All Figures Test Compilation

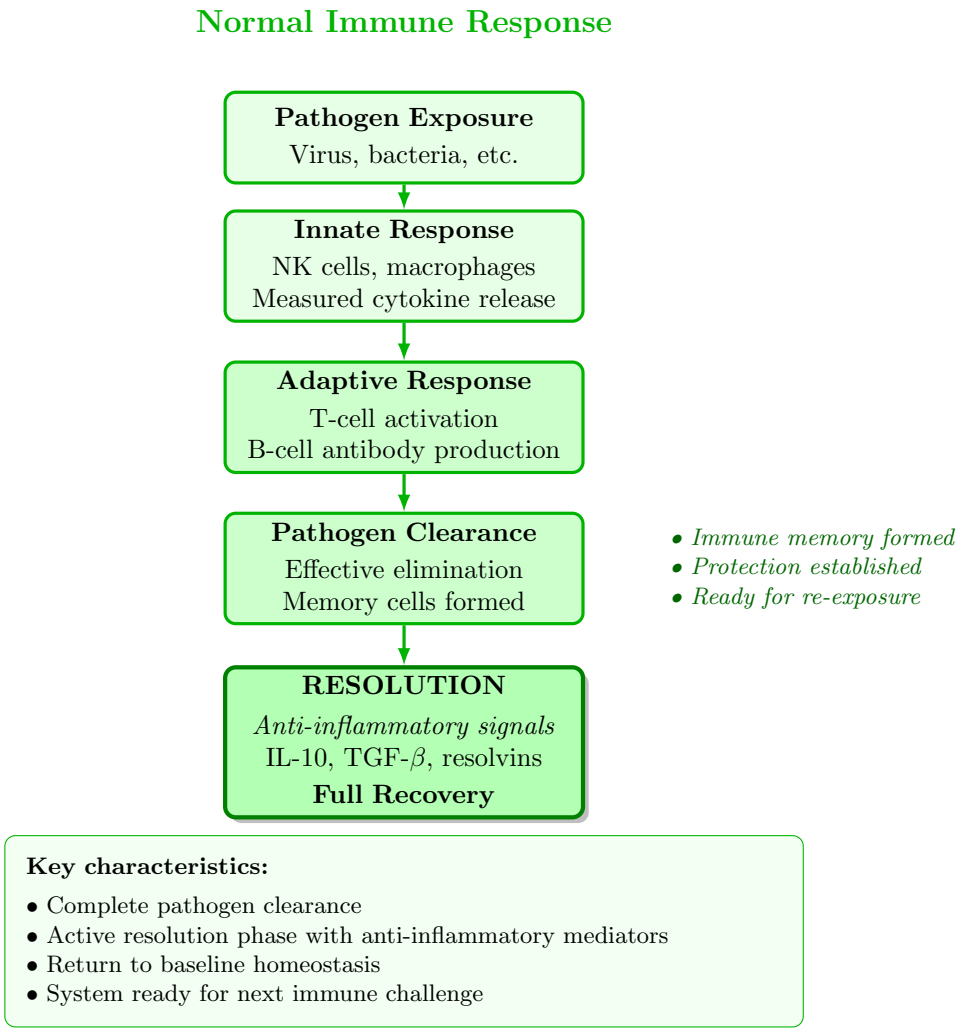


Figure 1: Normal immune response with appropriate activation and resolution.

