

## A Case of Atrial Tachycardia Sensitive to Increased Caffeine Intake

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### SUMMARY

A 33-year-old Japanese man with atrial tachycardia visited our clinic. He regularly consumed daily alcohol with cola, one cup of regular coffee, and a candy containing 0.7 mg of caffeine per tablet. After stopping his caffeine intake, his arrhythmia ameliorated. Since caffeine might be associated with his arrhythmia, a caffeine load test (equivalent to his daily intake of caffeine) was performed for 4 days. Atrial tachycardia time from a Holter recording was 44.2 minute/day before the caffeine load, compared with 215.2 minute/day during the caffeine load. Plasma caffeine concentration before and during caffeine loading was 3.1 mg/dL and 5.4 mg/dL, respectively. Caffeine use seemed to be an important factor for his atrial tachycardia, since his arrhythmia became worse during caffeine load testing and was ameliorated after the cessation of caffeine. (Int Heart J 2011; 52: 398-400)

**Key words:** Atrial tachycardia, Caffeine, Holter monitoring, Caffeine load test

Caffeine intake is usually safe in most normal subjects and cardiac patients in terms of cardiac arrhythmias. However, there are patients who are caffeine-sensitive and who will experience an aggravation of ventricular or atrial arrhythmias. Reports have described a link between arrhythmia and caffeine use, but a true association between the two is often not demonstrated. In this case report, we present a unique case in that the exacerbation of atrial tachycardia was associated with his caffeine intake. We performed caffeine load test and demonstrated that his arrhythmia became apparent during modest intake of caffeine with non-toxic plasma levels.

### CASE REPORT

A 33-year-old Japanese man visited our clinic for an arrhythmia work-up due to symptoms. The previous week he underwent surgery for a foreskin cyst under lumbar anesthesia after which he experienced recurrent palpitations associated with tachycardia in which heart rate was consistently over 100-110 beats per minute (bpm). Physical examination revealed no remarkable findings except for an irregular rapid heart beat. His BMI was 22.7, his blood pressure was 146/96 mmHg, and a chest X-ray showed no cardiomegaly. Echocardiogram revealed no organic heart disease and a left ventricular ejection fraction of 62.4%. A 12-lead ECG (Figure 1) revealed atrial tachycardia with a mean heart rate of 103 bpm. Further examination revealed a PP interval of 460 msec in V<sub>1</sub> lead. His heart rate decreased to 88 bpm upon application of carotid sinus massage. Subsequent 24-hour Holter monitoring showed frequent atrial tachycardia with heart rates consistently at 110 bpm or greater (Figure 2, upper panel left). The rapid heart rate continued all day as shown in the heart rate periodogram (Fig-

ure 2, upper panel right).

Detailed anamnesis revealed eating habits that included daily consumption of caffeine that involved consumption of alcohol with cola (500 mL/day), one cup of regular coffee, and consumption of 20 tablets of candy containing 0.7 mg of caffeine per tablet (MINTIA Dry Hard: Asahi Food and Health Care Co., Ltd). He reported a significant smoking history of 20 cigarettes per day for 10 years, but that he had stopped smoking. Because of the rapid heart rate and palpitations, metoprolol was initiated at a dose of 40 mg three times daily and his caffeine consumption was terminated within one month of the cardiology work-up. His resting heart rate decreased to approximately 70 bpm within two weeks, after which the metoprolol was discontinued.

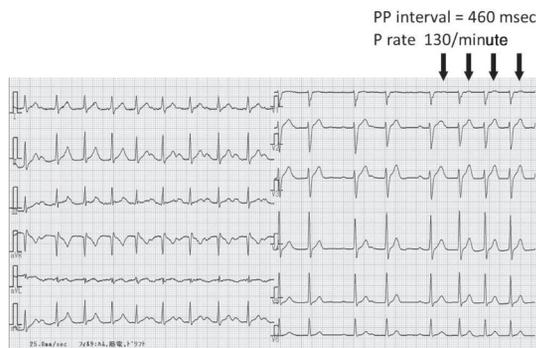
Since the intake of caffeine was suspected as an aggravating factor of his arrhythmia, a caffeine load test was performed after obtaining informed consent. At baseline, 1 day of Holter monitoring was performed when he did not take any cola, coffee, or MINTIA. He then returned to his former pattern of daily caffeine consumption for 4 days including the MINTIA Dry Hard candy, alcohol with cola (500 mL), and one cup of coffee. The mean amount of caffeine consumption was at least 160 mg per day. Holter monitoring was repeated on the 3<sup>rd</sup> and 4<sup>th</sup> day of caffeine loading. Before and during the caffeine load, venous blood samples were taken for the measurement of plasma levels of caffeine (HPLC method). Figure 2 shows representative ECG strips and HR periodograms from 3 Holter ECG studies. In order to quantify his arrhythmia, the duration of atrial tachycardia was calculated every hour for 24 hours for the latter 2 Holter ECG studies. The arrhythmia duration (expressed in minutes) was plotted over 24 hours in Figure 3. Atrial tachycardia occurred more frequently during the days of caffeine load (215.2 minutes/day) than during the days that

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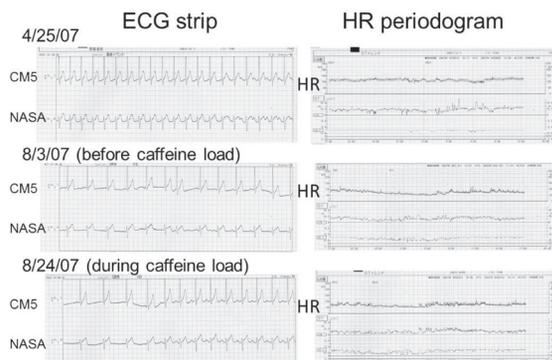
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**Figure 1.** 12-lead ECG on the day of 1<sup>st</sup> visit showing atrial tachycardia with heart rate of 103 beats per minute (bpm). PP interval was 460 msec (P rate of 130 bpm) in V<sub>1</sub> lead.



