

# Blood pressure elevations in hospital

## SUMMARY

Long-term hypertension control in the community significantly reduces cardiovascular risk. However, the benefit of controlling acute elevations of blood pressure in hospitalised patients is unclear.

In-hospital elevations of blood pressure are relatively common and might not reflect poorly controlled blood pressure before admission. The measurement of blood pressure in hospital patients significantly differs from the best practice recommended for primary care and outpatients.

Recent observational studies suggest that the pharmacological treatment of acute, asymptomatic, in-hospital elevations of blood pressure may have no benefit. However, it may increase the risk of in-hospital and post-discharge complications.

Pending the development of robust inpatient measurement protocols, acute blood pressure elevations in hospitalised patients should not routinely require antihypertensive treatment in the absence of symptoms or acute end-organ damage. Rather, such elevations should facilitate follow-up of blood pressure and other cardiovascular risk factors after discharge.

## Introduction

Long-term control of hypertension in patients living in the community effectively reduces cardiovascular morbidity and mortality. There is a substantial evidence base informing national and international hypertension management guidelines.<sup>1-3</sup> However, the evidence is less clear for a benefit from rapid control of acute, asymptomatic, uncomplicated elevations of blood pressure. In the hospital setting, elevation of blood pressure may trigger calls for urgent assessments by medical emergency teams.<sup>4,5</sup> Current hypertension guidelines do not address asymptomatic in-hospital blood pressure elevations or recommendations regarding their diagnosis, management and follow-up.<sup>1-3</sup>

## Epidemiology and causes of in-hospital hypertension

Acute elevations of blood pressure during an admission to hospital are common. However, there are currently no published data on the epidemiology of asymptomatic blood pressure elevations in Australian hospitals.

One international review reported a prevalence of in-hospital hypertension of 24–87%, however it included studies published between 1982 and 2009 which might not reflect current inpatient populations. Furthermore, the definition of in-hospital hypertension varied across the studies, including a history of hypertension on admission and various thresholds for systolic and diastolic blood pressure according to clinic or ambulatory blood pressure monitoring criteria.<sup>6</sup>

A more recent study captured information regarding pre-admission and in-hospital blood pressure control in a cohort of 14,915 older adults admitted for non-cardiac reasons within the US Veterans Administration Health System. Nearly half of the patients with uncontrolled blood pressure during admission had well-controlled blood pressure before admission.<sup>7</sup> It is currently unknown whether these observations can be extrapolated to Australia.

## Measurement

A critical issue in relation to in-hospital blood pressure elevations is how blood pressure is measured in hospital. The methods used are likely to differ from current recommendations designed for primary care and outpatient settings. For example, the methods for clinic blood pressure measurement emphasise the importance of repeated readings (typically three) taken in a standardised fashion in a quiet environment.<sup>1-3</sup> Out-of-office measurements (24-hour ambulatory blood pressure monitoring, or home blood pressure monitoring) are also important in the accurate diagnosis of hypertension.<sup>1-3,8</sup>

A study in a UK hospital highlighted why inpatient blood pressure measurement may be unreliable. Blood pressure was measured once only (96% of measurements), an incorrect cuff size was used (36%), and staff and patients were conversing during the measurement (41%).<sup>9</sup> This study casts doubt on the use of these measurements as a justification for starting or increasing antihypertensive treatment for inpatients who are asymptomatic.

Arduino A Mangoni<sup>1,2</sup>   
Elzbieta A Jarmuzewska<sup>3</sup>  
Genevieve M Gabb<sup>4,5,6,7</sup>  
Patrick Russell<sup>8</sup>

<sup>1</sup> Discipline of Clinical Pharmacology, College of Medicine and Public Health, Flinders University, Adelaide

<sup>2</sup> Department of Clinical Pharmacology, Flinders Medical Centre, Southern Adelaide Local Health Network

<sup>3</sup> Formerly Department of Internal Medicine, Polyclinic IRCCS, Ospedale Maggiore, University of Milan, Italy

<sup>4</sup> Acute and Urgent Care, Royal Adelaide Hospital, Central Adelaide Local Health Network

