis patients (MuST Study): contributions for a safe nursing intervention

Ricardo Peralta^{1,2*}, Anna Wammi³, Manuela Stauss-Gabo³, Óscar Dias¹, Helena Carvalho⁴ and António Cristóvão¹

MuST Study II - Methods

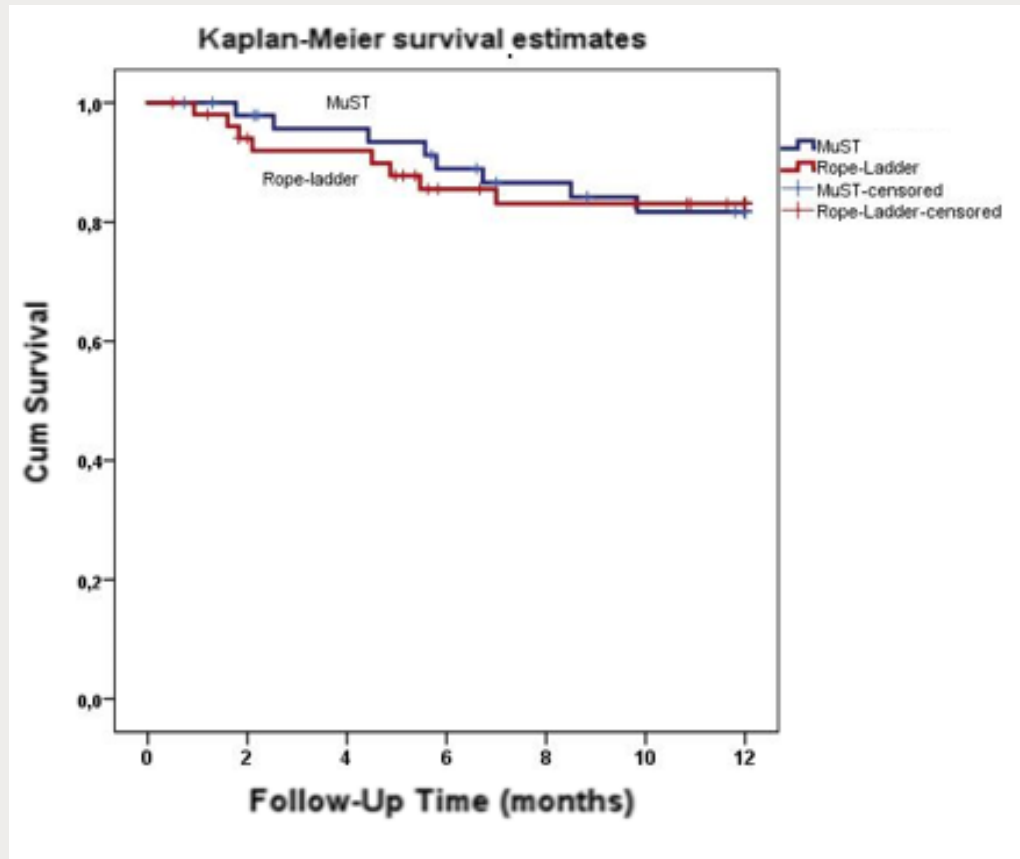
- Randomized controlled trial: multicenter study, prospective, non-blind, parallel-group;
- Participants were recruited in 3 private dialysis clinics
- MuST intervention group VS RL control group;
- Patients were randomized 1:1;
- Follow-up period were 12 months;
- Were included 49 patients in MuST group and 52 in RL



