

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

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Background: The buttonhole (constant site) arteriovenous fistulae cannulation technique, in which the inserted needle utilizes exactly the same site and the same angle every dialysis session, offers the advantage of an easier cannulation procedure, less pain associated with cannulation, and fewer complications when compared with the traditional method.

Objective: 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.

Material and Method: The duration of hemostasis after needle withdrawal and pain during needle puncture of AVF were prospectively recorded in 21 chronic hemodialysis patients at Siriraj Hospital. The data that were collected while using area puncture with sharp needle and while using buttonhole with blunt needle were compared by using Paired t-test.

Results: Compared with area puncture method, the duration of hemostasis after needle withdrawal in patients using buttonhole method was significantly shorter in both arterial (4.19 ± 1.66 mins vs. 9.12 ± 2.36 mins, $p < 0.0001$) and venous site (3.92 ± 1.37 mins vs. 9.12 ± 2.36 mins, $p < 0.0001$). The pain score during needle puncture of AVF in patients using buttonhole method was also significantly less than area puncture method in both arterial (1.20 ± 0.90 vs. 6.03 ± 0.90 , $p < 0.0001$) and venous site (1.38 ± 0.75 vs. 5.88 ± 0.82 , $p < 0.0001$).

Conclusion: Buttonhole AVF puncture method is a useful technique to reduce both the time for hemostasis after needle withdrawal and pain during needle puncture.

Keywords: Hemodialysis, Constant site, Buttonhole technique, Area puncture, Hemostasis, Pain

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The radiocephalic arteriovenous fistula (AVF), a surgically created connection between radial artery and cephalic vein at wrist, was first introduced as vascular access for chronic hemodialysis patients in 1966 by Brescia and Cimino^(1,2). It remains the first choice for permanent vascular access because of greater reliability and fewer complications^(3,4). The major complications of AVF are thrombosis, infection, venous hypertension, bleeding and aneurysm formation. Overall fistula survival depends on the quality of vessels, surgical technique, and the method of using

access, such as the puncture technique by dialysis nurse. Poor cannulation technique may increase risk of damage to the access and aneurysm formation. There are 3 puncture techniques currently used in chronic hemodialysis patients^(2,5): 1) area puncture technique in which needle cannulations are repeated in small circumscribed areas; 2) rope ladder technique in which the needle placement sites are rotated each time about 2-3 centimeters from the last puncture site along the whole length of access; 3) constant site (buttonhole) technique in which the needles are inserted exactly at the same site, the same angle and the same depth during every dialysis session. Area puncture technique may lead to vessel damage and the development of stenosis and aneurysm^(2,4-6). The rope-ladder technique use sharp needles have different angles of insertion⁽⁷⁾, which possibly causes more damage, initiating

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neointimal hyperplasia development resulting in stenosis. This technique requires a cannulation route of more than 10 cm to allow for rotation needle site and sufficient distance between the needles. Buttonhole technique was first used in Poland in 1977 in home dialysis patients with a very limited vascular access. This technique was used in the United States of America in 1997, and was subsequently recommended by NFK-K/DOQI since 2000 as a preferable technique for AVF cannulation⁽⁸⁾.

In the hemodialysis unit at Siriraj hospital, 76% of patients were using AVF as primary vascular access. Ninety-five percent of these patients were using area puncture technique for AVF cannulation because of exhibit difficult cannulation due to a short vein length or a complicated cannulation route. Only 5% of patients had enough length and good route of vascular access for using rope ladder technique. From our experience, we found that in some patients using area puncture technique had some important complications such as difficulty in hemostasis after needle withdrawal causing significant blood loss, pain and fear during cannulation, aneurysm formation and AVF stenosis. An alternative AVF cannulation possibility is the buttonhole technique that has been previously reported to reduce such complications. To improve quality of care to the presented hemodialysis patients, the authors have recently begun using the buttonhole technique for AVF cannulation. The present study was conducted to investigate the effect of cannulation technique, buttonhole vs. area puncture, on the hemostasis after needle withdrawal and on pain during needle puncture in chronic hemodialysis patients.

Material and Method

Patients

Patients undergoing maintenance hemodialysis at Siriraj Hospital for at least 3 months and aged 18 years or older were enrolled in the present study. Exclusion criteria were patients who had malignancy and severe infection. The present study was approved by the institutional Ethic Review Board, and written informed consent was obtained from all participants. From 1 February 2008 to 31 December 2008, twenty-one patients gave informed consent for the present study.

Data collection

Baseline data included age, sex, underlying diseases, hemodialysis vintage, hemodialysis times and hours per week, site of vascular access were recorded.

The duration of hemostasis after needle withdrawal and pain during needle puncture of AVF were prospectively recorded. The data were collected into 3 phases in the same patient as follows: 1) during using area puncture; 2) brake-in period during constant site (buttonhole) puncture with sharp needle until formation of permanent tract that is suitable for change to blunt needle; 3) during constant site puncture with blunt needle. During each dialysis session, pain during both arterial and venous needle cannulation were assessed by using a verbal rating 10-point scale (1 = no pain, 10 = extreme pain). The data of both duration of hemostasis and pain during cannulation were collected from 8 consecutive sessions of hemodialysis during phase 1 and phase 3. The data collection during using area puncture (phase 1) and buttonhole puncture with blunt needle (phase 3) were compared.

