Morning Surge in Blood Pressure
Norman M. Kaplan, MD

S
ome days it just doesn’t pay to get out of bed. As long
recognized, there is an increased risk for heart attack, stroke,
and sudden death in the first few hours of the morning.1,2 In
this issue of Circulation, Kario and colleagues have shown that, as
for strokes, this risk is associated with a morning surge in blood
pressure.3 Among the 519 elderly hypertensives in this study, the
risk of stroke identified by brain MRI was 2.7-fold greater among
the 55 who were in the top decile of the degree of morning surge of
systolic blood pressure compared with the remaining subjects.

See p 1401

For their prospective study, blood pressures were measured by
24-hour ambulatory monitoring and the morning surge was defined
as the difference between the mean systolic blood pressure during
the 2 hours after waking and arising minus the mean systolic blood
pressure during the hour that included the lowest blood pressure
during sleep. This definition of the morning surge provided better
discrimination than other definitions, including the difference be-
tween post-waking and preawakening levels as used by others.4
This definition should be used because the major component of the
morning surge occurs only after arising from sleep and not during
the time between awakening and arising.5

The risk of this morning surge has been seen by others,6 but the
study by Kario et al6 is the largest and most definitive. The risk also
has been noted after arising from afternoon siesta7 so it seems likely
that a sudden rise in pressure poses a risk whenever it occurs.

Mechanism Responsible
Sudden activation of the sympathetic nervous system is the
primary mediator of the morning surge. Increased α-mediated
sympathetic vasoconstriction has been found in normal sub-
jects.8 Whereas arousal from sleep is associated with a slight
rise in plasma epinephrine, arising induces a significant rise
both in epinephrine and norepinephrine.9

Recognition of the Morning Surge
Automatic measurements of blood pressure by ambulatory moni-
toring are required to closely examine the sleep/awake differences.
Unfortunately, ambulatory monitoring is unavailable to most prac-
titioners and patients in the United States, although it is utilized
more in other countries. Now that a small beginning in third-party
reimbursement for ambulatory monitoring has been made in the
United States, the procedure may become more generally available.

In the meantime, much of the clinically relevant information can
be utilized by simply having patients measure their blood pressure
in the early morning, soon after arising.8 Such reading are elevated
in most patients, whether their office readings are <140/90 mm Hg
or not.10 If they are elevated, the need for more effective, long-acting
antihypertensive therapy is established. Moreover, the potential
additional cardiovascular risk of heavy physical activity in the early
morning can be avoided.4

In the study of Kario et al,1 the danger of an early morning surge
was lessened among those who remained on one or another
antihypertensive medication during the 4-year follow-up. Unfortu-
nately, there are virtually no data documenting the ability of such
therapy in general or of specific types of therapy in particular on the
increased risks of cardiovascular catastrophes in the early morning.
Such information should be obtained in all therapeutic trials mea-
suring cardiovascular outcomes.

In the meantime, the clinical inferences of the data by Kario et al
are clear: (1) patients who experience surges of blood pressure after
arising are at risk for stroke and likely other cardiovascular events;
(2) the presence of such surges can be strongly inferred by home
blood pressure measurements; 3) if the early morning blood pressure
is >140/90 mm Hg, additional antihypertensive therapy is
indicated, logically to include formulations that provide 24-hour or
longer efficacy. Even if such formulations are used, early morning
home blood pressure measurements should be checked to ensure
maximal cardiovascular protection.

References
predictor of silent and clinical cerebrovascular disease in elderly hypertensives: a
4. Leary AC, Struthers AD, Donnan PT, et al. The morning surge in blood pressure
and heart rate is dependent on levels of physical activity after waking. J Hypertens.
2002;20:865–870.
5. Khoury AF, Sunderajan P, Kaplan NM. The early morning rise in blood pressure
8. Panza JA, Epstein SE, Quyyumi AA. Circadian variation in vascular tone and its
relation to α-sympathetic vasoconstrictor activity. N Engl J Med. 1991;325:
986–989.
consentrations of healthy humans associated with nighttime sleep and morning
10. Redon J, Roca-Cusachs A, Mora-Maciá J, on behalf of the ACAMPA investi-
gators. Uncontrolled early morning blood pressure in medicated patients: the

Keywords: Editorials ■ blood pressure ■ stroke ■ sleep

© 2003 American Heart Association, Inc.
Circulation is available at http://www.circulationaha.org
DOI: 10.1161/01.CIR.0000060887.83850.46
Morning Surge in Blood Pressure
Norman M. Kaplan

Circulation. 2003;107:1347
doi: 10.1161/01.CIR.0000060887.83850.46
Circulation is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
Copyright © 2003 American Heart Association, Inc. All rights reserved.
Print ISSN: 0009-7322. Online ISSN: 1524-4539

The online version of this article, along with updated information and services, is located on the World Wide Web at:
http://circ.ahajournals.org/content/107/10/1347

Permissions: Requests for permissions to reproduce figures, tables, or portions of articles originally published in Circulation can be obtained via RightsLink, a service of the Copyright Clearance Center, not the Editorial Office. Once the online version of the published article for which permission is being requested is located, click Request Permissions in the middle column of the Web page under Services. Further information about this process is available in the Permissions and Rights Question and Answer document.

Reprints: Information about reprints can be found online at:
http://www.lww.com/reprints

Subscriptions: Information about subscribing to Circulation is online at:
http://circ.ahajournals.org//subscriptions/