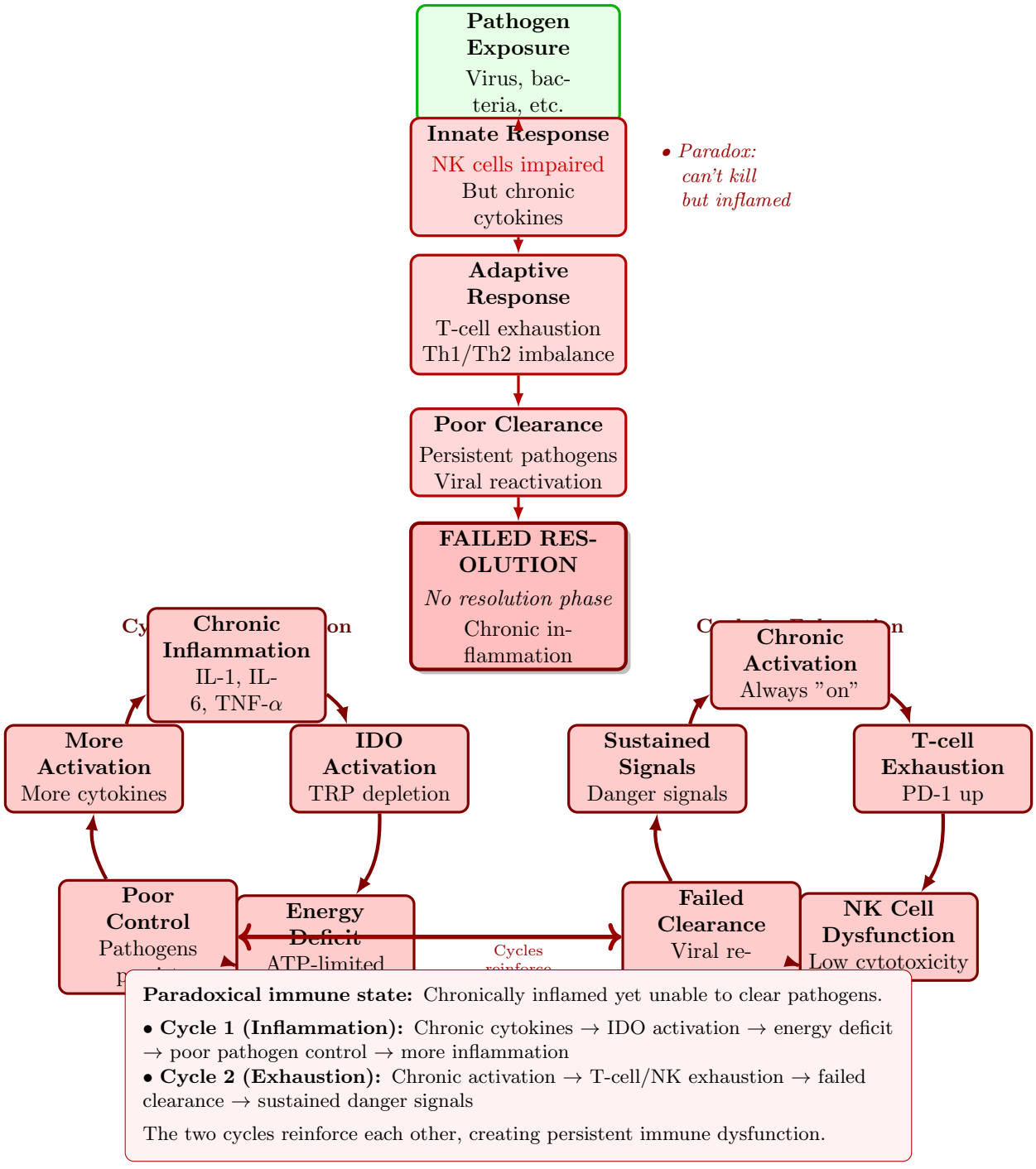


Figure 2: ME/CFS immune dysfunction with chronic inflammation and exhaustion cycles.

