Heart rate variability

Heart rate variability (HRV) is the physiological phenomenon of variation in the time interval between heartbeats. It is measured by the variation in the beat-to-beat interval.

Other terms used include: “cycle length variability”, “RR variability” (where R is a point corresponding to the peak of the QRS complex of the ECG wave; and RR is the interval between successive Rs), and “heart period variability”.

See also Heart rate turbulence, Sinus rhythm.

Methods used to detect beats include: ECG, blood pressure, ballistocardiograms, and the pulse wave signal derived from a photoplethysmograph (PPG). ECG is considered superior because it provides a clear waveform, which makes it easier to exclude heartbeats not originating in the sinoatrial node. The term “NN” is used in place of RR to emphasize the fact that the processed beats are “normal” beats.

Patients with craniopharyngioma are susceptible to autonomic dysfunction as a result of hypothalamic dysfunction. Jung et al. evaluated indices of heart rate variability (HRV) in patients with childhood-onset craniopharyngioma to investigate autonomic function and its relationship with components of the metabolic syndrome (MetS). This cross-sectional, case-only study included 53 patients (10-30 years of age). They measured the standard deviation of all normal R-R intervals (SDNN) and total power indicating overall HRV, the root-mean square of the difference of successive R-R intervals (RMSSD) and high frequency indicating parasympathetic modulation, and low frequency. These indices were compared according to the presence of the MetS. During the mean 10.8 years of follow-up, 25% of patients were diagnosed with the MetS. Patients with the MetS showed significantly lower levels of SDNN (29.0 vs. 40.6 ms), total power (416.1 vs. 1129.6 ms2), RMSSD (20.1 vs. 34.5 ms), high frequency (94.7 vs. 338.5 ms2), and low frequency (94.5 vs. 289.4 ms2) than those without ($p < 0.05$, for all). Individual components of the MetS including insulin resistance, serum triglycerides levels, and systolic blood pressure were inversely associated with SDNN, total power, RMSSD and high frequency. Higher overall variability and parasympathetic modulation were related to decreased odds ratios for having the MetS (OR 0.91, $p=0.029$ for SDNN; OR 0.91, $p=0.032$ for total power). In conclusion, autonomic dysfunction, as evidenced by reduced HRV indices, is associated with increased cardiometabolic risk in patients with childhood-onset craniopharyngioma [1)].

A total of 50 patients with newly diagnosed insular glioma in the age group of 18-60 year, were evaluated with heart rate variability (HRV). All the HRV parameters in patients with insular glioma were compared with normal healthy age and gender matched controls.

There was a significant difference (p-value < 0.05) in most of the HRV parameters between patients and controls. Patients with left insular glioma showed significantly increased heart rate ($p =0.027$), LF nu ($p=0.048$), and also increased LF/HF ($p=0.015$), which indicates sympathetic dominance. Patients with seizures had significantly lower values of total power ($p=0.042$). No significant difference was found in terms of the extent and size of the tumor or histopathological grades of gliomas.

Patients with insular gliomas have significant impairment of autonomic functions with left insular

glioma showing sympathetic dominance. Suppression of autonomic function is more in those presenting with seizures [2].

Autonomic impairment, as measured by heart rate variability and baroreflex sensitivity, is significantly associated with increased mortality after traumatic brain injury. These effects, though partially interlinked, seem to be independent of age, trauma severity, intracranial pressure, or autoregulatory status, and thus represent a discrete phenomenon in the pathophysiology of traumatic brain injury. Continuous measurements of heart rate variability and baroreflex sensitivity in the neuromonitoring setting of severe traumatic brain injury may carry novel pathophysiological and predictive information [3].

1)
Jung HW, Kim HY, Kim JY, et al. Autonomic Dysfunction is Associated with Increased Cardiometabolic Risk in Patients with Childhood-Onset Craniopharyngioma [published online ahead of print, 2020 Jun 8]. Horm Metab Res. 2020;10.1055/a-1169-0307. doi:10.1055/a-1169-0307
2)
Mishra A, John AP, Shukla D, Sathyaprabha T, Devi BI. Autonomic Function In Insular Glioma - An Exploratory Study. World Neurosurg. 2018 Jul 20. pii: S1878-8750(18)31585-7. doi: 10.1016/j.wneu.2018.07.107. [Epub ahead of print] PubMed PMID: 30036712.
3)
Sykora M, Czosnyka M, Liu X, Donnelly J, Nasr N, Diedler J, Okoroafor F, Hutchinson P, Menon D, Smielewski P. Autonomic Impairment in Severe Traumatic Brain Injury: A Multimodal Neuromonitoring Study. Crit Care Med. 2016 Mar 10. [Epub ahead of print] PubMed PMID: 26968025.