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Needling Technique
Ladder or Button Hole ?

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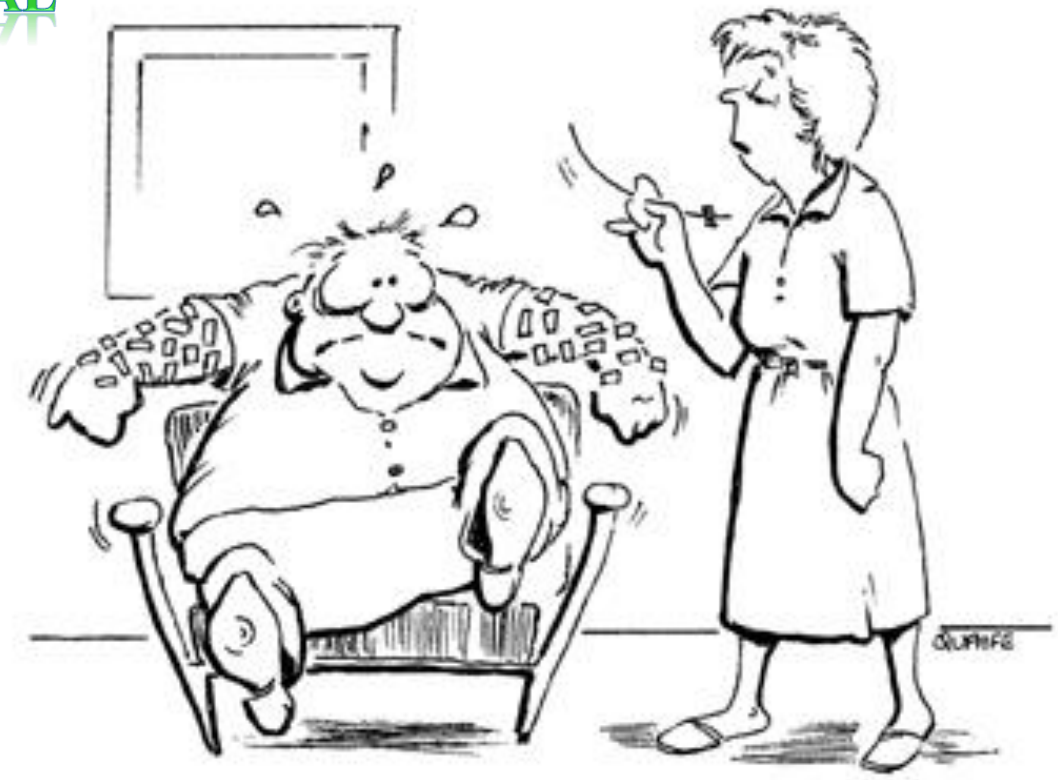

Don't worry, I'll find a good site soon.

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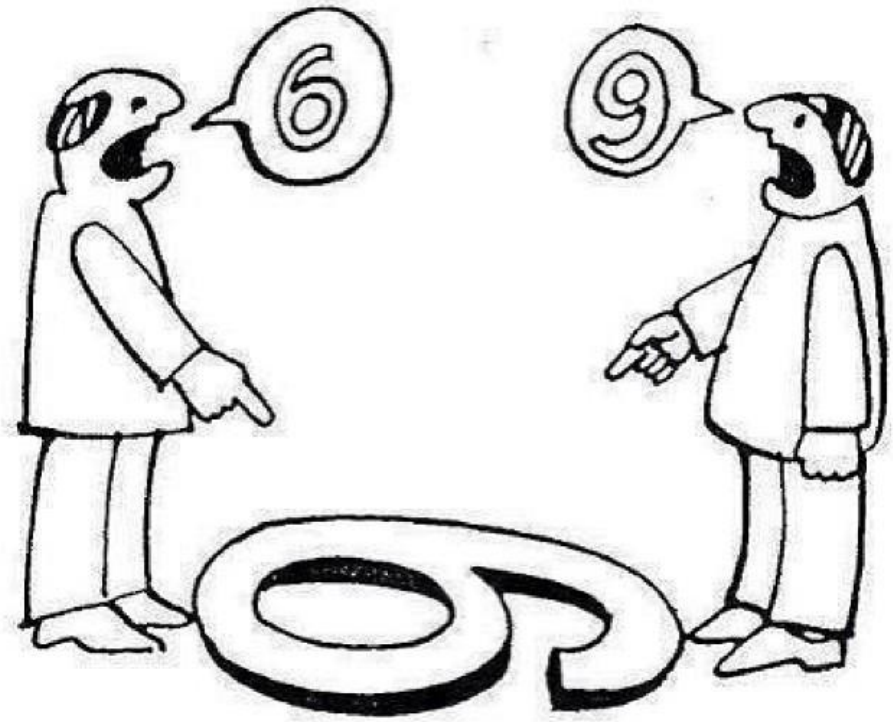
Button hole or Ladder ??



Vascular Access Cannulation

- It's a **Life Line of Hemodialysis patient**
- Arterio-venous fistula(AVF) is the K/DOQI guideline recomended
- 2 options for cannulation
  - Step-Ladder (rope-ladder, rotating site)
  - Button hole (Constant-site)

AV fistula

- It is considered the **gold-standard vascular access** because there is **least risk of infection and clotting** than with the AV graft or central venous catheter.
- An AV fistula is surgically created by connecting an artery and a vein, usually in an arm or leg.
- After the fistula is created, it will need to heal and mature for weeks or months before it can be used for hemodialysis.

Rule of 6

- Be minimum of 6 mm. in diameter
- Be less than 6 mm in deep
- Have blood flow greater than 600 ml/min
- Be evaluated for non maturation at least 6 weeks after surgical created

Ladder Technique

- the most common technique used for cannulation of Arterio-Venous Fistula(Conventional)
- It is the standard technique in many HD units worldwide (Ball, 2006). Area puncture requires repeated puncturing of one or two sites
- This involves needle placement sites that are rotated along the entire length of the fistula each time the patient receives dialysis venous fistula (AVF)

- thus allowing healing between sessions. sites, resulting in an increased risk of aneurysm formation, secondary to weakening of the vessel wall. This technique is less widely used, and is no longer recommended (McCann *et al., 2009)*
- Used sharp needles in every session

Button Hole Technique

- The first reported in US 1977 by Twardowski
- Is the " repeated cannulation into the exact, same puncture site , same ankle and a scar tissue tunnel tract develops. The scar tissue tunnel tract allows the needle to pass through to the vessel of the fistula following the same path each time."

