

Comparison of non-invasive blood pressure measured in the dependent arm in lateral decubitus position with silicone lateral gel bed versus axillary roll - A randomised controlled trial

INTRODUCTION

In the lateral decubitus position (LDP), the blood pressure of the dependent arm is more compared to the non-dependent arm due to hydrostatic pressure difference.^[1,2] The placement of the non-invasive blood pressure (NIBP) cuff on the dependent arm may lead to compression of the cuff and, therefore, inaccurate reading.^[3] The dependent arm NIBP correlates better with arterial blood pressure.^[2,4] So, the position of the dependent arm is imperative to NIBP measurement.

The neurovascular bundle of the dependent arm can be compressed in the axilla by the weight of the upper torso. Therefore, an axillary roll is usually placed to support the thorax and protect the dependent shoulder and axillary contents from the weight of the thorax.

Newer devices like silicone lateral gel bed (SLGB) have been used recently for lateral position.^[5] It is a single-piece silicone gel bed over which the patient's head and upper torso are placed in a lateral position [Figure 1]. It is a ramp-like silicone gel with a slot to accommodate the dependent arm. This decreases the amount of upper torso weight transmitted to the dependent arm.



Figure 1: Silicone lateral gel bed

Hence, we intended to study whether using SLGB can decrease the neurovascular compression on the dependent arm. Our primary objective was to study the effect of SGLB on NIBP measured in the dependent arm in LDP. We framed the null hypothesis as 'there is no difference in NIBP measured in dependent arm with SLGB versus axillary roll'.

METHODS

This randomised controlled study was conducted after approval from the institutional ethics committee (vide approval number ECR/966Inst/TN2017/RR-21 dated 23/11/2021). The study was registered in Clinical Trials Registry – India (vide trial registration CTRI/2021/12/038481, dated 7/12/2021, at www.ctri.nic.in) and was carried out in accordance with the principles of the Declaration of Helsinki, 2013. After explaining the study protocol to the patients, obtaining their written informed consent for participation and publication of the study for academic purpose, 60 patients of the American Society of Anesthesiologists physical status I–II, aged between 18 and 70 years, undergoing laparoscopic left donor nephrectomy, were included. Patients with morbid obesity, atrial fibrillation, coarctation of the aorta and vascular malformation involving the upper limbs were excluded. Patients with a difference of >20 mmHg in systolic blood pressure (SBP) or >10 mmHg in diastolic blood pressure (DBP) between the two upper arms were also excluded.

Appropriate blood pressure (BP) cuff size was selected as per the American Heart Association recommendations.^[6] The randomisation sequence was generated by a web-based randomisation program (www.randomizer.org), and allocation concealment was done by keeping the randomised sequence in a serially numbered, opaque, sealed envelope. Just before the surgery, the sealed envelopes were opened to reveal allocation in the two groups as follows:

Group 1 – LDP with SLGB

Group 2 – LDP with the axillary roll

On the day of surgery, baseline NIBP was measured simultaneously in both arms in a supine position with an automated oscillometer (Philips IntelliVue MP20; Philips Medical System, Eindhoven, The Netherlands). In the operating room, after placing an electrocardiogram, NIBP and oxygen saturation monitors, anaesthesia was induced with intravenous fentanyl 2 µg/kg, propofol 2 mg/kg and vecuronium

0.1 mg/kg. Trachea was then intubated with an appropriate-sized cuffed endotracheal tube. Anaesthesia was maintained with air, oxygen and sevoflurane. Adequate fluid was administered (10–20 ml/kg) to maintain a urine output of >2 ml/kg/h and mean arterial pressure (MAP) of >70 mmHg. Ephedrine (6 mg) was given intravenously to combat any fall in MAP.

The patients were then turned to LDP. Appropriate measures were taken to protect the pressure points. The dependent arm was flexed at the shoulder, slightly flexed at the elbow, and secured on a padded arm board. The non-dependent arm was flexed at the shoulder, flexed to less than 90° at the elbow, and secured on a padded arm board. As the height of the non-dependent arm can affect the NIBP readings, it was ensured that the entire non-dependent arm was kept at the level of the shoulder joint. In group 1, SLGB was used for positioning. In group 2, an axillary roll was placed [Figure 2a–d]. NIBP was measured every 15 min in both dependent and non-dependent arms or up to 2 h. The difference between the dependent and non-dependent arm NIBP (Δ SBP, Δ DBP and Δ MAP) was calculated. Repeated measures analysis of variance (ANOVA) was used to calculate the changes in Δ SBP, Δ DBP and Δ MAP over time.

Since a similar study was unavailable, this was a pilot study with 30 patients in each group.^[7] Data

were analysed using Statistical Package for the Social Sciences (SPSS) 16.0 statistical software. Patient demographics were compared with the Chi-square test. An unpaired *t*-test was used to compare Δ SBP, Δ DBP and Δ MAP.