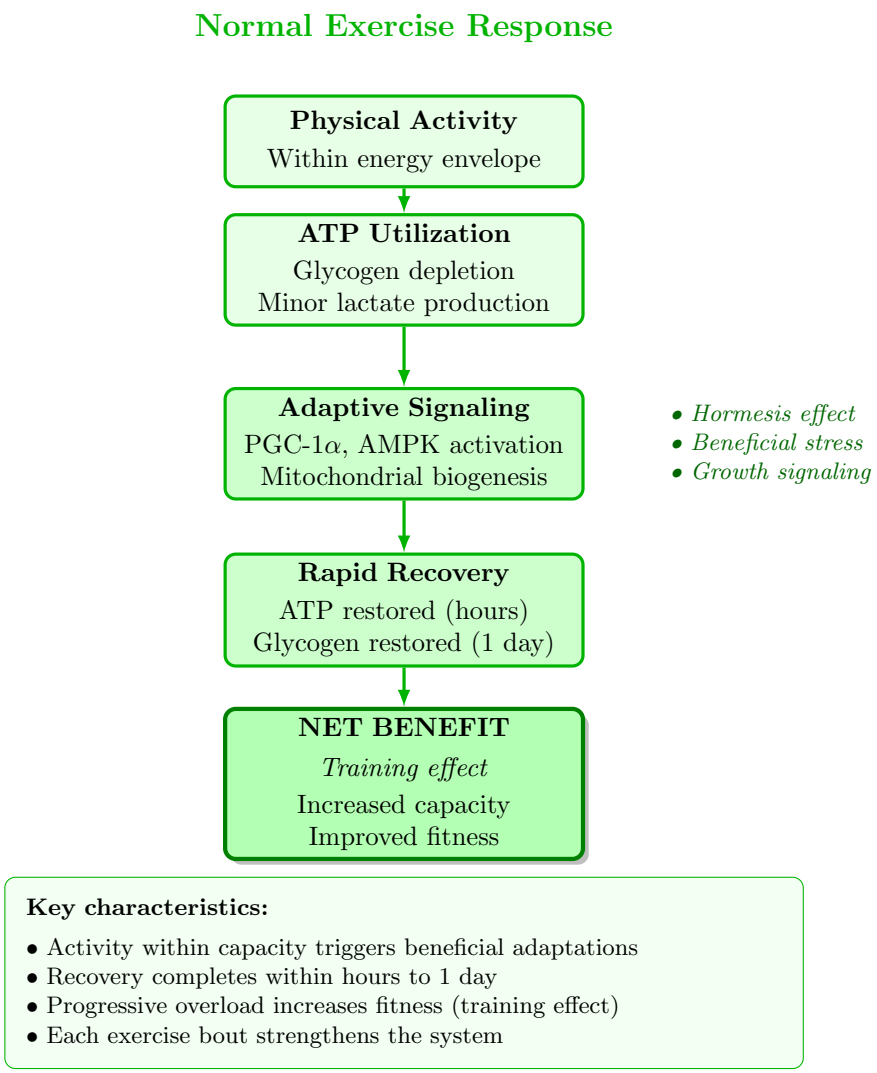


Figure 3: Normal exercise response with adaptive signaling and rapid recovery.