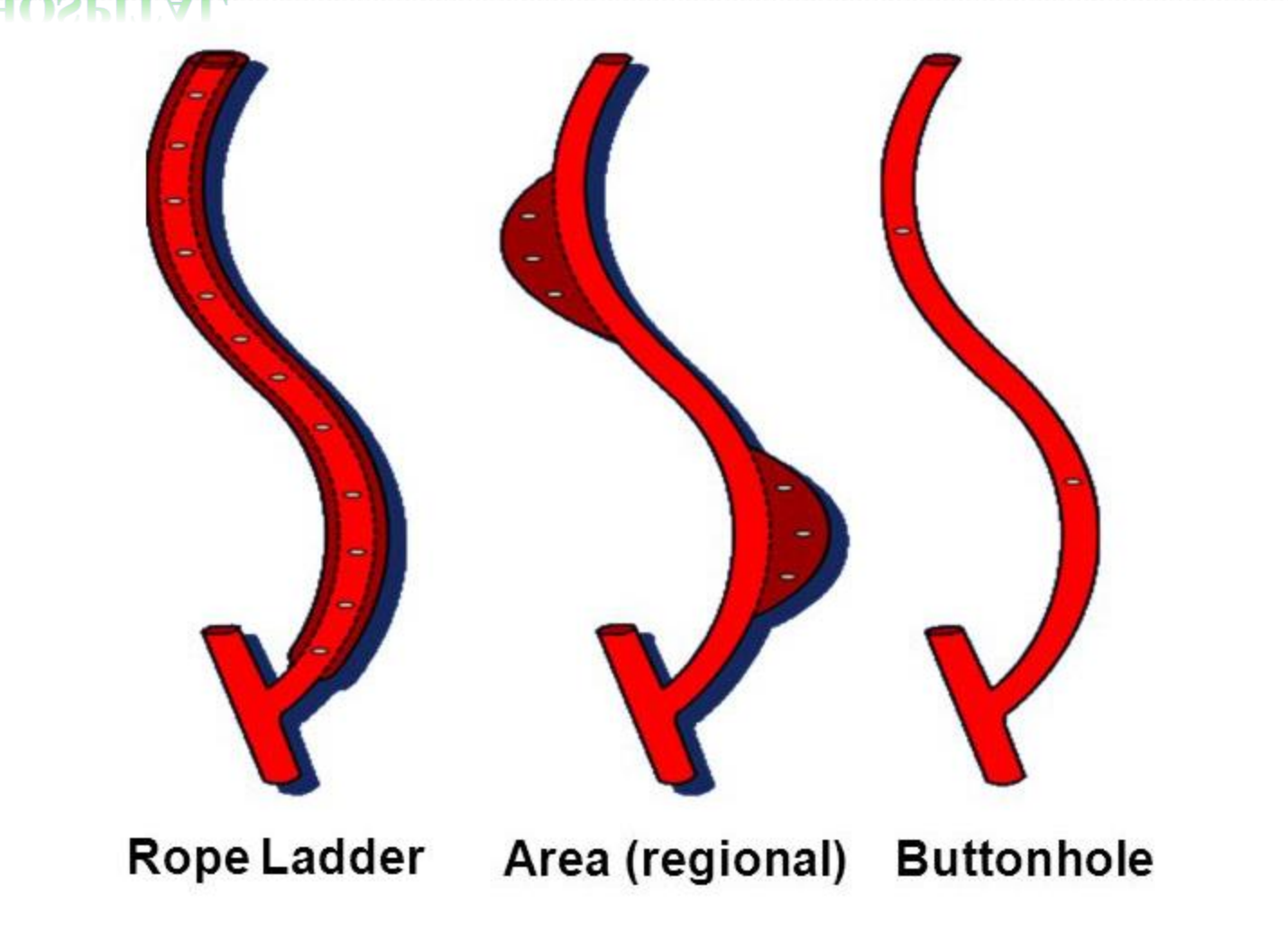
Twardowski Z. The buttonhole method of needle insertion takes center stage in an attempt to revive daily home hemodialysis.Contemp Dial Nephrol. 1977; 18: 18-19.

- The buttonhole cannulation site needs to be established by the same person cannulating the site every time.
- The site for buttonhole cannulation should be chosen carefully, taking into consideration the angle that you can most easily insert (self-cannulate) the needles.
- The buttonhole technique is recommended for those who self-cannulate either in the hemodialysis center or when performing home hemodialysis.

- After about **10 cannulations using sharp dialysis needles**, the buttonhole site will develop a scar tunnel track. This track is the same as a pierced ear that has scar tissue formed and will cause less to no pain and bleeding when cannulating.
- After the button hole is created, a **blunt dialysis needle** should be used, which eliminates **the risks of cuts and bleeding to the tract.**

Benefit of Button Hole

- Cannulation less painful
- Allows cannulation success where standard technique fails
- Cannulation is quicker and easier
- especially deep and small fistula
- Less needle trauma: infiltrations, bleeding and aneurysm formation
- **Reported Cannulation Infection**


Rope Ladder
Area (regional)
Buttonhole

What ’s the best ?

Comparison with BH & RL

	Button hole	Rope Ladder
Fear	↓	↔
Pain	↓	↔
Aneurysm	↓	↔
Prolong bleeding	↓	↔
Stenosis	↓	↔
Infection	↑	↔
Miscanulation	↓	↔
Survival	↔	↔

Buttonhole Versus Rope-Ladder Cannulation of Arteriovenous Fistulas for Hemodialysis: A Systematic Review

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Study	Study Type	Study Setting	Prespecified Primary Outcome	Population: Modality	Population: Patient Type	N	Mean Age (y)	% Male	Dialysis Vintage at Baseline (y)[a]	Age of AVF at Baseline (mo)[a]	Duration of Follow-up
					In-Center CHD						
Twardowski[6] (1979)	Retrospective before-after	Poland 1969-1973	Not explicitly stated (multiple outcomes reported)	In-center HD (2-6×/wk)	Prevalent ± incident[b]	20	NR	NR	NR	NR	~34 patient-y (BH), ~22 patient-y (RL)
Toma[29] (2003)	RCT	Japan	Not explicitly stated (multiple outcomes reported)	In-center CHD	Prevalent	80 (37 BH, 43 RL)	60 (BH), 64 (RL)	46 (BH), 37 (RL)	NR	42.6 (BH), 45.1 (RL)	3 mo
Marticorena[27] (2006)	Prospective before-after	Canada 2002-2003	Not explicitly stated (multiple outcomes reported)	In-center CHD	Prevalent	14	48.5	43	NR	Minimum 12	12 mo
Figueiredo[24] (2008)	Cross-sectional	Brazil 2007	Needling pain	In-center CHD	Prevalent	47 (19 BH, 28 RL)	57.3	38	NR	Median 14	NA
van Loon[8] (2010)	Prospective cohort	Netherlands 2007-2008	Not explicitly stated (multiple outcomes reported)	In-center CHD	Prevalent	145 (75 BH, 70 RL)	67 (BH), 65 (RL)	59 (BH), 67 (RL)	NR	44 (BH), 31 (RL)	9 mo
Birchenough[22] (2010)	Partially retrospective before-after	USA 2009-2010	Infection event rate	In-center CHD	Prevalent	NR	NR	NR	NR	NR	14 mo
Ludlow[26] (2010)	Partially retrospective before-after	Canada 2007	Not explicitly stated (multiple outcomes reported)	In-center CHD	Prevalent	29	65.9 (RL), 62.9 (BH)	62 (BH), 58 (RL)	3.2	32	3 mo
Struthers[7] (2010)	RCT	UK	Needling pain	In-center CHD	Prevalent	56 (28 BH, 28 RL)	61 (BH), 60 (RL)	58	NR	28 (BH), 25 (RL)	6 mo
Labriola[25] (2011)	Partially retrospective before-after	Belgium 2001-2010	Infection event rate	In-center CHD	Both	177	70.4	65.8	NR	NR	108 mo

