

CONCLUSION

In the present study, repeated exposure to EMR-2450 MHz (3G and Wi-Fi) produced neurological disorders such as stress, anxiety-like behavior, depressive-like symptoms and cognitive deficits. Long term exposure of EMR-2450 MHz altered the hemodynamics of highly perfused organs such as liver, GIT and heart in rats. EMR-2450 MHz altered the liver function and modulated the pharmacological effect of fluoxetine. Exposure of EMR-2450 MHz produced severe gastric ulcers, altered H^+K^+ ATPase activity and modulated the pharmacological effects of omeprazole. EMR-2450 MHz reduced cardiac performance by altering HR, MAP and ECG interpretation. EMR-900 and 1800 MHz did not change in the functions of brain and other biological system (depicted in figure 6.1).

Long term exposure to EMR caused activation of HPA axis which was observed through increased plasma corticosterone level and decrease of GRs, CRH-2 expression in amygdala. Reduced GRs activity lead to mitochondrial dysfunction which was observed as a decreased mitochondrial complex enzyme activities and loss of integrity in amygdala. The altered mitochondrial function lead to activation of intrinsic activity by altering the expression of Bax, Bcl₂ and cytochrome-c in cytoplasm activates pro-apoptotic caspase-9 in amygdala. Cell death was observed as a change in the intact structure of amygdala by histopathology. Thus, the long term exposure to EMR-2450 MHz led to the development of stress induced anxiety-like behaviour in experimental animals.

Further, long term exposure to EMR-2450 MHz induces depressive-like symptoms in rats by altering both vascular as well as neuronal functions in PFC. EMR-2450 MHz by decreased blood flow and VEGF level in PFC. Decreased vascularity in PFC leads to the necrotic damage of monoaminergic neurons and also the reduction in

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the release of BDNF. Therefore, long term exposure to EMR caused depressive-like symptoms in rats.

Repeated exposure to EMR-2450 MHz increased expression of A β and decreased cholinergic neurotransmission in the hippocampus, which are considered to be important factors for the development of cognitive deficits. EMR-2450 MHz caused decreased mitochondrial function and cholinergic neurotransmitter abnormalities in hippocampus. Mitochondrial dysfunction was assessed as decrease in complex activity, mitochondrial membrane potential in the hippocampus. Decreased mitochondrial stress lead to release of cytochrome-c into cytoplasm which activates expression of caspase-9/3 causing apoptosis. Therefore, exposure to EMR-2450 MHz caused learning and memory deficits in experimental animals. Overall EMR-2450 MHz altered the neurobehavioral performance indicating stress related anxiety, depressive-like symptoms and learning and memory deficits in experimental rats.

Repeated exposure of EMR affected the pharmacological activity of antidepressant. In the present objective long term exposure to EMR-2450 MHz decreased CYP2D6 level in liver as well as PFC. This lead to altered metabolism, pharmacokinetics of FLX and hepatic function in rats.

Long term exposure to EMR-2450 MHz decreased gastric hemodynamic activity, lead to altered defense mechanism of GIT causes gastric ulcer in rats. Decreased vascular activity in GIT lead to increased oxidative stress including activation of cytokines level in terms of increase in TNF- α , IL-6 and decrease in IL-10. It caused necrosis and cytoarchitectural changes of the stomach in rats. Treatment with supratherapeutic dose of omeprazole-30 mg/kg increased gastric hemodynamic and vascularity of GIT by increasing blood flow and VEGF in EMR exposed rats. OMZ-30

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mg/kg reduced level of inflammatory cytokines and maintained the cytoarchitecture of stomach in EMR-induced gastric ulcer.

EMR-2450 MHz causes alterations in the preliminary function of heart as indicated by an increase in HR, MAP and altered ECG interpretation lead to ventricular tachycardia and decrease in cardiac blood flow lead to ischemic-like condition as well as the loss of cardiac integrity of rats. ECG changes indicate that, long term exposure to EMR caused ventricular tachycardia in experimental rats. In the present study, EMR shows frequency dependent effect i.e., EMR 2450 MHz (Higher frequency) causes radiotoxic effects on brain and biological systems. However, EMR-900 and 1800 MHz (Lower frequency) did not modulate brain function and biological systems.

Therefore, the present finding suggested that, the severity of several diseases increase stress related anxiety, depressive-like behavior, learning memory deficits, liver toxicity, gastric ulcer and cardiac dysfunction with frequency and duration of EMR. Furthermore, as detrimental effects of EMR are frequency based switching to 4G (2600 MHz) or 5G (5925 MHz to 7150 MHz) can have worsening effects at a faster pace. These pathophysiological parameters can act as a guide to medical practitioners while diagnosing EMR affected patients. Further clinical studies are required for validating the effect of EMR in the humans.