Flowchart with the eligible patient's selection for the study

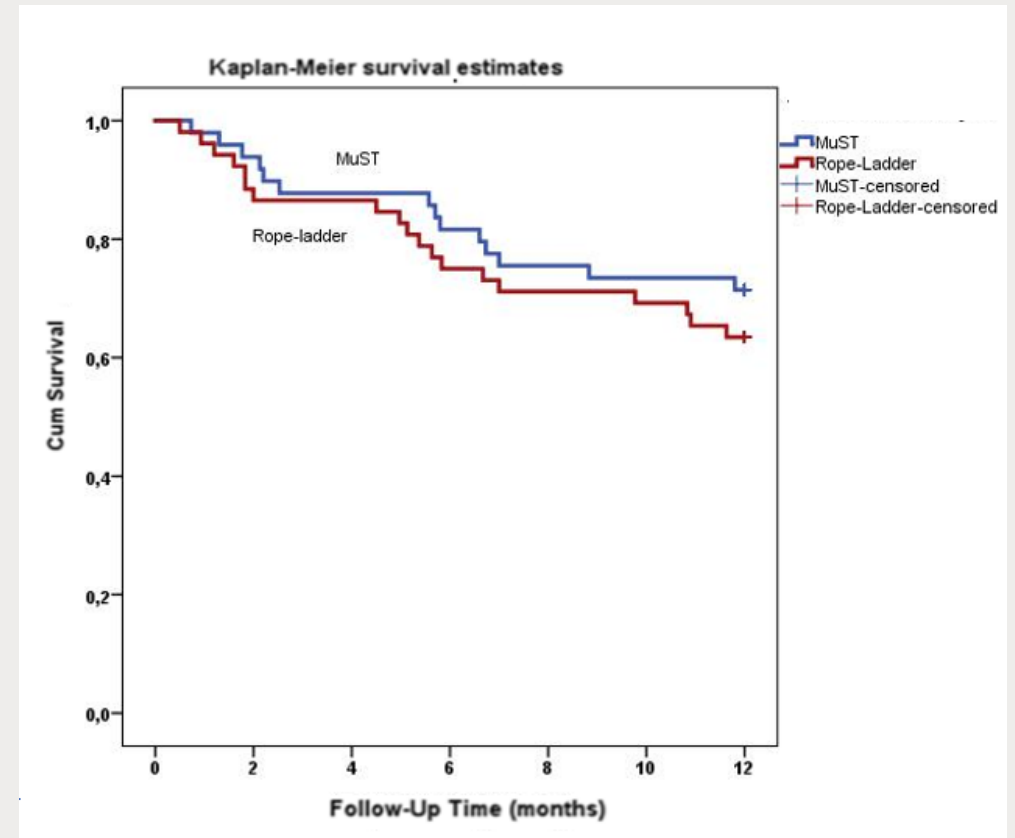
MuST Study II - Results

AVF - Unassisted Patency



Log rank test $p = 0,976$; Breslow $p = 0,826$; Tarone-Ware $p = 0,900$

AVF - Assisted Patency



Log rank test $p = 0,349$; Breslow $p = 0,318$ e Tarone-Ware $p = 0,332$

MuST Study II - Results

Frequency of secondary outcomes between the two groups

Secondary outcomes	MuST N = 49	Rope-ladder N = 52
Hematomas/infiltrations	7	8
Development of previous aneurysms	5	12
New aneurysms	0	4
Time to hemostasis > 10 min	5	1
Bleeding around the needle	5	0
Local signs of infection	0	0
Bacteremia	0	0

- Fistula complications of hematoma/infiltration rate was 15 episodes (0.04/1000 AVF-days) in both groups;
- Hematomas with RL use occurred most frequently at the last “step” (cannulation spot);
- We observed a high rate of aneurysms in the selected patients, 71 (70.30%), 17 continued to develop and four patients developed new aneurysms;
- A higher rate of development previous aneurysms and new aneurysms was observed, associated with RL

MuST Study II - Results

Frequency of secondary outcomes between the two groups: Pain

Cannulation techniques	Before the intervention	At 6 months	At 12 months	<i>p value</i>
MuST, mean (SD)	4.45 (1.66)	4.11 (1.43)	3.67 (1.59)	= 0.061
Rope-ladder, mean (SD)	4.04 (1.86)	3.77 (1.75)	3.52 (2.05)	= 0.307

- The pain score decreased during the study follow-up in both groups, however the difference was not significant (MuST group: $t_{(35)} = 1.93$, $p = 0.061$ versus RL group: $t_{(32)} = 1.04$; $p = 0.307$);
- There were also no differences between the two groups at the end of the study ($t_{(67)} = 0.35$, $p = 0.731$), however, two patients abandoned RL due to cannulation-related pain.

Successful and Safe Cannulation Technique



A: MuST at the beginning of the cannulation after 4 weeks.



B: After 18 months of use.



C: After 3 years.



D: After 5 years of use.

Picture source: Picture from the author and Hemodialysis International. 2022;26:4-12

Successful Cannulation Technique

MuST cannulation technique in the same patient in 10 years

- Example of MuST in the same patient in 10 years
- Very easy to implement and maintain.



Picture source: NephroCare Portugal SA database

MuST Implementation in Portugal



NephroCare Portugal
41 Clinics & HHD

76% Clinics with MuST
19% Patients with MuST
4 Clinics with $\geq 90\%$ Patients with MuST

 Clinics with MuST
 Clinics without MuST



Implementation in Clinics abroad



Visit to the Viseu Clinic

- The first step has been the presentation of the MuST results
- Face to face training with visit to the Clinic
- Meeting to discuss the work implementation
- Share the documentation

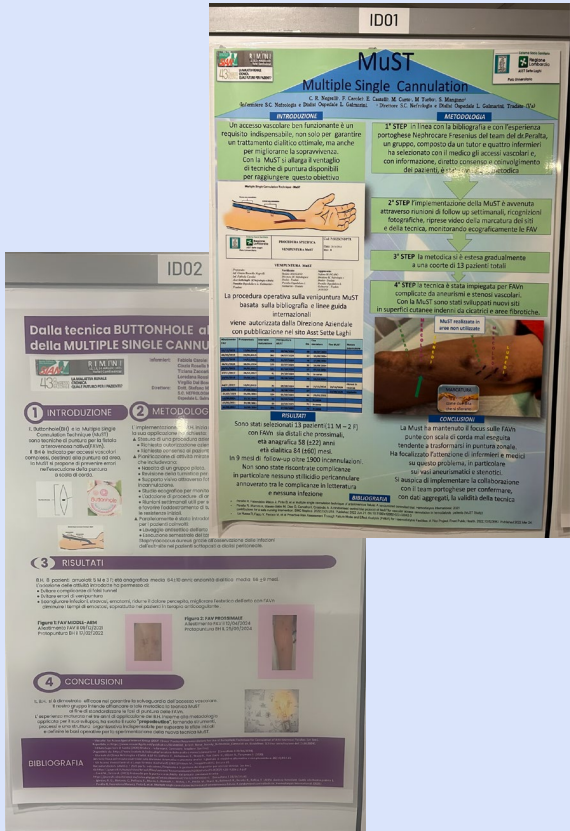


Implementation in Clinics abroad:

