Short Sleep Duration Is Associated With a Blood Pressure Nondipping Pattern in Type 1 Diabetes

The DIAPASOM study

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OBJECTIVE — To assess whether nocturnal blood pressure dipping status in type 1 diabetes is correlated with specific sleep characteristics and differences in nocturnal glycemic profiles.

RESEARCH DESIGN AND METHODS — Twenty type 1 diabetic adult patients underwent sleep studies with simultaneous 24-h ambulatory blood pressure monitoring and continuous nocturnal glucose monitoring.

RESULTS — Altogether, 55% of patients exhibited blunted blood pressure dipping. They did not differ from the dipper group in age, BMI, or systolic (SBP) and diastolic (DBP) blood pressure. Total sleep period (TSP) was higher in the dipper group (497 ± 30 vs. 407 ± 44 min for dippers and nondippers, respectively, P < 0.001). TSP was correlated with SBP and DBP day-night differences (r = 0.44 and 0.49, respectively). Periods of nocturnal hypoglycemia (i.e., % of TSP with glycemia < 70 mg/dl) were longer in the dipper group (81 ± 10.7 vs. 0.1 ± 0.4% for dippers and nondippers, respectively, P = 0.02).

CONCLUSIONS — Dipping status in type 1 diabetes was associated with longer sleep duration and with hypoglycemia unawareness.

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Sleep duration and blood pressure in type 1 diabetes

![Graph](image)

Figure 1—Sleep characteristics related to BP dipping status. Left: TST and sleep architecture in dipper and nondipper type 1 diabetic patients. TST was shorter in nondipper subjects. TST data are mean ± SD. *P < 0.05. Right: Positive correlation between TSP and day-night SBP differences.

**RESULTS**—Of the 20 participants, 9 dipper and 11 nondipper subjects were identified. The two groups did not differ in terms of anthropometrics (age 47 ± 12 years, BMI 26.7 ± 3.2 kg/m²), diabetes characteristics (A1C 8 ± 1%, disease duration 22 ± 10 years, plasma creatinine 87 ± 18 μmol/l, urinary albumin excretion 32 ± 32 μg/min), and 24-h mean SBP (121 ± 17 mmHg), DBP (79 ± 9 mmHg), and HR (71 ± 13 bpm).

Fifty-five percent of subjects exhibited an obstructive sleep apnea syndrome (AHI 22.6 ± 18.2 events/h) without difference in terms of prevalence and severity between dippers and nondippers. TSP and TST, i.e., the sum of all sleep periods assessed by electroencephalogram, were significantly higher in dipper patients (TSP 497 ± 30 and 407 ± 44 min, P < 0.001, TST 425 ± 82 and 356 ± 72 min, P = 0.03, for dippers and nondippers, respectively). Sleep architecture tended to demonstrate more stages 1–2 and less stages 3–4 and rapid eye movement (REM) in nondipper patients (stage 1–2, 65 ± 7 and 71 ± 14%; stage 3–4, 13 ± 6 and 9 ± 8%; REM, 22 ± 4 and 20 ± 7% for dippers and nondippers, respectively, NS). Sleep architecture tended to demonstrate more stages 1–2 and less stages 3–4 and rapid eye movement (REM) in nondipper patients (stage 1–2, 65 ± 7 and 71 ± 14%; stage 3–4, 13 ± 6 and 9 ± 8%; REM, 22 ± 4 and 20 ± 7% for dippers and nondippers, respectively, NS). SBP and DBP day-night differences were significantly correlated with TSP (r = 0.44 and r = 0.49 for SBP and DBP differences, respectively) (Fig. 1).

Nocturnal hypoglycemia was more frequent among dipper subjects (8.1 ± 10.7 and 0.1 ± 0.4% of sleep time spent in hypoglycemia for dippers and nondippers, respectively, P = 0.02). DQOL was significantly impaired in nondipper subjects only for the treatment satisfaction item (82.2 ± 13.5 vs. 63.7 ± 19.3 for dippers and nondippers, respectively, P = 0.03).

Nocturnal mean HR was negatively correlated with TSP (r = −0.53), TST (r = −0.44), and time spent in hypoglycemia (r = −0.56).

**CONCLUSIONS**—Sleep recordings, BP measurements, and continuous glucose monitoring were used together in type 1 diabetic patients. Such a complexity explains the relatively limited sample of patients included. Polysomnography allowed for objectively defining the beginning and end of sleep and then an appropriate classification for dippers and nondippers (11).

To our knowledge, no study has explored the potential link between abnormal nocturnal BP pattern and altered sleep quality in type 1 diabetes. In our work, shorter sleep duration explained 19–24% of the decrease in day-night BP difference (r² = 0.19 and 0.24 for SBP and DBP, respectively) and 28% of the increase in HR (r² = 0.28). Outside the scope of type 1 diabetes, general population studies have demonstrated that short sleep duration habits were associated with increased risk of developing hypertension (12).

We found a high prevalence of sleep apnea among our type 1 diabetic subjects. Although sleep apnea is clearly related to nondipping BP pattern (13), it was not an independent explaining factor for nondipping in our population.

Hypoglycemia unawareness during the night in type 1 diabetic patients is a major concern in disease management. Indeed, convulsions, neurologic aftereffects, and “dead-in-bed” syndrome have been reported in this condition (14). Subjects fail to awake when hypoglycemia occurs at night, in relation with blunted counterregulatory epinephrine level (5).

Other studies suggest that unperceived hypoglycemia occurred in patients with more efficient and more stage 3–4 sleep, without sympathetic activation (15). In our work, patients with dipping status, longer sleep duration, and lower HR presented more unperceived hypoglycemia. A more stable sleep, which is associated with a lower sympathetic activation, could explain these events.

Our study suggests that assessing sleep duration is fully relevant in clinical practice. BP nondipping status should receive particular attention in type 1 diabetic patients with short sleep duration, and hypoglycemia unawareness deserve careful prevention in patients with longer and more stable sleep.

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