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6.1 Conclusions are drawn from the present study

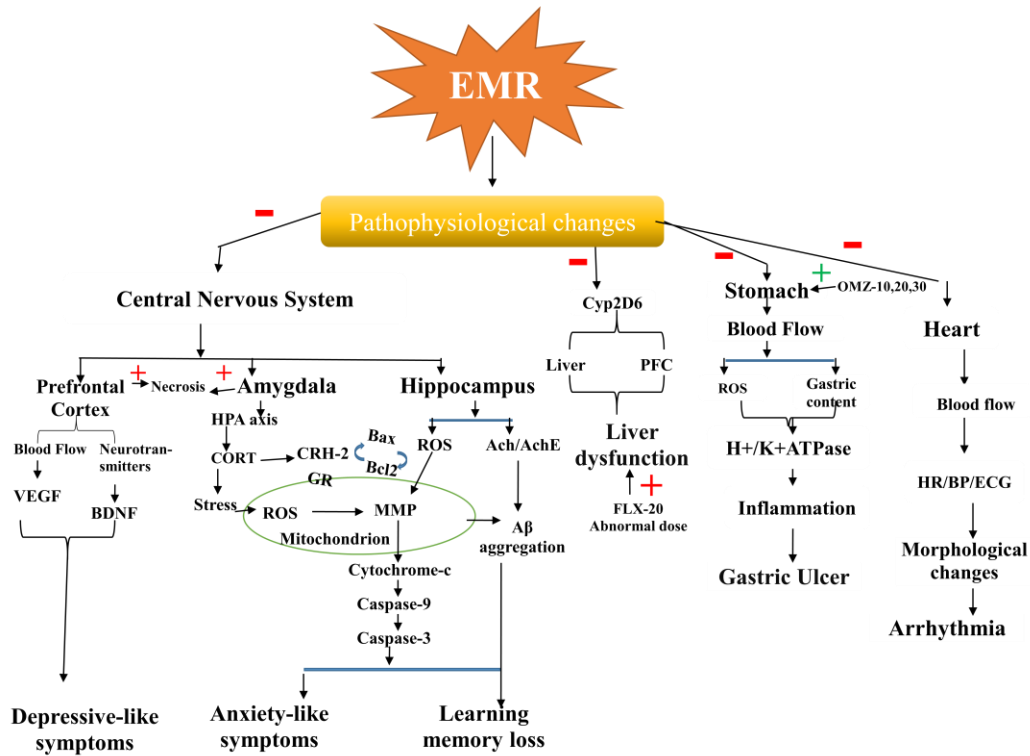


Figure 6.1 Conclusion [+ = activation; - = inhibition].

Hence it can be concluded that, repeated exposure of EMR-2450 MHz induces neurological disorders including stress induced anxiety-like behavior, depressive-like symptoms, learning and memory deficits. EMR-2450 MHz caused gastric ulcer which was improved by omeprazole-30 mg/kg. Long term exposure to EMR-2450 MHz alters the pharmacokinetics of high dose of fluoxetine causing liver toxicity by reducing activity of CYP2D6. It alters function of heart and causes ventricular tachycardia in rats. Therefore, the study indicated that the development of newer mobile phones and Wi-Fi should utilize technologies which make use of lower frequency as this can minimize the pathophysiological effects on biological systems.

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Summary

- ❖ EMR-2450 MHz causes
 - Stress and anxiety-like symptoms in rats.
 - Depressive-like symptoms in rats
 - Cognitive deficits in rats
- ❖ Long term exposure to EMR-2450 MHz reduces CYP2D6 in liver and PFC and alters pharmacokinetics of fluoxetine lead to liver toxicity in rats.
- ❖ Long term exposure to EMR-2450 MHz causes severe gastric ulcer in rats.
- ❖ Long term exposure to EMR-2450 MHz causes ventricular tachycardia in rats.

Limitations

The current research has some limitations. The extrapolation of the current results from rodents to human related to cell phone usage, pathophysiology and treatment effect are challenging tasks.

Recommendations

There are individuals who are more susceptible to electromagnetic radiation among us than the general population. Therefore, we need an intensive investigation and evaluation of the clinical studies for the validating the effect of EMR in the humans. All these pathophysiological parameters used in current study can serve as a reference for the diagnosis of EMR affected patients by medical practitioners.