<sup>5</sup> Faculty of Health and Medical Sciences, University of Adelaide

<sup>6</sup> Division of Medicine, Cardiac and Critical Care, Flinders Medical Centre, Adelaide

<sup>7</sup> College of Medicine and Public Health, Flinders University, Adelaide

<sup>8</sup> Department of Internal Medicine, Royal Adelaide Hospital, Central Adelaide Local Health Network

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In addition to the method of measurement, factors contributing to the high prevalence of in-hospital blood pressure elevations include uncontrolled pain, noise, anxiety and disrupted sleep patterns. There may also be an interruption to the regular doses taken by patients already on antihypertensive drugs.<sup>10</sup>

### Physicians' attitudes towards in-hospital hypertension

A few studies have examined the attitude of doctors towards treatment. In a survey of 181 US hospital residents, most (79%) regarded controlling blood pressure in hospital as important or very important, and decisions regarding blood pressure lowering should be based on current national guidelines (66%). Many residents (44%) considered drugs should be started or adjusted if the systolic blood pressure was mildly high (140–159 mmHg) and that patients with in-hospital blood pressure elevations should be discharged on the antihypertensive regimen prescribed in hospital (91%).<sup>11</sup>

In another survey, about a third of hospital doctors would transfer an asymptomatic patient to an intensive care unit because of high blood pressure even in the absence of target organ damage. The average blood pressure that would prompt the transfer was 210/117 mmHg for house officers and 193/110 mmHg for other hospital doctors.<sup>10</sup>

In Australia, the wide adoption of set criteria for calling rapid medical emergency teams to respond to specific alterations of vital parameters<sup>4,5</sup> might lead hospital doctors to treat acute elevations of blood pressure even in absence of symptoms or acute end-organ damage. However, as previously discussed, there is no available information regarding the incidence and the treatment of acute, asymptomatic blood pressure elevations by Australian hospital medical emergency teams.

### Management

Studies of in-hospital blood pressure elevations have primarily reported the acute effects of treatment on the blood pressure rather than clinical outcomes. For example, in a study of medical inpatients with asymptomatic hypertension, hydralazine or labetalol given orally or intravenously acutely reduced blood pressure in 85% of patients. In 22% the systolic blood pressure was reduced by at least 25% within six hours.<sup>12</sup> Such an acute and excessive reduction in blood pressure could decrease cerebral and myocardial perfusion. This approach should be avoided except in particular circumstances such as hypertensive emergencies with end-organ damage (e.g. aortic dissection or acute renal failure).<sup>13,14</sup> Clinical features of hypertensive emergencies may include

chest pain, severe headache, confusion, blurred vision, nausea and vomiting, severe anxiety, dyspnoea, seizures and reduced consciousness. Papilloedema is a hallmark of malignant hypertension and can be seen on examination of the optic fundi.

### Outcomes

Observational studies published since 2018 have reported the effect on clinical end points of starting or increasing antihypertensive treatment in hospital. One study reported that 14% of older patients admitted for non-cardiac reasons were discharged with new or intensified antihypertensive treatment. Among those who started treatment, 29% received renin-angiotensin system inhibitors, 42% beta blockers, 27% calcium-channel blockers, 11% thiazide diuretics and 12% other antihypertensives. More than half (52%) of the patients whose treatment was intensified had well-controlled blood pressure before admission. The probability of antihypertensive intensification was 25% for patients with moderately elevated blood pressure and 42% for those with severe elevations.<sup>7</sup>

In another study, patients discharged with a new or intensified antihypertensive regimen were more likely to be readmitted (hazard ratio (HR) 1.23, 95% confidence interval (CI) 1.07–1.42, number needed to harm (NNH) 27, 95% CI 16–76) or experience serious adverse events within 30 days (HR 1.41, 95% CI 1.06–1.88, NNH 63, 95% CI 34–370). In secondary analyses, new or intensified inpatient treatment was associated with an increased risk of cardiovascular events within 30 days of discharge (HR 1.65, 95% CI 1.13–2.40).<sup>15</sup>