Study	Study Type	Study Setting	Prespecified Primary Outcome	Population		N	Mean Age (y)	% Male	Dialysis Vintage at Baseline (y)[a]	Age of AVF at Baseline (mo)[a]	Duration of Follow-up
				Modality	Patient Type						
Pergolotti[28] (2011)	Prospective cohort	USA	Not explicitly stated (multiple outcomes reported)	In-center CHD	Prevalent	45 (21 BH, 24 RL)	56.0 (BH), 66.5 (RL)	81 (BH), 83 (RL)	NR	Minimum 6	3 mo
MacRae[19] (2012)	RCT	Canada	Needling pain	In-center CHD	Prevalent	140 (70 BH, 70 RL)	70.3 (BH), 66.7 (RL)	72.9 (BH), 65.7 (RL)	Median 2.8 (BH), 3.0 (RL)	NR	2 mo for primary outcome, 12 mo for infectious complications
Aitken[33] (2013)	Cross-sectional	UK	Prevalence of AVF-associated pain	In-center CHD	Prevalent	447 (209 BH, 238 RL)	60.5	56.6	86.5% > 1 y	62	NA
Kim[35] (2013)	Prospective before-after	Korea 2009-2010	Not explicitly stated (multiple outcomes reported)	In-center CHD	Prevalent	32	62.4	63	NR	58.8	16 wk (BH), 8 wk (RL)
Smyth[37] (2013)	Prospective cohort	Australia 2011-2012	Signs/symptoms of infection, hematoma formation, aneurysm formation, success of cannulation	In-center CHD	Prevalent	104 (41 BH, 63 RL)	60 (BH), 61 (RL)	34.1 (BH), 55.6 (RL)	NR	31.2	12 wk
Vaux[21] (2013)	RCT	UK 2007-2010	AVF survival at 1 y	In-center CHD	Both	127 (58 BH, 69 RL)	62 (BH), 64 (RL)	67 (BH), 63 (RL)	NR	NR	12 mo
MacRae[38] (2014)	RCT	Canada 2006-2011	Access survival	In-center CHD	Prevalent	139 (70 BH, 69 RL)	70.2 (BH), 66.1 (RL)	73 (BH), 67(RL)	Median 3.12 (BH), 2.58 (RL)	Median 26.2 (BH), 31.9 (RL)	Median 19.2 mo (BH), 17.2 mo (RL)
Chan[34] (2014)	Retrospective cohort	USA 2004-2011	Primary AVF patency	In-center CHD	Prevalent	83 (45 BH, 38 RL)	60.9 (BH), 64.1 (RL)	64 (BH), 63 (RL)	0.36	NR	Median 12 mo

Study	Study Type	Study Setting	Prespecified Primary Outcome	Population: Modality	Population: Patient Type	N	Mean Age (y)	% Male	Dialysis Vintage at Baseline (y)[a]	Age of AVF at Baseline (mo)[a]	Duration of Follow-up
Mixed and Home HD											
Verhallen[31] (2007)	Prospective before-after	Netherlands 2004-2006	Not explicitly stated (multiple outcomes reported)	Home 3-5×/wk HD and home NHD	Prevalent	33	49	73	2	NR	Mean 11 ± 6 mo
Nesrallah[32] (2010)	Retrospective before-after	Canada 1998-2009	*Staphylococcus aureus* bacteremia rate	Home NHD	Both	56	51.5	62	3.7	Minimum 6	286.9 patient-y
Van Eps[30] (2010)	Retrospective cohort	Australia 2003-2006	Rates of serious complications requiring hospital admissions	Home NHD and in-center CHD	Prevalent	235 (63 NHD: 76% BH; 172 CHD: 92% RL)	51.7 (NHD), 58.3 (CHD)	79.4 (NHD), 58.5 (CHD)	1.9 (NHD), 3.1 (CHD)	NR	NHD: median 13.9 mo (86.2 patient-y); CHD: median 12 mo (142.7 patient-y)
Chow[23] (2011)	RCT	Australia	Needling pain	Home (unknown prescriptions) and in-center CHD	Both	69 (34 BH, 35 RL)	NR	70	NR	NR	6 mo
O'Brien[20] (2012)	Retrospective cohort	Ireland 2004-2011	Infection event rate	Home (unknown prescriptions) and in-center CHD	Prevalent	127 (74 BH, 53 RL)	Median 50 (BH), 68 (RL)	78 (BH), 55 (RL)	Median 3.2 (BH), 2.6 (RL)	56 (BH), 46 (RL)	NR
Muir[36] (2014)	Retrospective before-after	Australia 2003-2010	Coprimary: systemic AVF-related infections, fistula loss/surgical interventions	Home (overnight or during waking hours)	Both	72 (BH), 30 (RL)	Median 52	73	0.34	NR	3,765 AVF-mo (2,767 BH, 998 RL)

Table 2. Pain With Cannulation Outcome

Study	Study Type	RL Cannulation	BH Cannulation	Between-Group *P*	Notes
			In-Center CHD		
Toma[29] (2003)	RCT	40.5% of pts "significant pain at the time of puncture at baseline, but none with the BH technique"; 40.5% of pts "pain with the BH technique was less than with the conventional method"; 18.9% of pts "experienced the same mild pain with either approach"		—	Assessed by a single item on questionnaire 1 wk after initiation of BH puncturing
Struthers[7] (2010)	RCT	1 at baseline; 1 at F/U[a]	3 at baseline; 2.5 at F/U[a]	NR; NR	Measured by 10-point visual analogue scoring system (not further described); 1/25 RL pts completing the trial stopped using any local anesthetic vs 6/22 BH patients ($P < 0.01$)
MacRae[19] (2012)	RCT	1.5 (IQR, 0.4-3.2) at baseline; 1.2 (IQR, 0.4-2.4) at F/U	1.6 (IQR, 0.5-3.2) at baseline; 1.5 (IQR, 0.5-3.4) at F/U	$P = 0.8$; $P = 0.6$	Measured by 10-cm visual analogue scale; all pts received a topical 5% lidocaine gel applied to AVF for 5 min during the time of pain assessment; respective within-group median pain scores did not change over F/U of 8 wk
Vaux[21] (2013)	RCT	1.2 (IQR, 1.0-1.5)	1.3 (IQR, 1.2-1.9)	$P = 0.05$	Measured by self-reported modified numeric pain rating scale (1 = pain free, 10 = unbearable pain); 8/58 pts in BH group abandoned BH due to pain, and subsequent pain scores excluded from the analysis; 37% RL pts vs 41% BH pts required topical or injected local anesthetic use during at least 1 cannulation session during study ($P = 0.7$)
Marticorena[27] (2006)	Before-after	6.5 (IQR, 5.8-8.5) for venous needle; 7.0 (IQR, 5.8-8.0) for arterial needle	1.0 (IQR, 1.0-2.0) for venous needle; 1.0 (IQR, 1.0-2.0) for arterial needle	$P < 0.001$; $P < 0.001$	Measured by 10-point visual analogue pain scale (1 = no pain, 10 = extreme pain); daily HD pts experienced less pain than those dialyzing 3×/wk throughout study ($P < 0.01$)