- Refresh the training before implementation;
- Carry out training for nurses at MuST before starting the MuST project;
- Select a minimum of 6/10 patients from each Clinic to start the project. Discuss which shift or shifts.
- Weekly/Monthly meetings



SIAN - Italy
Congresso Nazionale

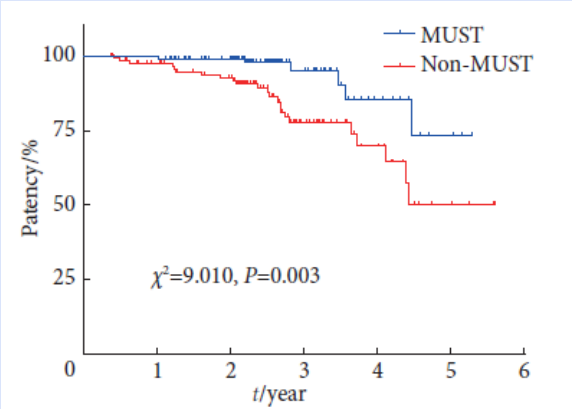


China
MusT in arteriovenous graft

Multiple Single Cannulation Technique Improves the Outcomes of Arteriovenous Graft in Hemodialysis Patients: A Retrospective Study WANG Ruimin, WANG Siyan, XUE Xiaoling, YUE Xiaohong, WANG Xinfang, WANG Pei, LIANG Xianhui^Δ. Blood Purification Center, The First Affiliated Hospital of Zhengzhou University, Zhengzhou 450052, China
^Δ Corresponding author, E-mail: fccliangxh@zzu.edu.cn



图1 AVG多单点穿刺技术 (MUST) 示例
Fig 1 Example of AVG multiple single cannulation technique (MUST)
A, A MUST plan was designed for a subject. A total of 9 puncture points were subsequently made in the arterial puncture area of the AVG, which were used for cannulation in rotation in the order of from the bottom one to the top one. The latest cannulation site was the fourth point (enlarged in Fig B). B, Healing status on the first day after puncture. C, Healing status on the 3rd day after puncture. D, Healing on the 5th day after puncture. E, Healing after 1 week after puncture. F, Healing after 2 weeks after puncture.



Studies published abroad

Hemodialysis International

ORIGINAL ARTICLE

Access

Multiple Single Cannulaton Technique for Puncturing Arteriovenous Fistulas: Randomized Comparison With Rope Ladder Technique Cannulation

Fang Xu | Jun Qiu | Shanshan Huo | Haitao Bai | Xia Wang | Peng Shu

The Central Hospital of Wuhan, Tongji Medical College, Huazhong University of Science and Technology, Wuhan, China

TABLE 2 | Comparison of AV fistula-related complications between the two groups of patients.

	Experimental group (n = 58)	Control group (n = 59)	t/ χ^2	p
Aneurysms (%)	2 (3.44)	9 (15.3)	4.79	0.029
Stenosis (%)	1 (1.72)	7 (11.9)	4.72	0.030
Infiltration (%)	11 (19.0)	4 (6.78)	3.89	0.049
Thrombosis (%)	1 (1.72)	8 (13.6)	5.77	0.016
Pain scores	1.82 ± 0.93	3.29 ± 0.77	9.41	<0.001
Cannulation difficulty	1.41 ± 0.54	2.24 ± 1.04	5.32	<0.001
Canulation success rate (%)	8307 (99.5)	8409 (99.0)	12.8	<0.001

Conclusions:

- Significant **reduction** the number of:
 - Aneurysms,
 - Stenosis,
 - Thrombosis,
 - Pain Scores,
 - Cannulation difficulty.
- MuST was associated with **increased** infiltrations.

Conclusions/Application to Practice

- MuST showed similar AVF survival to RL*.
- No significant differences were observed in hematomas or thrombosis rates and no local inflammatory or infectious signs or bacteremia were identified.
- The lower incidence in the **development and new aneurysms** formation in MuST, may prove to be a differentiating factor for patient safety and well-being when deciding between which CT to select.
- The results of this studies suggest that **MuST** might be an **applicable and reliable CT for self-cannulation** and **can be adapted** for patients undergoing **dialysis more than 3 times a week**.



Picture source: Picture from the author of the presentation

* The RL technique during the study was with a personalized diagram

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