Statistical methods

Data are presented as mean \pm SD. A comparison between the two procedures was performed using Paired t-test (two tailed). A p-value of 0.05 or less was considered statistically significant.

Results

The baseline data are listed in Table 1. Of a total of 21 patients, 15 patients (71%) were male and 6 patients (28.6%) were female. The mean age of the patients was 56.3 ± 3.0 years. There were 13 (61.9%) patients on hemodialysis 2 times per week and 8 (38.1%) patients on hemodialysis 3 times per week. During break-in period for buttonhole technique, the AVF was punctured by the same experienced nurse using sharp needle and inserted exactly at the same site, the same angle and the same depth every dialysis session until formation of the permanent tract. Mean puncture time

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

during using sharp needle insertion before permanent tract developed were 9.3 ± 3.0 times (median 10, range 4-16) of hemodialysis sessions.

The mean duration of hemostasis after needle withdrawal in buttonhole technique was significantly less than area puncture technique at both arterial site (4.19 ± 1.66 vs. 9.12 ± 2.36 mins, $p < 0.0001$) and venous site (3.92 ± 1.37 vs. 9.12 ± 2.36 mins, $p < 0.0001$) (Table 2). Pain score during AVF cannulation with buttonhole technique by using blunt needle was also significantly less than area puncture technique at both arterial site (1.20 ± 0.90 vs. 6.03 ± 0.90 , $p < 0.0001$) and venous site (1.38 ± 0.75 vs. 5.88 ± 0.82 , $p < 0.0001$) as shown in Table 3.

Discussion

In the present study, we found that the buttonhole technique showed both a significant improvement of hemostasis after needle withdrawal and decreased pain associated with AVF cannulation compared with area puncture technique. The present results were concordant with previous studies^(7,9,10). During the break-in period of buttonhole technique by using sharp needle inserted at the same site and same angle for creating a permanent tract may cause local nerves damage and scar formation around the tract. These may result in lesser pain associated with blunt cannulation after the break-in period^(4,9-12). Each time during constant site puncture elongation of the front wall of the fistula is caused because of tissue displacement and created a valve-like flap that was easily closed after needle removal. Buttonhole

technique using blunt needle cannulation along the tract causes lesser damage to AVF, whereas area puncture technique using sharp needle causes more skin and AVF injury. For these reasons, the bleeding after needle withdrawal was more easily controlled and less time required for compression in buttonhole technique^(13,14). The other advantages of buttonhole cannulation are reduce hematoma formation, easier identification of insertion site and needle insertion, and decrease cannulation failure rate^(7,9). Needle fear and pain associated with needle insertion are importance factors that may affect patients' attitude for using AVF as primary vascular access^(1,2). Buttonhole technique is a new alternative option that may lead to a positive attitude toward AVF placement, which may reduce the usage of temporary catheter for hemodialysis due to refusal of AVF placement. Although buttonhole technique has been introduced recently in Thailand, there are only limited hemodialysis nurses that have experience with this technique. In the future, this technique will be disseminated to other hemodialysis units and it will improve the quality of care and decrease AVF complications. There are some limitations in the present study such as small sample size and short follow-up period. Longer follow-up period, monitoring of aneurysm formation and infection rate will be required in any future study.

Conclusion

Compared with area puncture technique, Buttonhole technique offers the advantage of better hemostasis after needle withdrawal and lesser pain

during AVF cannulation.

Potential conflicts of interest

None.