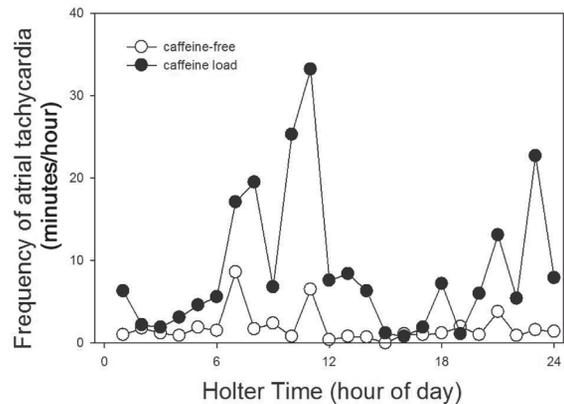
**Figure 2.** Upper panels show ECG strip and heart rate periodogram by Holter monitoring on the day of the 3<sup>rd</sup> visit (2 weeks later). Rhythm strip showed atrial tachycardia with heart rate of 122 beats per minute. Heart rate (HR) periodogram showed a rapid heart rate that lasted all day long. Middle and lower panels show ECG strips and heart rate periodograms by Holter monitoring before and during caffeine load on separate days. Note that during caffeine load, the heart rate was increased with frequent atrial tachycardia.

were caffeine-free (44.2 minutes/day). Plasma caffeine concentration before and during caffeine loading was 3.1 mg/dL and 5.4 mg/dL, respectively. He stopped taking caffeine and he is currently asymptomatic without medication.

### DISCUSSION

Previous studies have pointed out that caffeine overdose causes various kinds of arrhythmias,<sup>1-3)</sup> including atrial tachycardia.<sup>4)</sup> Josephson, *et al*<sup>4)</sup> reported a case of paroxysmal atrial tachycardia in a 42-year-old man with asymptomatic aortic regurgitation, after increased amounts of coffee consumption (30 cups a day) in addition to tea and cola.

The precise underlying mechanisms of caffeine-induced arrhythmia have not been elucidated, but data from both animal and human studies have been obtained. In a canine model, Mehta, *et al*<sup>5)</sup> showed that small doses (1 mg/kg) of intrave-



**Figure 3.** Atrial tachycardia duration expressed as minutes/hour for 24 hours during Holter monitoring is illustrated during no caffeine (open symbol) and during the caffeine load (solid symbol). Atrial tachycardia was consistently higher throughout the day during the caffeine load, and the sum of the total atrial tachycardia duration was 44.2 minutes/day during caffeine-free baseline, and 215.2 minutes/day during the caffeine load.

nous caffeine generated benign arrhythmias due to vagal stimulation, while more severe arrhythmias like ventricular tachycardia, multifocal ventricular premature contraction, atrial flutter, and atrial fibrillation were generated with the higher dose of caffeine (5 mg/kg). Donnerstein, *et al*<sup>6)</sup> investigated the acute effects of caffeine ingestion on signal-averaged ECG in normal subjects. They found that moderate caffeine ingestion (5 mg/kg body weight) produced a small but significant prolongation of signal-averaged QRS complexes. They speculated that further prolongation of QRS complexes may be a factor in the arrhythmias associated with caffeine toxicity. Dobmeyer, *et al*<sup>7)</sup> investigated the effects of caffeine on electrophysiological properties in normal and cardiac patients, and found that caffeine shortened the effective refractory period of the right atrium, atrioventricular node, and the right ventricle, while the left atrial refractory period was prolonged. This effect may be due, in part, to the effect of caffeine to increase cytosolic calcium concentrations by blocking the uptake of calcium into the sarcoplasmic reticulum. This results in an intracellular calcium overload which has been demonstrated to enhance arrhythmogenesis via triggered activity.<sup>8)</sup> Other possible mechanisms of caffeine-induced arrhythmias include; 1) antagonizing effect on endogenous adenosine,<sup>9)</sup> and 2) increasing serum concentration of epinephrine and norepinephrine.<sup>10)</sup> Thus, caffeine consumption may aggravate an existing predilection to arrhythmogenesis in caffeine-sensitive individuals.

Although multiple reports have documented severe cardiac arrhythmias after massive caffeine ingestion,<sup>1,11)</sup> other investigators<sup>12-15)</sup> reported that moderate ingestion of caffeine *does not* increase the frequency or severity of cardiac arrhythmias in normal persons, patients with ischemic heart disease, or those with pre-existing serious ventricular ectopy. Thus, most normal subjects and cardiac patients can enjoy caffeine-containing beverages safely. Nevertheless, there are patients who are caffeine-sensitive and who will experience an aggravation of ventricular or atrial arrhythmias. Caffeine should be taken with caution in such susceptible individuals. We believe that he is

one of such individuals, because his arrhythmia became apparent during modest intake of caffeine with nontoxic plasma levels.

We acknowledge that this case study is limited in that there was 1) no direct evidence of a causal relationship between caffeine and his atrial tachycardia, and 2) no dose-dependency demonstrated. Nevertheless, the association of his atrial tachycardia and caffeine use was demonstrated by the associated amelioration of atrial tachycardia with cessation of caffeine use and the exacerbation of atrial tachycardia with moderate caffeine loading equivalent to his prior consumption. In clinical settings, physicians often link arrhythmia with caffeine use by the patient, but a true association between the two is often not demonstrated. This case is unique in that the exacerbation of atrial tachycardia was associated with his caffeine intake, and the association was strongly suggested by the caffeine load test.

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