Table 2 (Cont'd). Pain With Cannulation Outcome

Study	Study Type	RL Cannulation	BH Cannulation	Between-Group *P*	Notes
Aitken[33] (2013)	Cross-sectional	3 (IQR, 2.5); >5 for 27.7%	3 (IQR, 2.4); >5 for 18.2%	$P = 0.4$; $P = 0.09$	Measured by 10-point visual analogue scale (0 = "no pain," 10 = "worst pain ever"); % of pts with severe acute pain (score > 5); AVF pain unrelated to cannulation per se (ie, chronic pain), was no different between RL and BH
Kim[35] (2013)	Before-after	6.3 ± 1.3 for venous needle; 6.1 ± 1.2 for arterial needle	5.1 ± 1.8 for venous needle; 3.3 ± 1.8 for arterial needle	$P = 0.001$; $P = 0.001$	Measured by 10-cm visual analogue scale (0 = "no pain," 10 = "severe pain")
Smyth[37] (2013)	Cohort	1.82 ± 0.934	1.90 ± 1.069	$P = 0.6$	Measured by 10-point visual rating scale (1 = "no pain," 10 = "terrible pain"); variable local anesthetic use
			Mixed and Home HD		
Chow[23] (2011)	RCT	0.81 (95% CI, 0.48-1.15) at baseline; 0.71 (95% CI, 0.34-1.09) at F/U	0.81 (95% CI, 0.41-1.20) at baseline; 0.56 (95% CI, 0.13-0.99) at F/U	NS; NS	Mixed HD; measured by Wong-Baker Pain Rating (visual analogue) Scale, from 0 (no pain) to 5 (worst pain); use of lidocaine at last F/U: 77% of RL pts vs 44% of BH pts, $P = 0.01$ (data unavailable for 17% of pts)
Verhallen[31] (2007)	Before-after	2.3 ± 2.2	1.6 ± 2.0	$P = 0.1$	Home HD; measured by visual analogue scale; BH: average pain score from 1.5-18 mo

Note: Unless otherwise indicated, values given in cannulation columns are presented as median (IQR), mean ± standard deviation, or mean (95% CI).

Abbreviations: AVF, arteriovenous fistula; BH, buttonhole; CHD, conventional hemodialysis; CI, confidence interval; F/U, follow-up; HD, hemodialysis; IQR, interquartile range; RL, rope-ladder; NR, not reported; NS, not significant; pts, patients; RCT, randomized controlled trial.

[a]Values are medians.

[b]Values are means.

Study	Study Type	Micro-organisms Identified	Complications	Infection Rate			Notes
				RL Cannulation	BH Cannulation	Between-Group *P*	
				In-Center CHD			
Toma[29] (2003)	RCT	NR	NR	0 events/1,000 AVF-d	0.9 events/1000 AVF-d	NR	Local infectious event defined by 1 of the following: redness, swelling, tenderness, exudate or pus; limited to a 3-mo observation period
Struthers[7] (2010)	RCT	NR	NR	0/28 (0%) pts	1/28 (3.6%) pts	NR	NR
MacRae[19] (2012)	RCT	BH: 1 *S aureus* bacteremia; RL: no positive cultures	NR	9.6 events/1,000 AVF-d	21.4 events/1,000 AVF-d	*P* = 0.003	Localized infection defined as erythema, pus, or swelling at fistula site during 8-wk study period; after study completion (within 12 mo) 2 BH pts developed *S aureus* bacteremia and 9 developed AVF abscess; 0 complications reported with RL
Vaux[21] (2013)	RCT	BH: no positive cultures; RL: 2 *S aureus* bacteremias	NR	Bacteremias: 0.09 event/1,000 AVF-d; ESIs: 0/1,000 AVF-d	Bacteremias: 0/1,000 AVF-d; ESIs: 0.12 event/1,000 AVF d	NR; NR	Infection rate defined by bacteremias or ESIs
Twardowski[6] (1979)	Before-after	NR	NR	0.12 event/1,000 AVF-d	0.24 event/1,000 AVF-d	NR	Infectious events defined by those requiring antibiotics
van Loon[8] (2010)	Cohort	BH: 2 *S aureus* bacteremias; 2 local infections (*S aureus* & *Clostridium perfringens*); RL: no positive cultures	NR	0/70 (0%) pts	4/75 (5.3%) pts	*P* = 0.001	Access-related infection defined by need for antibiotics; cannot determine AVF-d of follow-up

Study	Study Type	Micro-organisms Identified	Complications	Infection Rate		Between-Group *P*	Notes
				RL Cannulation	BH Cannulation		
		(RL vs BH distribution NR)	1 nonfatal endocarditis; 1 metastatic costovertebral arthritis	CI, 0.086-0.31); period 2, 0.11 (95% CI, 0.0014-0.63)	period 4, 0.34 (95% CI, 0.19-0.55)	compared with period 3)	or drainage from cannulation site(s) and/or bacteremia caused by a skin micro-organism even without local signs; period 1: all pts using RL technique, period 2: progressive switch to BH method, period 3: all pts using BH method before educational workshops, period 4: all pts using BH method after educational workshops
Smyth[37] (2013)	Cohort	BH: NR; RL: 1 *S aureus* local infection	NR	0.76 event/1,000 AVF-d	0.87 event/1,000 AVF-d	$P = 0.9$	Signs and symptoms of infection (redness, swelling, heat, discharge, pain) assessed by clinical observation, and pathology (wound swab, blood culture) when applicable
Chan[34] (2014)	Cohort	NR	NR	5/45 (8%) pts	3/38 (11%) pts	$P = 0.6$	Bacteremia rates defined as at least 1 positive blood culture with definite or probable association with infection secondary to the AVF, treated with antibiotics
Mixed and Home HD							
Chow[23] (2011)	RCT	BH: 1 *Klebsiella pneumoniae* and coagulase-negative staphylococcus; RL: no positive cultures	Presented with features of local infection and fever	1/35 (2.9%) pts	4/34 (11.8%) pts	$P = 0.1$	Mixed HD; exit-site infection ± bacteremia; the only pt in RL group with infection was dialyzing at home and had self-initiated BH cannulation; after the infection, the pt