The association between inpatient treatment initiation or intensification and specific end points was studied in 22,834 adults admitted with non-cardiac diagnoses at 10 hospitals in the USA. At least one hypertensive reading was recorded in 78% of patients. Of these, 33% were treated mainly with oral antihypertensives. After controlling for patient and blood pressure characteristics, treatment was associated with an increased risk of in-hospital acute kidney injury (odds ratio (OR) 1.36, 95% CI 1.21–1.52) and myocardial injury (OR 2.23, 95% CI 1.56–3.20). By contrast, there were no significant differences in the risk of in-hospital stroke, length of stay, myocardial infarction within 30 days and blood pressure control one year after discharge.<sup>16</sup>

A cohort study matched 4219 patients admitted without a primary cardiovascular diagnosis who received antihypertensive drugs on an as-needed basis, in addition to scheduled antihypertensives, with 4219 patients who only received scheduled antihypertensives. The former group had an increased risk of an abrupt lowering of systolic blood pressure by more than 25% within one hour of administration

(OR 2.05, 95% CI 1.56–2.71), acute kidney injury (OR 1.24, 95% CI 1.09–1.42), ischaemic stroke (OR 8.5, 95% CI 1.96–36.79), death (OR 2.36, CI 1.26–4.41), and prolonged hospitalisation (4.7 vs 2.9 days). Ischaemic events were more frequent with abrupt blood pressure reductions and more doses of as-needed drugs. Notably, 93% of the as-needed drugs were given intravenously, with hydralazine (53%) and labetalol (43%) being the most common drugs.<sup>17</sup>

The results of these observational studies, primarily conducted in the USA, suggest that proactively managing asymptomatic in-hospital blood pressure elevations does not confer clear benefits. Treatment may be associated with significant adverse outcomes, at least in the short term.

## Conclusion

There is overwhelming evidence of the benefit of identifying and treating hypertension in the community. However, little is known about the clinical significance of common, asymptomatic and short-term blood pressure elevations in hospitalised patients. This is compounded by the variability of how blood pressure is measured in hospital, the lack of consideration for an individual patient's overall cardiovascular risk and the absence of evidence about drug treatment and follow-up strategies.

Recent studies, albeit with the limitations of observational data, suggest that the as-needed use, initiation, or intensification of antihypertensive drugs

in asymptomatic patients admitted for non-cardiac reasons provides no clinical benefit. It is, however, associated with an increased risk of in-hospital and post-discharge complications.

A significant problem in investigating in-hospital blood pressure elevations and their management is the lack of robust protocols for inpatient blood pressure measurement. A more robust assessment would facilitate diagnosis and risk stratification, as well as the planning of appropriately designed intervention studies assessing the efficacy and safety of specific drugs and post-discharge follow-up strategies. Only then can the clinical significance of asymptomatic in-hospital blood pressure elevations be appropriately determined in Australia and worldwide.

At present, it appears that acute blood pressure elevations in asymptomatic hospitalised patients do not routinely require drug treatment. The criteria used by hospital medical emergency teams require review and revision, in relation to blood pressure elevations without alterations in other vital parameters, to prevent unnecessary and potentially dangerous antihypertensive treatment.

Blood pressure elevations in hospital should prompt consideration of post-discharge assessments to check the blood pressure and the need for starting long-term treatment. In this context, a clear communication with GPs is essential to appropriately plan investigations and management. ◀

