Central Sleep Apnea in Cardiovascular Disease

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Abstract

Central sleep apnea (CSA) is a complex disorder of ventilatory control, particularly relevant in patients with cardiovascular diseases (CVD). This review addresses the fundamental mechanisms underlying CSA, its association with cardiovascular disease, and current therapeutic approaches. Respiratory regulation involves behavioral and metabolic control. During sleep, the reduction in behavioral influences makes ventilation more dependent on chemoreceptor-mediated feedback. Instability in this system, commonly described by the concept of *loop gain*, plays an important role in the pathogenesis of CSA. Elevated loop gain produces exaggerated ventilatory responses, hypocapnia, and crossing of the apneic threshold, resulting in periodic breathing patterns such as Cheyne–Stokes respiration, frequently observed in patients with heart failure (HF). CSA may result from mechanisms involving hypoventilation or, more commonly, hyperventilation. In patients with HF, prolonged circulation time and increased chemosensitivity contribute to ventilatory instability. Although obstructive sleep apnea is more prevalent overall, CSA is particularly relevant in patients with heart failure with reduced ejection fraction (HFrEF). CSA has also been associated with increased mortality, irrespective of heart failure status. Treatment strategies primarily involve optimization of cardiac function, followed by targeted respiratory interventions, including continuous positive airway pressure (CPAP), adaptive servo-ventilation (ASV), oxygen therapy, and noninvasive ventilation in selected patients. Recent studies suggest that loop gain may help predict response to CPAP, while specific airflow patterns may correlate with the severity of cardiac dysfunction. Although recent trials have not demonstrated a mortality benefit of ASV, improvements in sleep quality and disease-specific quality of life have been reported. Emerging evidence also suggests a potential relationship between early treatment of sleep apnea and reduced myocardial infarct size. In conclusion, CSA represents an important comorbidity in cardiovascular disease. A growing body of evidence supports increasingly individualized therapeutic strategies.

Keywords: central sleep apnea; heart failure; cardiovascular diseases; respiration

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Centralna apneja u spavanju u kardiovaskularnim bolestima

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Sažetak

Centralna apneja u spavanju (CSA) složen je poremećaj regulacije disanja, osobito važan u bolesnika s kardiovaskularnim bolestima (KVB). Ovaj pregled prikazuje temeljne mehanizme nastanka CSA-e, njezinu povezanost s kardiovaskularnim bolestima te suvremene terapijske pristupe. Regulacija disanja uključuje bihevioralnu i metaboličku kontrolu. Tijekom spavanja smanjenje bihevioralnih utjecaja čini ventilaciju ovisnijom o povratnim mehanizmima posredovanima kemoreceptorima. Nestabilnost tog sustava, koja se često opisuje pojmom *loop gain*, ima važnu ulogu u patogenezi CSA-e. Povišeni *loop gain* uzrokuje pretjerane ventilacijske odgovore, hipokapniju i prelazak apnejičkog praga, što dovodi do periodičkih obrazaca disanja, poput Cheyne–Stokesova disanja, često prisutnog u bolesnika sa srčanim zatajenjem (SZ). CSA može nastati zbog mehanizama povezanih s hipoventilacijom ili, češće, hiperventilacijom. U bolesnika sa SZ-om produljeno vrijeme cirkulacije i povećana kemoreceptorska osjetljivost pridonose ventilacijskoj nestabilnosti. Iako je opstruktivna apneja u spavanju općenito češća, CSA je osobito važna u bolesnika sa srčanim zatajenjem i sniženom ejekcijskom frakcijom (HFrEF). CSA je također povezana s povećanom smrtnošću, neovisno o prisutnosti srčanog zatajenja. Terapijske strategije prvenstveno uključuju optimizaciju srčane funkcije, a potom ciljane respiratorne intervencije, uključujući kontinuirani pozitivni tlak u dišnim putovima (CPAP), adaptivnu servoventilaciju (ASV), terapiju kisikom i neinvazivnu ventilaciju u odabranih bolesnika. Novija istraživanja upućuju na to da *loop gain* može pomoći u predviđanju odgovora na CPAP, dok određeni obrasci protoka zraka mogu korelirati s težinom srčane disfunkcije. Iako novija istraživanja nisu dokazala smanjenje smrtnosti primjenom ASV-a, zabilježena su poboljšanja kvalitete spavanja i kvalitete života povezane s bolešću. Novi dokazi također upućuju na moguću povezanost ranog liječenja apneje u spavanju sa smanjenjem veličine infarkta miokarda. Zaključno, CSA predstavlja važan komorbiditet u kardiovaskularnim bolestima. Sve veći broj dokaza podupire razvoj individualiziranih terapijskih strategija.

Ključne riječi: centralna apneja u spavanju; srčano zatajenje; kardiovaskularne bolesti; disanje

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