Table 3 (Cont'd). Infectious Outcomes

Study	Study Type	Micro-organisms Identified	Complications	Infection Rate		Between-Group *P*	Notes
				RL Cannulation	BH Cannulation		
Van Eps[30] (2010)	Cohort	Among NHD pts (76% using BH), 71.4% of positive cultures isolated Gram-positive organisms (60% of these are *S aureus*); Gram-negative organisms isolated in 7.1%	NR	0.09 (95% CI, 0.04-0.16) event/pt-y; ie, 0.25 event/1,000 AVF-d	0.22 (95% CI, 0.12-0.38) events/pt-y; ie, 0.60 event/1,000 AVF-d	*P* = 0.04 for IRR of 3.0 (1.04-8.66)	Mixed HD (CHD pts: 92% RL; NHD pts: 76% BH); septic events, defined as admission to hospital with local changes at access site suggesting infection (eg, erythema, warmth, pain, discharge from cannulation, or CVC exit sites) and/or fever or rigors, which required intravenous antibiotic treatment documented or suspected sepsis when the dialysis access was deemed by the treating clinicians to be the most probable portal of entry for the infection and no other cause was identified
O'Brien[20] (2012)	Cohort	BH: 8 *S aureus*, 1 *S epidermidis*; RL: no positive cultures	4 endocarditis (1 fatality); 1 cervical discitis	0 event/1,000 AVF-d	0.073 event/1,000 AVF-d	*P* = 0.02	Mixed HD; AVF-associated infection defined by a positive blood culture yielding typical pathogens with cellulitis overlying the AVF
Muir[36] (2014)	Before-after	NR	NR	Event/1,000 AVF-d: measure 1, 0.03; measure 2, 0.07; measure 3, 0.10	Event/1,000 AVF-d: measure 1, 0.20; measure 2, 0.18; measure 3, 0.39	NS; NS; *P* ≤ 0.05	Home HD; measure 1: local AVF infections defined as erythema, pain, or swelling of fistula site requiring treatment with oral antibiotics with negative blood cultures in the absence of systemic symptoms; measure 2: systemic AVF-related infection events (blood culture–positive

Table 4 (Cont'd). Secondary Outcomes

Study	Study Type	Dialysis Modality	RL Cannulation	BH Cannulation	Between-Group *P*	Note
			Access Survival			
Vaux[21] (2013)	RCT	In-center	9/69 (13%)	0/58 (0%)	$P = 0.005$	Access failure defined as AVF no longer used for successful HD at 1 y
MacRae[38] (2014)	RCT	In-center	16.0 (IQR, 10.6-29.3) mo	18.4 (IQR, 10.9-32.7) mo	$P = 0.2$	Access survival defined as time from study start until time of access abandonment, death, modality transfer, or end of F/U
Chan[7] (2014)	Cohort	In-center	3 mo: 89%; 6 mo: 71%; 12 mo: 60%	3 mo: 86%; 6 mo: 72%; 12 mo: 57%	$P = 0.6$	Primary patency evaluated from initial date of BH or matched RL to date of referral for access dysfunction
			Hemostasis			
Toma[29] (2003)	RCT	In-center	<5 min in 27.9%; 5-10 min in 58.1%; >10 min in 14.0%	<5 min in 54.1%; 5-10 min in 40.5%; >10 min in 5.4%	NR	Hemostasis defined as time until bleeding stopped at puncture site after withdrawal of needle at end of treatment
Struthers[7] (2010)	RCT	In-center	6.7 ± 0.55 min (baseline); 6.7 ± 0.52 min (6 mo)	5.7 ± 0.60 min (baseline); 5.0 ± 0.43 min (6 mo)	NS	—
MacRae[19] (2012)	RCT	In-center	Rate of no bleeding post-HD: 23.6/1,000 dialysis sessions; rate of any bleeding post-HD: 97.6/1,000 dialysis sessions	Rate of no bleeding post-HD: 28.3/1,000 dialysis sessions; rate of any bleeding post-HD: 97.2/1,000 dialysis sessions	$P = 0.4$; $P = 0.9$	F/U of 8 wk
Vaux[21] (2013)	RCT	In-center	9.1 (IQR, 6.9-11.3) min	7.9 (IQR, 6.3-10.4) min	$P = 0.3$	Hemostasis defined as total time from removal of first needle to achievement of hemostasis for both needles
Marticorena[27] (2006)	Before-after	In-center	20 (IQR, 15-40) min	13 (IQR, 9-20) min	$P < 0.001$	Hemostasis determined as follows: 5 min after removing each needle (venous first), pressure on site was released; if blood appeared through folded gauze, pressure was reapplied immediately in same manner; this process was repeated every 5 min until there was no sign of fresh blood in needle entrance site
Ludlow[25] (2010)	Before-after	In-center	14.08 ± 3.31 min	13.72 ± 3.99 min	NS	Hemostasis not defined
Pergolotti[28] (2011)	Cohort	In-center	Pts in BH group had average hemostasis time 23.7% shorter than pts in RL group		$P = 0.007$	Hemostasis defined as cessation of puncture bleeding at arterial site as assessed at 1-min and then 30-sec intervals following needle removal

Table 4 (Cont'd). Secondary Outcomes

Study	Study Type	Dialysis Modality	RL Cannulation	BH Cannulation	Between-Group *P*	Note
Chow[23] (2011)	RCT	Mixed	No difference in hemostasis time			Details NR
Verhallen[31] (2007)	Before-after	Home	8.7 ± 3.6 min	7.6 ± 4.0 min	*P* = 0.004	Hemostasis defined as average compression time after cannula removal; BH value based on times collected from 1.5-18 mo of F/U
Hematoma Formation						
Struthers[7] (2010)	RCT	In-center	27 reported episodes over 6 mo	19 reported episodes over 6 mo	NR	Hematoma defined as peripuncture subcutaneous infiltration
MacRae[19] (2012)	RCT	In-center	436/1,000 dialysis sessions	295/1,000 dialysis sessions	*P* = 0.03	F/U of 8 wk; hematoma categorized as 0-4.9, 5-10, >10 cm (not further defined)
Twardowski[5] (1979)	Before-after	In-center	12.5%	0.1%	NR	Hematoma formation not defined; presumably expressed as percentage of no. of HD sessions
van Loon[8] (2010)	Cohort	In-center	14.0 ± 15.6 (no. per pt over 9 mo)	2.0 ± 3.7 (no. per pt over 9 mo)	*P* < 0.0001	Hematoma defined as abnormal infiltration of blood
Ludlow[26] (2010)	Before-after	In-center	33.7% of pts over 3 mo	37.9% of pts over 3 mo	NS	Hematoma defined as needle infiltration
Smyth[37] (2013)	Cohort	In-center	31.7% of pts over 12 wk	26.8% of pts over 12 wk	*P* = 0.8	Hematoma defined as abnormal localized infiltration of blood caused by needle cannulation
Chow[23] (2011)	RCT	Mixed	0% of pts over 6 mo	11.8% of pts over 6 mo	*P* = 0.03	Hematoma formation not defined
Aneurysm Formation						
Struthers[7] (2010)	RCT	In-center	30% ± 7% increase in diameter of AVF over 6 mo	1% ± 22% increase in diameter of AVF over 6 mo	*P* < 0.01	Fistulas from both groups were photographed and maximum transverse diameter measured prerandomization and at study termination
Vaux[21] (2013)	RCT	In-center	17% of pts develop new aneurysm over 12 mo; 67% of pts with enlargement of existing aneurysm over 12 mo	4% of pts develop new aneurysm over 12 mo; 23% of pts with enlargement of existing aneurysm over 12 mo	NR; NR	Aneurysm defined as new dilatation > 0.5 cm; enlargement of existing aneurysm defined as dilatation > 0.5 cm
van Loon[8] (2009)	Cohort	In-center	67% of pts over 9 mo	1% of pts over 9 mo	*P* < 0.001	Aneurysm formation defined as localized dilatation of vessel
Smyth[37] (2013)	Cohort	In-center	28.6% of pts over 12 wk	7.3% of pts over 12 wk	*P* = 0.02	Aneurysm defined as localized dilatation of vessel on visual inspection

Note: In cannulation columns, values given with IQRs are medians; values given before and after ± are mean and standard deviation, respectively.

