KALP BİR POMPADAN ÖTE BİR ŞEY OLAMAZ MI?

COULDN’T HEART BE MORE THAN A PUMP?

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Anahtar kelimeler: SA nod, kalp nakli, nörokardiyak etkilesim, duygudurum

Keywords: SA node, heart transplantation, neurocardiac interaction, emotion

ÖZET

Kalp nakilinde meydana gelen kişilik değişiklikleri, kalp ve beyin arasındaki karşılıklı iletişim, REM (rapid eye movement) uyku sırasında kardiyovasküler düzenlemeye amgadanın rolü, yine REM uyusunun gelişmesiyle olan beyinde nöron gelişimi ve hafıza konsolidasyonu üzerindeki etkileri, atriyal ve beyin natriüretik peptitlerin çeşitli etkileri ve kardiyak nóral krista hücrelerinin kalp gelişimindeki rollerine dayanarak bu çalışmada kalbin ve özellikle SA (sinoatriyal) düğümün emosyonel hafıza işleme ve saklanamada etkin olabileceği hipotezini öne sürdüm. Bunun da ötesinde SA düğümüne yapılacak çeşitli müdahalelerin, altında istenmeyen anların ve yaşam deneyimlerinin yatıkı düşünen bazı psikiyatrik hastalıklarda tedavi amaçlı olarak kullanılabileceği önerisi de tartışıldı.

ABSTRACT

Based on the 1) personality changes observed following heart transplantations; 2) the two-way, dynamic, ongoing dialog between the brain and the heart and its reflection as alterations in heart rate variability; 3) the prominent role of amygdala in cardiovascular regulation during rapid eye movement sleep and 4) the importance of rapid eye movement sleep in the developing brain to establish proper neuronal circuits and its memory consolidation effect; 5) the role of cardiac neural crest cells in heart development and 6) the effects of Atrial and Brain Natriuretic Peptides; I hypothesize that the heart, particularly the SA node, could function in emotional memory processing and storage in collaboration with related brain regions. Moreover, intervention to SA node in certain psychiatric diseases with underlying unwanted memories and life experiences could be a novel choice of therapy.
expression(2); amygdala lesions cause impairments in emotional learning(3), deficits in the perception of emotions in facial expressions(4), and impaired memory for emotional events(5).

Neurocardiac interaction is assessed by heart rate variability (HRV) and reflects heart-brain interactions. HRV is a measure of the naturally occurring beat-to-beat changes in heart rate. Recent research conducted at the Institute of HeartMath has demonstrated that HRV dynamics are particularly sensitive to changes in emotional state reflected by changes in heart rhythm patterns with positive and negative emotions(6). Moreover, it was reported that amygdala seems to take prominent role in cardiovascular regulation during rapid eye movement sleep (REMs) (7). Amygdala is also reported to be one of the most active brain regions during REMs (8). There are three theories concerning the functions of REMs. According to the Ontogenetic Hypothesis of REM sleep, this sleep phase (also known as Active Sleep in neonates) is particularly important to developing brain to establish proper neuronal circuits. That's why babies spend as much as 50 percent of their sleep in REMs. If we think the importance of emotions in early life learnings, one could suggest that emotional processing in REMs plays crucial roles in neural development. Moreover studies investigating the effects of Active Sleep deprivation have shown that deprivation early in life can result in behavioral problems, permanent sleep disruption, decreased brain mass (9).

The other theory about REMs suggests that REM sleep is important for consolidation of procedural and spatial memories. Furthermore, numerous studies have provided evidence for the efficacy of eye movement desensitization and reprocessing therapy (EMDR) in the treatment of posttraumatic stress disorder (10).

