

Comparison of iNIBP linear inflation method and conventional deflation method non-invasive blood pressure measurement in hemodialysis patients



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Background

In patients undergoing hemodialysis, the treatment can cause hemodynamic variations which affect the blood pressure. Also, the cuff attachment and repeated inflations of non-invasive blood pressure (NIBP) measurement can be stressful. Nihon Kohden's iNIBP linear inflation technology NIBP measurement has the advantages of shorter measurement time with only the lowest necessary cuff pressure. This can be useful for dialysis patients.

Objective

We evaluated the usefulness of iNIBP during hemodialysis.

Methods

NIBP was measured by one of the two methods before, during and after dialysis on a given day. Statistical difference between each method was determined by Student's t-test and Mann-Whitney U test.

Significant difference was defined as $P < 0.05$. Pain intensity was measured by the numeric rating scale (NRS).

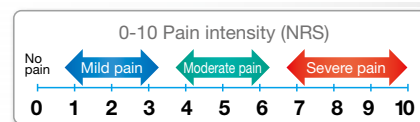
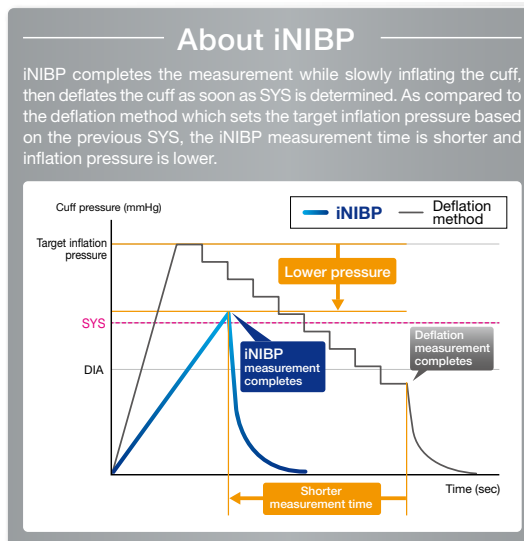
Measurement Items

- Systolic blood pressure (mmHg)
- Diastolic blood pressure (mmHg)
- Mean blood pressure (mmHg)
- Pulse rate (bpm)
- Arrhythmias
- Measurement time (s)
- Maximum inflation Pressure (mmHg)
- Excess pressure = Δ (max inflation pressure - SYS) (mmHg)
- NRS

*SYS: Systolic blood pressure

Evaluated Devices

	Conventional Method	iNIBP
Device	Dialysis unit	Nihon Kohden bedside monitor
Measurement principle	Oscillometric method	Oscillometric method
Measurement method	Conventional deflation method	Linear inflation and deflation method
Accuracy	± 3 mmHg	± 3 mmHg
Inflation range	10–300 mmHg	0–300 mmHg
Cuff	-	YAWARA CUFF 2



Results

n=160

	Conventional	iNIBP	P value
Systolic blood pressure (mmHg)	136 \pm 19	140 \pm 24	0.21
Diastolic blood pressure (mmHg)	76 \pm 12	77 \pm 12	0.50
Mean blood pressure (mmHg)	95 \pm 18	98 \pm 17	0.37
Pulse rate (bpm)	73 \pm 11	76 \pm 17	0.21
Arrhythmias (%)	30 \pm 50	10 \pm 30	0.10
Measurement time (s)	31 \pm 14	22 \pm 11	<0.01
Max inflation pressure (mmHg)	192 \pm 19	159 \pm 25	<0.01
Excess pressure = Δ (max inflation pressure - SYS) (mmHg)	51 \pm 25	19 \pm 16	<0.01

Student's t-test for above items

NRS	1.3 \pm 1.5	0.8 \pm 1.4	0.011
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Mann-Whitney U test for above item