*Conflicts of interest: none declared*

## REFERENCES

- Gabb GM, Mangoni AA, Anderson CS, Cowley D, Dowden JS, Golledge J, et al. Guideline for the diagnosis and management of hypertension in adults - 2016. *Med J Aust* 2016;205:85-89. <https://doi.org/10.5694/mja16.00526>
- Unger T, Borghi C, Charchar F, Khan NA, Poulter NR, Dorairaj P, et al. 2020 International Society of Hypertension global hypertension practice guidelines. *Hypertension* 2020;75:1334-57. <https://doi.org/10.1161/HYPERTENSIONAHA.120.15026>
- Williams B, Mancia G, Spiering W, Agabiti Rosei E, Azizi M, Burnier M, et al. 2018 ESC/ESH Guidelines for the management of arterial hypertension. *Eur Heart J* 2018;39:3021-104. <https://doi.org/10.1093/eurheartj/ehy339>
- Concord Medical Emergency Team (MET) 2 Study Investigators. Outcomes following changing from a two-tiered to a three-tiered hospital rapid response system. *Aust Health Rev* 2019;43:178-187. <https://doi.org/10.1071/AH17105>
- Bergmeir C, Bilgrami I, Bain C, Webb GI, Orosz J, Pilcher D. Designing a more efficient, effective and safe Medical Emergency Team (MET) service using data analysis. *PLoS One* 2017;12:e0188688. <https://doi.org/10.1371/journal.pone.0188688>
- Axon RN, Cousineau L, Egan BM. Prevalence and management of hypertension in the inpatient setting: a systematic review. *J Hosp Med* 2011;6:417-22. <https://doi.org/10.1002/jhm.804>
- Anderson TS, Wray CM, Jing B, Fung K, Ngo S, Xu E, et al. Intensification of older adults' outpatient blood pressure treatment at hospital discharge: national retrospective cohort study. *BMJ* 2018;362:k3503. <https://doi.org/10.1136/bmj.k3503>
- Head GA, McGrath BP, Mihailidou AS, Nelson MR, Schlaich MP, Stowasser M, et al. Ambulatory blood pressure monitoring in Australia: 2011 consensus position statement. *J Hypertens* 2012;30:253-66. <https://doi.org/10.1097/HJH.0b013e32834de621>
- Holland M, Lewis PS. An audit and suggested guidelines for in-patient blood pressure measurement. *J Hypertens* 2014;32:2166-70; discussion 2170. <https://doi.org/10.1097/HJH.0000000000000306>
- Weder AB. Treating acute hypertension in the hospital: a lacuna in the guidelines. *Hypertension* 2011;57:18-20. <https://doi.org/10.1161/HYPERTENSIONAHA.110.164194>
- Neal Axon R, Garrell R, Pfahl K, Fisher JE, Zhao Y, Egan B, et al. Attitudes and practices of resident physicians regarding hypertension in the inpatient setting. *J Clin Hypertens (Greenwich)* 2010;12:698-705. <https://doi.org/10.1111/j.1751-7176.2010.00309.x>
- Gaynor MF, Wright GC, Vondracek S. Retrospective review of the use of as-needed hydralazine and labetalol for the treatment of acute hypertension in hospitalized medicine patients. *Ther Adv Cardiovasc Dis* 2018;12:7-15. <https://doi.org/10.1177/1753944717746613>
- van den Born BH, Lip GYH, Brguljan-Hitij J, Cremer A, Segura J, Morales E, et al. ESC Council on hypertension position document on the management of hypertensive emergencies. *Eur Heart J Cardiovasc Pharmacother* 2019;5:37-46. <https://doi.org/10.1093/ehjcvp/pvy032>
- Burton TJ, Wilkinson IB. The dangers of immediate-release nifedipine in the emergency treatment of hypertension. *J Hum Hypertens* 2008;22:301-2. <https://doi.org/10.1038/sj.jhh.1002324>
- Anderson TS, Jing B, Auerbach A, Wray CM, Lee S, Boscardin WJ, et al. Clinical outcomes after intensifying antihypertensive medication regimens among older adults at hospital discharge. *JAMA Intern Med* 2019;179:1528-36. <https://doi.org/10.1001/jamainternmed.2019.3007>
- Rastogi R, Sheehan MM, Hu B, Shaker V, Kojima L, Rothberg MB. Treatment and outcomes of inpatient hypertension among adults with noncardiac admissions. *JAMA Intern Med* 2021;181:345-52. <https://doi.org/10.1001/jamainternmed.2020.7501>
- Mohandas R, Chamarthi G, Bozorgmehri S, Carlson J, Ozrazgat-Baslanti T, Ruchi R, et al. Pro re nata antihypertensive medications and adverse outcomes in hospitalized patients: a propensity-matched cohort study. *Hypertension* 2021;78:516-24. <https://doi.org/10.1161/HYPERTENSIONAHA.121.17279>