Abbreviations: AVF, arteriovenous fistula; BH, buttonhole; CVC, central venous catheter; F/U, follow-up; HD, hemodialysis; IQR, interquartile range; NR, not reported; NS, not significant; pt, patient; RCT, randomized controlled trial; RL, rope-ladder; URR, urea reduction ratio.

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

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Designed of study

- To studied 145 hemodialysis patients 70 of Rope ladder andof 75 BH technique were compared
- The following parameters were registered: haematoma occurrence,redness, swelling, aneurysm formation, the use of sharp or dull needles, miscannulations, and interventions.
- Needling pain and fear of puncture were assessed using a verbal rating scale (VRS).
- The duration of the follow-up was 9 months.

Table 4. Comparison of cannulation characteristics in percentages, between the rope-ladder and the buttonhole cannulation techniques

Cannulation practice	Rope-ladder ($n = 70$) 6882 dialysis sessions	Buttonhole ($n = 75$) 6847 dialysis sessions
Type of needle used		
Metal sharp	90	44
Metal dull	–	56
Catheter	10	–
Needle Gauche		
14 Gauche	–	7
15 Gauche	100	93
Needle position		
Bevel up	52	99
Bevel down	48	1
Axis rotation needle		
Yes	6	13
No	94	87
Direction arterial needle		
Antegrade	95	76
Retrograde	5	24
Tourniquet use		
Yes	50	73
No	50	27
Sonographic guided cannulation		
Yes	–	–
No	100	100
Experience dialyses nurse		
<3 years	41	32
≥3 years	59	68

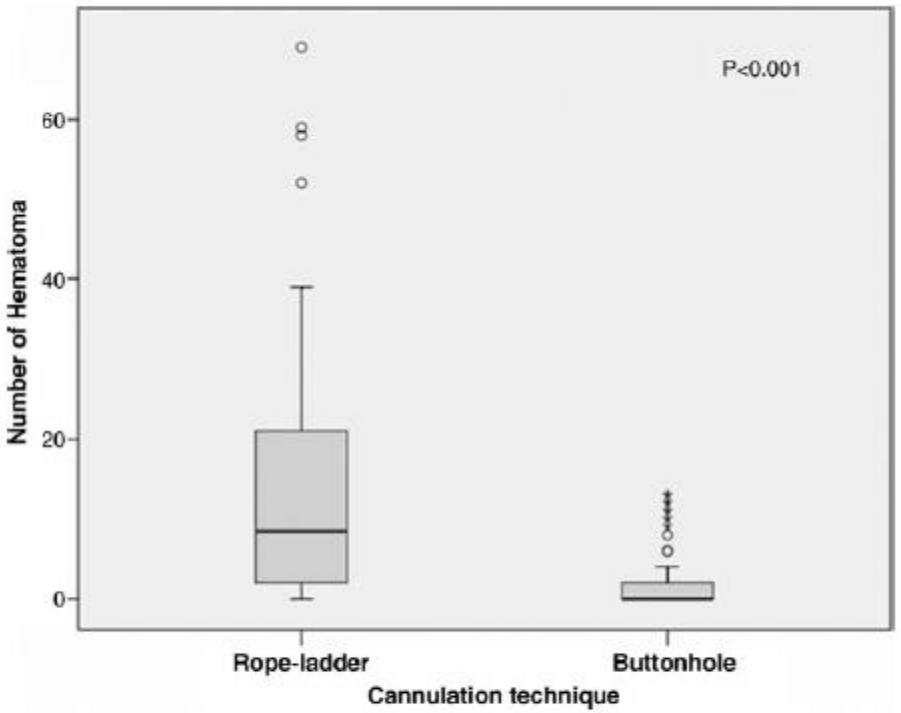

Fig. 2. Number of haemotomas with the rope-ladder and buttonhole cannulation techniques. Box indicates 25th and 75th percentiles (thick line is the median value). Capped bars indicate minimum and maximum values including outliers. The mean (SD) number of haemotomas for the rope-ladder technique was 14.0(15.6) and for the BH technique 2.0(3.7).

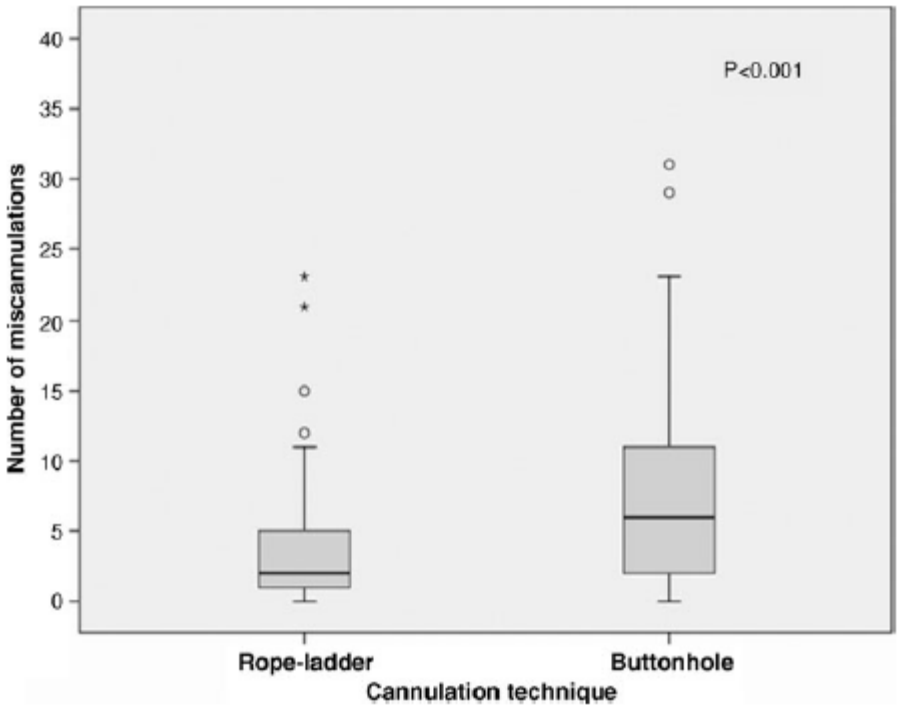

Fig. 1. Comparison of miscannulations between the rope-ladder and buttonhole cannulation techniques. Box indicates 25th and 75th percentiles (thick line is the median value). Capped bars indicate minimum and maximum values including outliers. The mean (SD) number of miscannulations for the rope-ladder technique was 3.7(4.7) and for the BH technique 8.1(7.0).

