

# AF and Hypertension: Is My Home Monitor Fibbing?

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## CardioCase presentation

### Doug's Case

Doug, 70, is a retired foreman and father of 3 from rural Saskatchewan with long-standing hypertension (HTN) who subsequently developed atrial fibrillation (AF). Office BP readings have been "high." His home BP monitor readings range from 116/69 mmHg to 202/102 mmHg with about half of the readings < 135/85 mmHg.

#### Past medical history

- No known MI, stroke, transient ischemic attack or intermittent claudication
- No history of asthma

#### Family and social history

Doug's family and social history is unremarkable save HTN in his mother. He is a non-smoker with minimal alcohol intake.

#### Functional inquiry

- Recent onset of shortness of breath on exertion with walking less than one city block
- Chest discomfort with variable threshold
- Nocturia 1-2 times

#### Physical examination

Doug's exam revealed the following:

- Weight: 83 kg
- BMI: 27.3
- Waist circumference: 95 cm
- Supine apex rate: 84 bpm
- BP: 172/86 mmHg supine, 164/84 mmHg standing
- Chest clear to auscultation
- Cardiac apex not palpable
- Heart sounds are normal (i.e., no extra sounds or murmurs)
- Jugular venous pressure: 2 cm above sternal angle
- Positive hepatojugular reflux
- Ankle edema

#### Home monitor reading

- Pulse: 77
- BP: 152/78 mmHg, a second reading resulted in "error"

**For more on Doug, see page 21.**

## CardioCase discussion

### *What is atrial fibrillation (AF) and why does it occur?*

AF is characterized by rapid, uncoordinated atrial contractions that occur at rates of 350 to 900 per minute.<sup>1</sup> Most impulses are blocked by the atrioventricular (AV) node, so that the ventricles contract 90 to 170 bpm.<sup>1</sup> Triggers of AF include premature ectopic atrial beats and atrial flutter. Diseases or substrates predisposing to AF include:

- diabetes,
- hypertension (HTN),
- congestive heart failure (CHF),
- ischemic heart disease,
- valvular disease,
- MI,
- pulmonary embolism and
- hyperthyroidism.<sup>1,2</sup>

HTN is the most common underlying etiology, being found in 35% of cases of AF.<sup>2</sup> Pathophysiologically, AF develops due to raised atrial pressure causing:

- enlargement,
- atrial hypertrophy,
- myocardial ischemia,
- fibrosis,
- inflammation and
- infiltration.<sup>2</sup>

### *Epidemiology and significance of AF*

AF is the most common arrhythmia in adults.<sup>1,3,4</sup> Its prevalence increases with age—the median age at onset being 75.<sup>3</sup> Men are affected more commonly than women so that 9% of men and

5% of women over 65-years-of-age have AF. These figures are likely an underestimate due to exclusion of unrecognized, asymptomatic AF.<sup>4</sup> Race also appears to be a predictor of AF; one group of investigators showed Caucasians to be affected approximately four times more often than Asians in a particular geographic region.<sup>4</sup> The presence of AF doubles a patient's risk of CV events. The most significant danger is a five-fold increased risk of stroke.<sup>3,4</sup> This risk is further increased in those with:

- prior stroke,
- HTN,
- diabetes,
- heart failure and
- advancing age.<sup>3,4</sup>

### *Measurement of BP in patients with AF*

It is well recognized that attaining accurate, indirect (cuff) BP readings in patients with AF is



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more difficult, less reproducible and less reliable than in those in sinus rhythm.<sup>5,6</sup> This is largely due to the variation in stroke volume that accompanies such an arrhythmia.<sup>5</sup> Since RR intervals are irregular, the amount of time during which the ventricles fill with blood is variable. This gives rise to variable stroke volumes and by extension, variable systolic pressures. This variability in stroke volume makes it difficult to measure BP accurately—via either manual or automated techniques.<sup>5</sup> As a consequence of these technical challenges, the British Hypertension Society recommends that multiple auscultatory readings be taken in patients with AF.<sup>7</sup>

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It is important to note that the reliability and accuracy of automated BP devices have not been validated in patients with AF.<sup>8</sup> As such, it is important to interpret automated readings in AF with caution.<sup>7,8</sup> Oscillometric systems, now most common, sense the oscillations in arm circumference. It was found empirically that oscillations change in amplitude with changes in cuff pressure. Moreover, the point of maximal oscillation corresponds to mean arterial pressure.<sup>9</sup> The monitor notes this, then calculates systolic and diastolic BP using proprietary algorithms.<sup>9</sup> When the RR interval is variable, the monitor has difficulty finding the point of maximum oscillation. It may give an “error” message or a false reading. We have found that commonly used home and hospital oscillometric BP monitor readings differ from those

## More on Doug...

Although home BP monitoring is usually very useful, it may be less so in patients with AF. Doug was informed that, unfortunately, his home monitor could not be trusted.

He was referred to a cardiologist for exercise testing. He was limited by dyspnea at stage 4 of the Bruce protocol. His heart rate was recorded at 198 bpm and systolic BP at 202 mmHg. He denied chest pain and there were no EKG changes. An ECHO showed good systolic function (ejection fraction 55%), but impaired diastolic function and mild pulmonary hypertension.