References

1. Brescia MJ, Cimino JE, Appel K, Hurwich BJ. Chronic hemodialysis using venipuncture and a surgically created arteriovenous fistula. *N Engl J Med* 1966; 275: 1089-92.
2. McCann M, Einarsdottir H, Van Waelegheem JP, Murphy F, Sedgewick J: Vascular access management I; an overview. *J Ren Care* 2008; 34 (2): 77-84.
3. Besarab A. Resolved: Fistulas are preferred to grafts as initial vascular access for dialysis. *Pro. J Am Soc Nephrol* 2008; 19: 1629-31.
4. Twardowski Z, Kubara H. Different sites versus constant sites of needle insertion into arteriovenous fistulas for treatment by repeated hemodialysis. *Dial Transplant* 1979; 8: 978-80.
5. Peterson P. Fistula cannulation: the buttonhole technique. *Nephrol Nurs J* 2002; 29: 195.
6. Konner K, Nonnast-Daniel B, Ritz E. The arteriovenous fistula. *J Am Soc Nephrol* 2003; 14: 1669-80.
7. Verhallen AM, Kooistra MP, van Jaarsveld BC. Cannulating in haemodialysis: rope-ladder or buttonhole technique? *Nephrol Dial Transplant* 2007; 22: 2601-4.
8. Clinical practice guidelines for vascular access. Vascular Access 2006 Work Group. *Am J Kidney Dis* 2006; 48 (Suppl 1): S176-247.
9. Marticorena RM, Hunter J, Macleod S, Petershofer E, Dacouris N, Donnelly S, et al. The salvage of aneurysmal fistulae utilizing a modified buttonhole cannulation technique and multiple cannulators. *Hemodial Int* 2006; 10: 193-200.
10. van Loon MM, Goovaerts T, Kessels AG, van der Sande FM, Tordoir JH. Buttonhole needling of haemodialysis arteriovenous fistulae results in less complications and interventions compared to the rope-ladder technique. *Nephrol Dial Transplant* 2010; 25: 225-30.
11. Struthers J, Allan A, Peel RK, Lambie SH. Buttonhole needling of arteriovenous fistulae: a randomized controlled trial. *ASAIO J* 2010; 56:319-22.
12. Ball LK. The buttonhole technique for arteriovenous fistula cannulation. *Nephrol Nurs J* 2006; 33: 299-304.
13. Murcutt G. Buttonhole cannulation: should this become the default technique for dialysis patients with native fistulas? Summary of the EDTNA/ERCA Journal Club discussion Autumn 2007. *J Ren Care* 2008; 34: 101-8.
14. Twardowski ZJ. Constant site (buttonhole) method of needle insertion for hemodialysis. *Dial Transplant* 1995; 24: 559-76.

การแทงเข็มฟอกเลือดโดยใช้เทคนิค Buttonhole ดีกว่าเทคนิค area puncture ในระยะเวลาการกีดห้ามเลือดหลังถอดเข็ม และลดระดับความเจ็บปวดขณะแทงเข็มในผู้ป่วยที่ฟอกเลือดด้วยเครื่องไตเทียม

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ภูมิหลัง: การแทงเข็ม arteriovenous fistula (AVF) โดยใช้เทคนิค buttonhole (constant site) ซึ่งเป็นวิธีการแทงเข็มในตำแหน่งเดิมและองศาเดิมทุกครั้งของการฟอกเลือด มีการศึกษาพบว่าช่วยให้การแทงเข็ม AVF ง่ายขึ้น ลดความเจ็บขณะแทงเข็ม และพบภาวะแทรกซ้อนน้อยกว่าเมื่อเทียบกับวิธีแทงเข็มแบบมาตรฐาน

วัตถุประสงค์: เพื่อเปรียบเทียบผลของการแทงเข็ม AVF โดยใช้เทคนิค buttonhole และเทคนิค area puncture ต่อระยะเวลาในการกีดห้ามเลือดหลังถอดเข็ม และระดับความเจ็บปวดของผู้ป่วยขณะแทงเข็ม

วัสดุและวิธีการ: เป็นการศึกษาโดยการเก็บข้อมูลแบบไปข้างหน้าของผู้ป่วยที่ใช้ AVF ในการฟอกเลือดในโรงพยาบาลศิริราช จำนวน 21 คน โดยเก็บข้อมูลระยะเวลาการกีดห้ามเลือดหลังถอดเข็ม AVF และระดับความเจ็บปวดของผู้ป่วย ขณะแทงเข็ม AVF ในระหว่างที่ใช้เทคนิคการแทงเข็มแบบ area puncture ซึ่งใช้เข็มปลายแหลมเปรียบเทียบกับ ในระหว่างที่ใช้เทคนิค buttonhole ซึ่งใช้เข็มปลายทุ่แทงผ่านรูเข็มตามแนวร่องเข็มที่สร้างไว้ โดยใช้สถิติ Pair t-test

ผลการศึกษา : พบว่าการแทงเข็มโดยใช้เทคนิค buttonhole ช่วยลดระยะเวลาการกีดห้ามเลือดหลังถอดเข็ม AVF ได้ดีกว่าเทคนิค area puncture ทั้งบริเวณ arterial site (buttonhole 4.19 ± 1.66 นาที, area puncture 9.12 ± 2.36 นาที, $p < 0.0001$) และบริเวณ venous site (buttonhole 3.92 ± 1.37 นาที, area puncture 9.12 ± 2.36 นาที, $p < 0.0001$) และคะแนนความเจ็บปวดของผู้ป่วยขณะแทงเข็มเมื่อใช้เทคนิค buttonhole น้อยกว่าการใช้เทคนิค area puncture ทั้งบริเวณ arterial site (buttonhole 1.20 ± 0.90 , area puncture 6.03 ± 0.90 , $p < 0.0001$) และบริเวณ venous site (buttonhole 1.38 ± 0.75 , area puncture 5.88 ± 0.82 , $p < 0.0001$)

สรุป: การแทงเข็มโดยใช้เทคนิค buttonhole ช่วยลดระยะเวลาการกีดห้ามเลือดหลังถอดเข็ม AVF และลดความเจ็บปวดขณะแทงเข็ม