**THE HYPOTHESIS**

Taken together, I hypothesize that the heart, particularly the SA node, could function in emotional memory processing and storage in collaboration with related brain regions. Heart's contribution to brain's emotion processing circuitry could develop as follows: In early years of life, babies spend most of their time sleeping with a predominance of REM sleep. During this long periods of REM sleeps, emotions that are processed in certain brain regions are transferred and stored in the heart, particularly SA node. Since the basics of personality, intellectual capacity and learning are structured with the strong support of emotions in early years of life, and even in prenatal life; SA node is continuously encoded by brain regions such as amygdala in long REM periods of long babyhood and childhood sleeps. And in adulthood, SA node mostly gains its autonomy in emotional responses via its repertory of emotional memory stored mostly till adulthood. After adulthood, encoding and storage goes on but in a slower rate. Furthermore heart could be the final decision center of behavioral responses to the data obtained from emotional processing. The emotional data stored in the heart, particularly SA node, could be the principal guide shaping our behavioral responses. In this heart-based emotional processing period, the related regions in the brain should be acting as a receptor and co-player. Emotional processing takes place in the brain, but brain should be asking to the heart before any action. Perhaps the emotional data stored in the heart, SA node, is the thing we call conscience.

Here, it is worth to remind the role of cardiac crest cells in heart development (11). Myocardial expression of various neural markers were found to be expressed in regions containing the conduction system (12, 13). In addition, those cells' novel role in heart development has also been documented by Wald et al (14). Therefore it makes sense to propose a strong neural function for particularly the conduction system. Another evidence supporting the current hypothesis could come from the surprising set of diversified functional properties of natriuretic peptides. Shortly after the discovery of atrial natriuretic factor by Bold and colleagues(15), its detailed chemical structure and fundamental effects were described and then called as Atrial Natriuretic Peptide (ANP). Another peptide called Brain Natriuretic Peptide (BNP) was initially purified from the brain. But it is present at the highest concentration in the heart(16). The behavioral effects of ANP and BNP were studied extensively by Bidzseranova et aI(17-24) and found that this cardiac peptides play active roles in emotion-memory-behavior circle. Furthermore ANP was found to inhibit hypotalamic pituitary adrenocortical system(25) and has been demonstrated to exhibit anxiolytic activity(26). In other words, heart could be more than a pump.

In conclusion, potential evidences could be; 1) the functional and anatomical links between brain regions functioning in emotional processing such as amygdala and other related structures and the heart(1, 7, 27); 2) the concept of cellular memory; 3) reflection of the...
relation between emotional states and the heart as alterations in HRV(28-31), since heart rate is initiated and mainly regulated by SA node; 4) the role of neural crest cells in heart development; 5) the effects of ANP and BNP; and 6) personality changes following heart transplants(32, 33).

To test the hypotheses; it makes sense to perform an intervention to SA node in certain psychiatric diseases with underlying unwanted memories and life experiences. Foreexample, a behavioral study could be performed with rats grown up in stressful conditions from prenatal period to adulthood. Then their behaviors could be observed in an unstressful environment with a group of normally grown up rats. Following this, rats with previous stresses that show stress-related behavioral patterns could undergo some interventions in order to normalize their agitated responses. The intervention could be a local electric shock or interruption of certain neural circuits in the heart. Furthermore, SA node transplants could be performed. If it works, it means that the stressful emotional data in SA node is erased or could be replaced.

Moreover, to test the autonomy of SA node; certain stresses and the object's responses to those stresses before adulthood could be recorded. After adulthood, emotion-related brain regions like limbic lobe could be removed and its responses to same stresses could be observed in order to investigate the heart's, particularly SA node’s predominance in responses to certain emotional stimuli.

**CONCLUSION**

Active and integrated role of the heart with the brain in emotional responses via functional and anatomical links, and ongoing explorations about the heart's role in emotional functions should be assessed as encouraging factors to find novel therapeutic approaches for certain psychiatric diseases. Since human's behavioral patterns are very complex, it is very hard to explain results of animal experiments, and to apply to human. But if we consider the increasing incidence of psychiatric disorders all over the world and the insufficiency of current therapies; every effort and idea should be evaluated deeply to find new treatment options.

**REFERENCES**

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