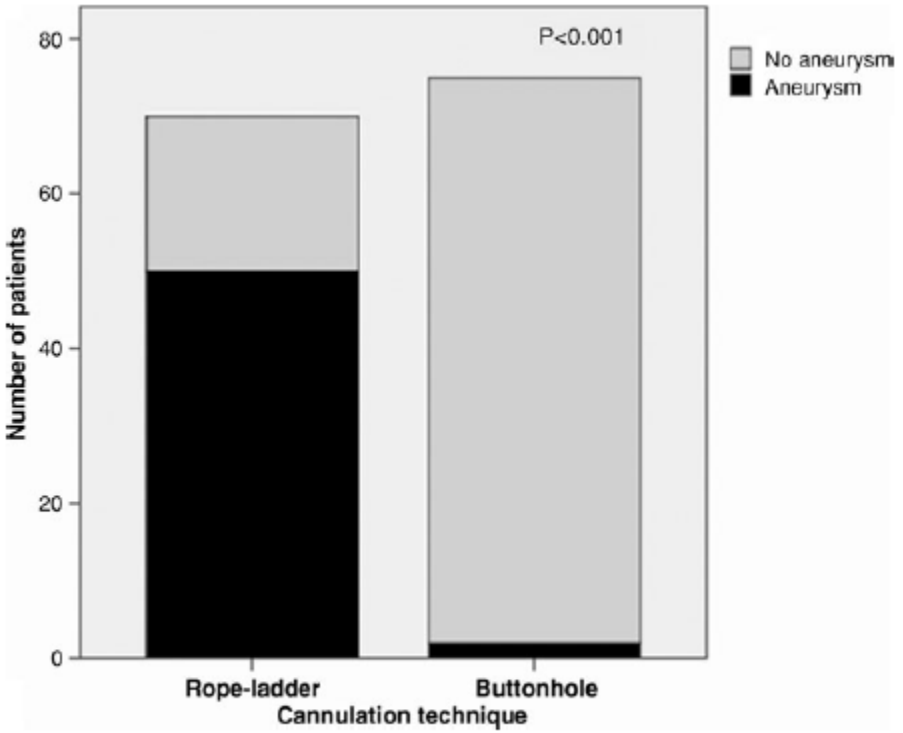

Fig. 3. The number of patients who experienced an aneurysm.

Table 5. Pain and fear with the different cannulation techniques assessed by a verbal rating scale in the various groups

Cannulation practice	Rope-ladder ($n = 70$)	Buttonhole ($n = 75$)	*P*-value
Age (years)	67 (20–90)	65 (21–87)	0.49
Gender			0.29
Female	33 (23%)	31 (41%)	
Male	67 (77%)	44 (59%)	
Use of local anaesthetic cream	30%	8%	<0.001
Pain score	1.0 (0–5.4)	1.6 (0–5.0)	<0.001
Fear score	0.38 (0–4.1)	0.63 (0–8.2)	<0.002

Table 6. Diagnositic tests and interventions with the different cannulation techniques during 9 months

	Rope-ladder ($n = 70$)	Buttonhole ($n = 75$)	*P*-value
Patients with diagnostic tests	28	15	
Diagnostic tests	73	24	0.004
Duplex	14	11	
Fistulogram	51	10	
MRA	8	3	
Patients with interventions	21	6	
Interventions	41	10	0.001
Angioplasty	35	2	0.001
Thrombectomy	3	1	0.81
Surgical revisions	3	3	0.55
Antibiotic treatments because of access-related infections	–	4	0.001

RAJAVEJ CHIANGMAI HOSPITAL

A Randomized Trial Comparing Buttonhole with Rope Ladder Needling in Conventional Hemodialysis Patients

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CJASN ePress. Published on July 19, 2012 as doi: 10.2215/CJN.02730312

Objectives study

- To compare patient perceived pain and fistula complications in buttonhole and standard needling.

Design of study

- Studied in 140 conventional hemodialysis patients
- They were randomly assigned to buttonhole or standard needling.
- The primary outcome was patient perceived pain with needling at 8 weeks.
- Fistula complications of hematoma, bleeding postdialysis, and infection were tracked.

Table 1. Characteristics of patients randomized to buttonhole or standard needling groups

Characteristic	Standard Needling (*n*=70)	Buttonhole Needling (*n*=70)
Mean age (SD) in years	66.7 (14.4)	70.3 (12.3)
Male sex (*n*; %)	46 (65.7)	51 (72.9)
Comorbid illnesses (*n*; %)		
Diabetes mellitus	39 (55.7)	33 (47.1)
Coronary artery disease	28 (40.0)	31 (44.3)
Years on hemodialysis (median)	3.0 (1.6–5.4)	2.8 (1.6–5.6)
Coumadin (*n*; %)	9 (12.9)	5 (7.1)
Mean international normalized ratio (SD)	2.2 (0.3)	2.4 (0.4)
Type of arteriovenous fistula (*n*; %)		
Radiocephalic	13 (18.6)	11 (15.7)
Brachiocephalic	32 (45.7)	43 (61.4)
Brachial basilic	24 (34.3)	16 (22.9)
Other	1 (1.4)	0
Previous fistulogram/fistuloplasty (*n*; %)	48 (68.6)	43 (61.4)
Anesthesia used (*n*; %)	20 (28.6)	17 (24.3)
Type of anesthesia if used		
Eutectic mixture of local anesthetics topical	9 (45.0)	13 (76.5)
Lidocaine topical	9 (45.0)	2 (11.8)
Intradermal lidocaine	2 (10.0)	2 (11.8)

Data are expressed as mean ± SD, median (25th to 75th percentile), or number (percentage).

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Table 2. Pain scores at baseline and 8 weeks with standard and buttonhole needling

	Standard Needling (n=70)	Buttonhole Needling (n=70)	P Value (Between Group)
Baseline (week 1) median (25th to 75th percentile)	1.5 (0.4–3.2)	1.6 (0.5–3.2)	0.78
Study end (week 8) median (25th to 75th percentile)	1.2 (0.4–2.4)	1.5 (0.5–3.4)	0.57
P value (within group)	0.24	0.86	

The median value is based on the three pain scores per patient each week and expressed as median (25th to 75th percentile).

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Table 3. Rates of secondary outcomes (per 1000 dialysis sessions) for standard and buttonhole needling

Outcomes	Standard Needling Rate per 1000 Dialysis Sessions	Buttonhole Needling Rate per 1000 Dialysis Sessions	*P* Value
Hematoma formation	436	295	0.003
Bleeding postdialysis			
No bleeding	23.6	28.3	
Any bleeding	97.6	97.2	0.40
Signs of localized infection	22.4	50.0	0.003

Signs of localized infection included erythema, pus, or swelling at the fistula site.