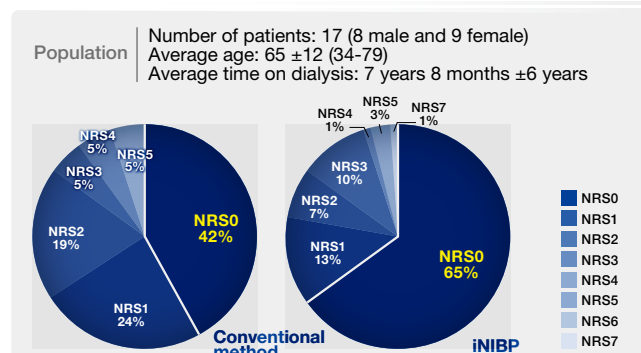


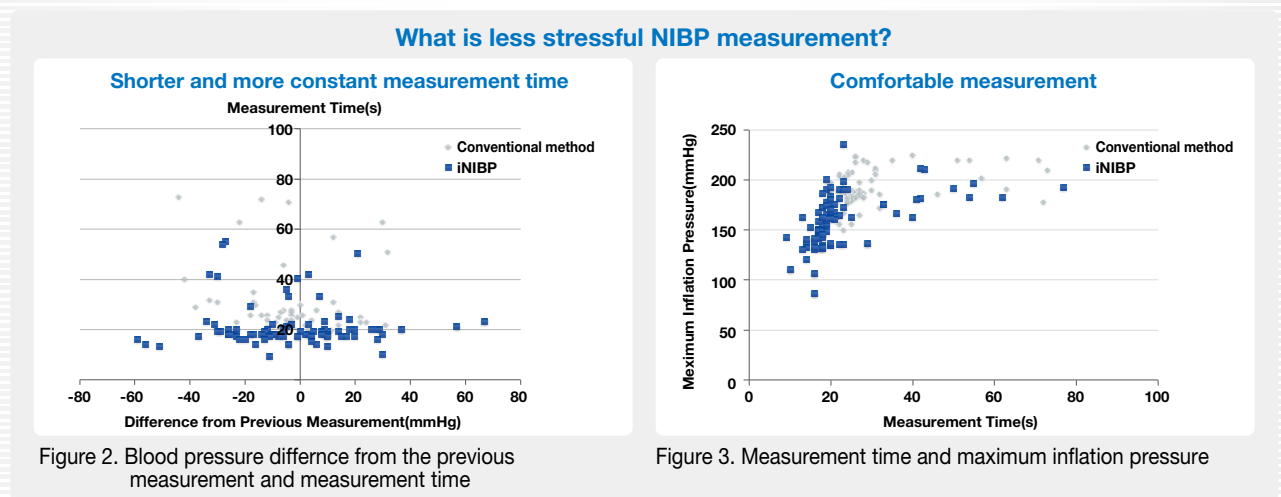
Figure 1. Distribution of NRS values during NIBP measurement

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Discussion

Compared to the conventional method, iNIBP had a higher proportion of zero pain NRS 0 ratings (Figure 1) which means less stressful measurement. In dialysis patients receiving multiple NIBP measurements, blood pressure can vary greatly between measurements. Compared with the conventional method, iNIBP measurement time tended to be less affected by blood pressure variation. This means that iNIBP can provide measurement in a shorter amount of time even during sudden blood pressure changes (Figure 2).

Excessive cuff pressure and long measurement time can cause patients stress but iNIBP was able to provide a mild and comfortable measurement environment (Figure 3).



Summary

- Patients tended to feel less pain during NIBP measurement with the iNIBP method.
- The maximum inflation pressure of the iNIBP method was nearly equal to the systolic pressure; this contributed to a shorter measurement time.
- By reducing the measurement time and inflation pressure and keeping the measurement time constant, iNIBP relieved the stress of blood pressure measurement in patients undergoing hemodialysis.
- iNIBP can benefit medical staff involved with dialysis by delivering operating efficiency for patients with frequent NIBP measurement and fast NIBP results during sudden blood pressure drop.

Conclusion

Blood pressure measurement with iNIBP can be beneficial for dialysis patients.

This report is from a presentation at the 26th Congress of Japan Association for Clinical Engineers and the 61st Annual Meeting of the Japanese Society for Dialysis Therapy.

About the Use of Disposable Cuffs in Our Facility

In our dialysis center, we usually use reusable cuffs but after the abovementioned dialysis congress, we tried Nihon Kohden's newly released disposable cuffs. These disposable cuffs have a thin vinyl chloride surface that is water-repellent, easy to clean and low maintenance.

The Guidelines for Standard Hemodialysis Procedure and Prevention of Infection in Maintenance Hemodialysis Facilities (4th ed) call for stricter measures to prevent the transmission of pathogens so our facility would also like to use disposable NIBP cuffs as one infection-control measure against hepatitis virus, HIV, MRSA, and other pathogens.