Furosemide was increased to 60 mg b.i.d. and timolol to 20 mg b.i.d; his symptoms improved. Subsequent clinic BP readings were under 140/90 mmHg, averaging multiple readings. His resting apex rate was 60-70 and his exercise heart rate around 100 bpm. His INR remains between 2.0 and 3.0.

obtained by a reliable observer using a mercury sphygmomanometer by up to 40 mmHg (unpublished observations). Clinicians should be mindful of this when interpreting home monitor readings such as those reported by AF patients like Doug.

Multiple auscultatory readings should be taken in these patients, especially in a hypertensive such as Doug where accurate BP readings are essential to proper patient management.

## Management of AF in hypertensive patients

Many studies have shown rate control to be as effective as rhythm control in reducing mortality and morbidity in patients with AF. Usually

$\beta$ -blockers, with or without digoxin and calcium antagonists, are used. As mentioned above, HTN is the leading cause for the development of AF in the US.<sup>10</sup> There are four main areas which need to be addressed in treating anyone with AF. These include:

- conversion to sinus rhythm,
- prevention of recurrence of AF,
- control of the ventricular response and
- anticoagulation.

Since Doug is also hypertensive, it is important to be mindful of certain complications which are more likely to occur in AF with superimposed HTN. These include:

- thromboembolism,
- left atrial hypertrophy,
- left ventricular dysfunction (LVD) and
- CHF.<sup>10</sup>

In the case of thromboembolism, hypertensives may be three to five times more likely to suffer from this complication than those with AF and normal BP.<sup>10,11</sup> As such, warfarin should be strongly considered in these patients.

Doug also has clinical findings compatible with CHF, such as:

- dyspnea on moderate exertion,
- positive hepatojugular reflux and
- ankle edema.


Patients on minoxidil usually retain fluid and require a potent diuretic to prevent it. The non-selective  $\beta$ -blocker timolol is useful for controlling Doug's ventricular rate and reducing consequences of heart failure. Often digoxin is necessary as well.<sup>10</sup> To control BP, the potent vasodilator minoxidil and furosemide were used.

## Conclusion

Both HTN and AF are common disorders. It is therefore imperative that clinicians are well-versed in the pathophysiology, diagnosis and management of these conditions. Since HTN can

predispose one to developing AF, it is important to be mindful of this arrhythmia in those with elevated BP. It is also important to understand the special risks that accompany the coexistence of these two conditions in the same individual. These include:

- an even greater risk of thromboembolism than in AF alone,
- left atrial hypertrophy,
- LVD and
- CHF.<sup>10</sup>

Of particular importance is accurate BP recording using mercury or validated aneroid sphygmomanometers. For the moment, automated monitors would seem less useful. 

## References

1. Andrews M, Nelson BP: Atrial fibrillation. Mt Sinai J Med 2006; 73(1):482-92.
2. Rudd JH, Maxwell S, Kendall M: The Causes and Management of Atrial Fibrillation. J Clin Pharm Ther 1996; 21(1):37-43.
3. Chugh SS, Blackshear JL, Shen WK, et al: Epidemiology and Natural History of Atrial Fibrillation: Clinical Implications. J Am Coll Cardiol 2001; 37(2):371-8.
4. Ryder KM, Benjamin EJ: Epidemiology and Significance of Atrial Fibrillation. Am J Cardiol 1999; 84(9A):131R-138R.
5. Watson T, Lip GY: Blood Pressure Measurement in Atrial Fibrillation: Goodbye Mercury?[comment]. [Comment. Journal Article] Journal of Human Hypertension. 20(9):638-40, 2006 Sep.
6. O'Brien E, Waeber B, Parati G, et al: Blood Pressure Measuring Devices: Recommendations of The European Society of Hypertension. BMJ 2001; 322(7285):531-6.
7. Williams B, Poulter NR, Brown MJ, et al: Guidelines for Management of Hypertension: Report of the Fourth Working Party of the British Hypertension Society, 2004-BHS IV. J Hum Hypertens 2004; 18(3):139-85.
8. Stewart MJ, Gough K, Padfield PL: The Accuracy of Automated Blood Pressure Measuring Devices in Patients With Controlled Atrial Fibrillation. J Hypertens 1995; 13(3):297-300.
9. Amooe JN, Vacher E, Murray IC, et al: Effect of The Shapes of The Oscillometric Pulse Amplitude Envelopes and Their Characteristic Ratios on The Differences Between Auscultatory and Oscillometric Blood Pressure Measurements. Blood Press Monit 2007; 12(5):297-305.
10. Kowey PR, Marinchak RA, Rials SJ, et al: Management of Atrial Fibrillation in Patients With Hypertension. J Hum Hypertens 1997; 11(11):699-707.
11. Kannel WB, Abbott RD, Savage DD, et al: Epidemiologic Features of Chronic Atrial Fibrillation:The Framingham Study. N Engl J Med 1982; 306(17):1018-22.