RESULTS

Patient demographics were comparable between both groups. The difference in NIBP (Δ SBP, Δ DBP, Δ MAP) measured between the dependent and non-dependent arm at various time periods in both groups were comparable. On application of repeated measures ANOVA, it was noted that there was no statistically significant difference in Δ SBP, Δ DBP and Δ MAP over time within groups and between groups ($P > 0.05$) [Figure 3].

DISCUSSION

We observed that NIBP (Δ SBP, Δ DBP, Δ MAP) measured between the dependent and non-dependent arm with SLGB versus axillary roll was comparable. Thus, the use of a silicone gel bed did not alter the NIBP reading of the dependent arm in LDP.

No guidelines are available for the site of NIBP measurement in LDP under anaesthesia. Also, the opinion of anaesthesiologists is varied regarding the site of NIBP measurement in LDP.^[2,4] But studies have found that the NIBP of the dependent arm correlates with arterial BP in LDP.^[4] Also, about hand dominance and BP difference, the results are varied.



Figure 2: (a and b) Patient in lateral decubitus position with axillary roll. (c and d) Patient in lateral decubitus position with Silicone lateral gel bed

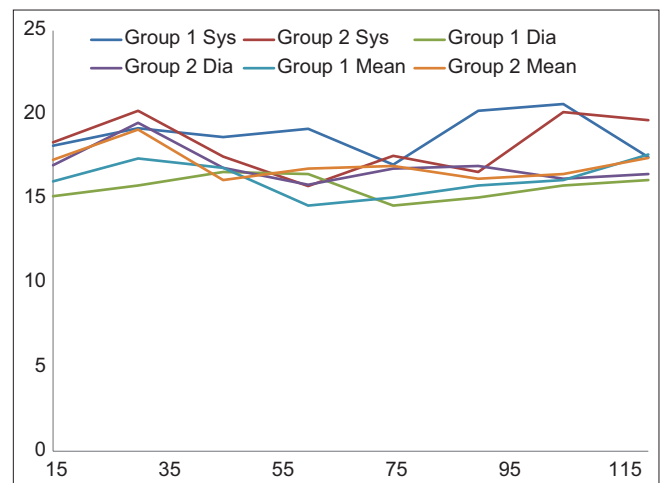


Figure 3: Changes in Δ SBP, Δ DBP and Δ MAP of group 1 and group 2 over time. X-axis = time in minutes. Y-axis = Δ BP in mmHg. Standard deviation ranged from 5.6 to 8.4 for Δ SBP, Δ DBP and Δ MAP in both groups. BP = blood pressure, DBP = diastolic blood pressure, MAP = mean arterial pressure, SBP = systolic blood pressure

Dominant arms tend to have a greater girth and muscle development than non-dominant arms. So, the cuff pressures needed to obtain systolic pressure may be greater on the dominant arm, causing greater SBP. Studies of Mayrovitz *et al.*^[8] and Maeda *et al.*^[9] found no association between hand dominance and BP difference. In a meta-analysis by Joshi *et al.*, they found that for right-handed subjects, the SBP was 1.3 mmHg higher in the right arm, but did not differ in left-handed subjects.^[9] To rule out the effect of hand dominance on BP measurement, we included only right-handed patients in our study. Also, laparoscopic donor nephrectomy is a commonly done procedure in our hospital. Hence, we studied only left laparoscopic donor nephrectomy (as it is more common than right).

Our study has limitations that we compared the NIBP of the dependent arm in LDP with and without a silicone gel bed in the different patient and would have been ideal to study in same patient. But this is not practically possible in an anaesthetised patient. So, we made two groups – group 1 with the silicone gel bed and group 2 with the axillary roll. We took the non-dependent arm NIBP as a reference and calculated the difference between the dependent and non-dependent arms (Δ SBP, Δ DBP, Δ MAP) in each patient. The neurovascular compression of the dependent arm in LDP resulting in a noticeable low BP reading is a rare occurrence. Rarely occurring events cannot be studied by a randomised control design. But a minimal neurovascular compression causing a minimal fall in BP reading can be more common and misdiagnosed as actual hypotension. Hence, we intended to study this problem. Studies with a larger number of patients are needed to find if there is any minimal fall in the BP reading in the dependent arm.

CONCLUSION

The use of an SLGB did not affect the NIBP reading of the dependent arm in LDP.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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Submitted: 16-Jul-2022

Revised: 23-Feb-2023

Accepted: 07-Apr-2023

Published: 14-Jun-2023

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Access this article online	
Quick response code	Website: https://journals.lww.com/ijaweb
	DOI: 10.4103/ija.ija_615_22

How to cite this article: Sherfudeen KM, Kaliannan SK, Noor Mohamed ME, Sankarlal NK. Comparison of non-invasive blood pressure measured in the dependent arm in lateral decubitus position with silicone lateral gel bed versus axillary roll – A randomised controlled trial. *Indian J Anaesth* 2023;67:556-9.