Conclusion

Liver regeneration is a compensatory hyperplasia and hypertrophy that occurs as a response to viral or toxic liver injury or hepatic resection. The ability of hepatocytes to undergo cellular growth and proliferation during regeneration, while continuing to carry out their metabolic tasks, makes possible a relatively gradual restoration of the delicate homeostatic equilibrium even after serious insult to the liver. Disturbances in metabolism result in neurological dysfunctions and structural changes in the CNS. Thus achievement of enhanced liver cell proliferation with simultaneous neuronal maintenance by GABA and 5-HT chitosan nanoparticles is the present focus. The proliferative signalling through GABA\(B\) and 5-HT\(2A\) receptors associated second messengers and transcription factors activated liver cell division. Our study showed a decreased expression of apoptotic factors - Bax and caspase-8 in both liver and brain regions, supported active liver cell multiplication and neuronal maintenance. Increased expression of growth factors - HGF and IGF-1 confirmed enhanced cell proliferation in injured liver. Restoration of GABAergic and serotonergic neurotransmissions in cerebral cortex, corpus striatum and brain stem was observed in the rats treated with GABA and 5-HT chitosan nanoparticles. Neuronal survival mechanisms in brain regions were activated with progressive liver cell proliferation associated restoration of metabolic functions. This was studied by examining the expression patterns of NF-\(\kappa\)B, TNF-\(\alpha\), Akt-1, IGF-1, BDNF and GDNF. Functional disturbances in neurons of corpus striatum affected motor coordination in partially hepatectomised rats. The rotarod, grid walk and narrow beam tests gave a clear idea of regaining motor control in rats treated with GABA and 5-HT chitosan nanoparticles. Thus our results conclude the regenerating ability of GABA and 5-HT chitosan nanoparticles and successive increase in neuronal survival which has a novel therapeutic role in the management of liver diseases.
Partial hepatectomy

Regeneration without treatment
- DNA and protein syntheses
- $\text{GABA}_A$ receptors
- $5-HT_{2A}$ receptors
- CREB, PLC
- Apoptotic factors

DNA and protein syntheses
$\text{GABA}_A$ receptors
$5-HT_{2A}$ receptors
CREB, PLC
Apoptotic factors

Regeneration with GABA and 5-HT chitosan nanoparticles treatment

Slow proliferation of liver cells
Active liver cell proliferation
Liver injury induced brain damage

No treatment

GABA\textsubscript{A} receptors
5-HT\textsubscript{2A} receptors
Apoptotic factors
Neuronal survival factors

Decreased neuronal survival and motor activity

GABA and 5-HT chitosan nanoparticles treatment

GABA\textsubscript{A} receptors
5-HT\textsubscript{2A} receptors
Apoptotic factors
Neuronal survival factors

Increased neuronal survival and motor activity