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- Used a visual analog scale was similar for SD:BH (1.2 [0.4–2.4] : 1.5 [0.5–3.4]; P=0.57).
- Hematoma formation in standard needling was higher
- No bleeding post dialysis SD : BH 23.6 : 28.3 per 1000
- Rate of localized signs of infection in standard versus buttonhole needling was 22.4 versus 50 per 1000 (P=0.003).
- 1 episode of **S. aureus** bacteremia in BH
- 9 episodes had needling site abscesses in BH and required intravenous antibiotics

RAJAVEJ CHIANGMAI HOSPITAL

Buttonhole Technique Better Than Area Puncture Technique on Hemostasis and Pain Associated with Needle Cannulation

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Objective study

- *To compare buttonhole arteriovenous fistula (AVF) cannulation technique with area puncture method on the effect of hemostasis after needle withdrawal and pain during needle puncture.*

Table 1. Patient's characteristics

Characteristics	n = 21
Age (years)	56.3 ± 3.0
Sex Male : Female	15:6
Vintage on hemodialysis (years)	5.3 ± 4.6
HD 2x/wk : HD 3x/wk	13:8
Diabetes	14.3%
Site of AVF	
- Left upper arm	28.6% (6)
- Left forearm	38.1% (8)
- Right upper arm	23.8% (5)
- Right forearm	9.5% (2)

Table 2. Comparison of mean duration of hemostasis after needle withdrawal (n = 21)

	Duration of hemostasis after needle withdrawal (min)		p-value
	Buttonhole	Area puncture	
Arterial site	4.19 ± 1.66	9.12 ± 2.36	< 0.0001
Venous site	3.92 ± 1.37	9.12 ± 2.36	< 0.0001

Table 3. Comparison of mean pain score during AVF cannulation (n = 21)

	Pain score		p-value
	Buttonhole	Area puncture	
Arterial site	1.20 ± 0.90	6.03 ± 0.90	< 0.0001
Venous site	1.38 ± 0.75	5.88 ± 0.82	< 0.0001

Result Study

- The mean duration of hemostasis after needle withdrawal in BH was significantly less than technique at both arterial site and venous
- Pain score during AVF cannulation with buttonhole technique by using blunt needle was also significantly less than area puncture technique at both arterial site and venous site

RAJAVEJ CHIANGMAI HOSPITAL

OUTCOMES OF BUTTONHOLE AND ROPE-LADDER CANNULATION TECHNIQUES IN A TROPICAL RENAL SERVICE

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	Rope-ladder (n = 63, 60.6%)	Buttonhole (n = 41, 39.4%)	Total (n = 104)	χ^2 (p-Value)
Gender				
Male	35 (55.6%)	14 (34.1%)	49 (47.2%)	$\chi^2 = 3.750$ (p = 0.053)
Female	28 (44.4%)	27 (65.9%)	55 (52.8%)	
Age (years)				
≤60	32 (50.8%)	20 (48.8%)	52 (50.0%)	$\chi^2 = 0.000$ (p = 1.000)
>60	31 (49.2%)	21 (51.2%)	52 (50.0%)	
	Mean = 61	Mean = 60	Mean = 60	
	Median = 60	Median = 62	Median = 61	
	Range = 29–91	Range = 22–83	Range = 22–91	
	SD = 14	SD = 14	SD = 14	
BMI*			(n = 103)	$\chi^2 = 7.318$ (p = 0.062)
≤18.50	3 (4.8%)	1 (2.4%)	4 (3.8%)	
18.51–24.99	29 (46.8%)	13 (31.7%)	42 (40.8%)	
25.00–29.99	18 (29.0%)	9 (22.0%)	27 (26.2%)	
≥30.00	12 (19.4%)	18 (43.9%)	30 (29.1%)	
Aboriginal and Torres Strait Islander	28 (44.4%)	26 (63.4%)	54 (51.9%)	$\chi^2 = 2.861$ (p = 0.091)
Diabetic	40 (63.5%)	28 (68.3%)	68 (65.4%)	$\chi^2 = 0.085$ (p = 0.770)
Location dialysis				
TTH	38 (60.3%)	10 (24.4%)	48 (46.2%)	$\chi^2 = 23.543$** (p = 0.000)
North Ward	12 (19.0%)	15 (36.6%)	27 (26.0%)	
Home Hill	9 (14.3%)	3 (7.3%)	12 (11.5%)	
Palm Island	2 (3.2%)	1 (2.4%)	3 (2.9%)	
Mt Isa	2 (3.2%)	12 (29.3%)	14 (13.5%)	

Table 1: Participant descriptive data.

*Missing = 1 (double leg amputee BMI unable to be determined).
**Statistically significance, $p < 0.05$.

OUTCOME VARIABLES AND MEASURES

- Signs and symptoms of infection (redness, swelling, heat,discharge, pain), as assessed by clinical observation, and pathology (wound swab, blood culture) where applicable.
- Haematoma formation, defined as an abnormal localised infiltration of blood caused by needle cannulation.
- Aneurysm formation, defined as a localised dilatation of a vessel on visual inspection.
- Success of cannulation as measured by the number of attempts at cannulation. The operational definition of unsuccessful cannulation attempts was the need to make more than two attempts to cannulate the same site.

secondary outcome measures:

- Pain score, as indicated by the participant on a 10-point visual rating scale, on which ‘no pain’ was represented by a score of 1, to ‘terrible pain’ which was represented by a score of 10.
- Fear score, as indicated by the participant on a 10-point visual rating scale, on which ‘not frightened’ was represented by a score of 1, to ‘very scared’ which was represented by a score of 10.

The result

Primary outcome: participants with clinical signs of ...	Rope-ladder (n = 63)	Buttonhole (n = 41)	Total (n = 104)	χ^2 (p-Value)
Infection	4 (6.3%)	3 (7.3%)	7 (6.7%)	$\chi^2 = 0.000$ ($p = 1.000$)
Haematoma	20 (31.7%)	11 (26.8%)	31 (29.8%)	$\chi^2 = 0.1000$ ($p = 0.752$)
Aneurysm	18 (28.6%)	3 (7.3%)	21 (20.2%)	$\chi^2 = 5.706^{**}$ ($p = 0.017$)
Number of dialysis sessions attended	Rope-ladder (n = 1,876)	Buttonhole (n = 1,372)	Total (N = 3,248)	χ^2 (p value)
Miscannulation	68 (3.6%)	92 (6.7%)	160 (4.9%)	17.115 ($p < 0.0001$)
Secondary outcome: pain and fear	Mean (range)	Mean (range)		Z (p-value)
Pain score	1.82 (1–5) SD = 0.934	1.90 (1–6) SD = 1.069		$Z = -0.514$ ($p = 0.607$)
Fear score	1.69 (1–6) SD = 1.145	1.43 (1–4) SD = 0.635		$Z = -0.669$ ($p = 0.504$)

Table 3: Primary and secondary outcome results.

**Statistically significance, $p < 0.05$.

What should we Know ?

- **Pain** is probably not better in buttonhole cannulation compared to Rope ladder cannulation
- **Aneurysm** formation and need for interventions **may be reduced** in buttonhole technique
- **Infections** are **increased** in buttonhole cannulation compared to Rope ladder cannulation
- Use of button holes should be **limited to** patients with **difficult cannulation** or **short segments** unless strict infection control measures including topical antibiotics can be assured

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