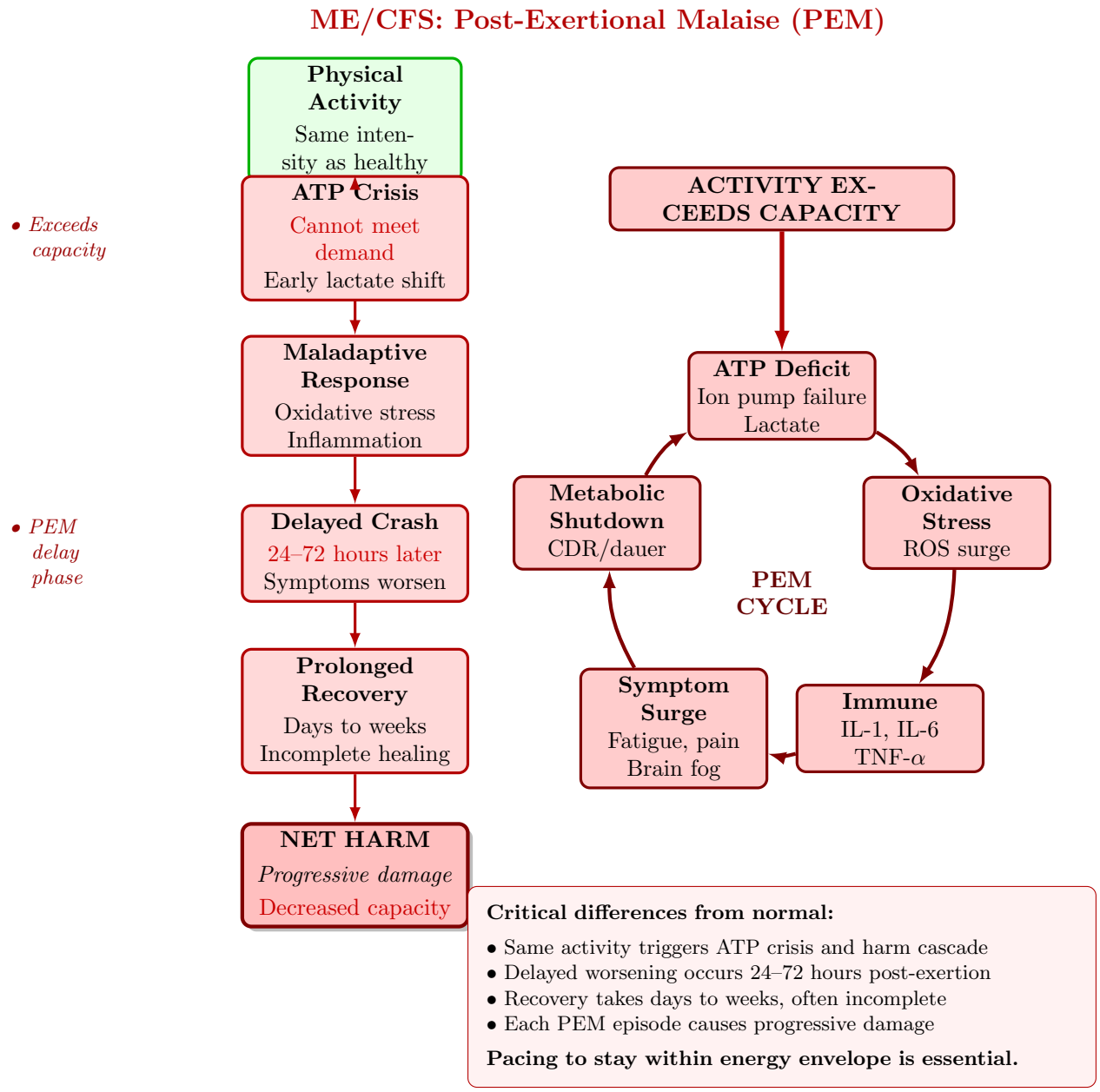
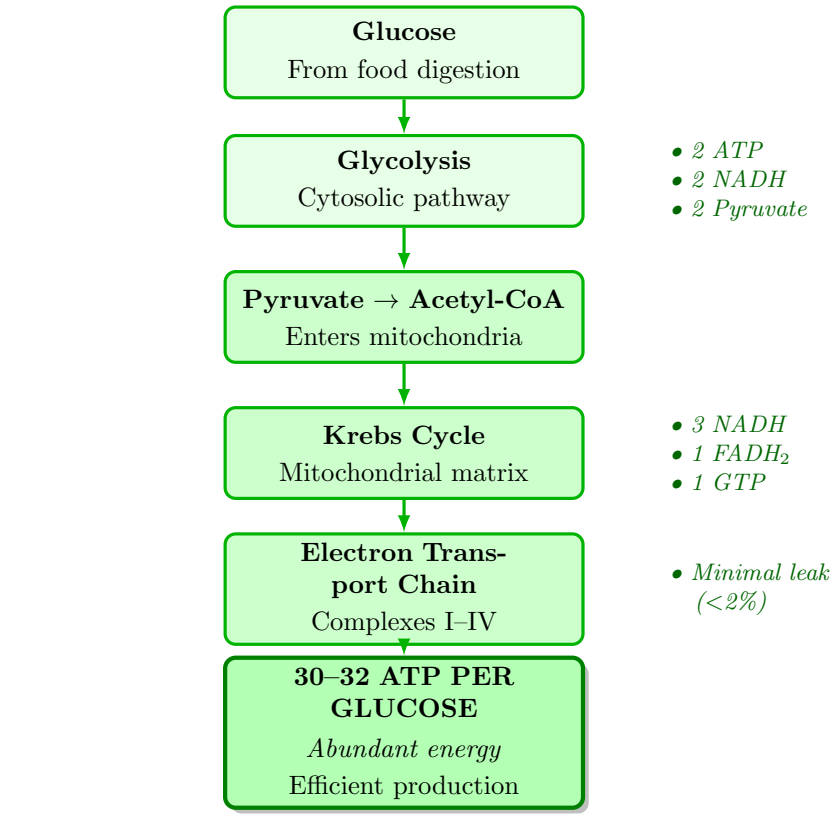


Figure 4: ME/CFS post-exertional malaise mechanism with harmful vicious cycle.

Normal Cellular Energy Production

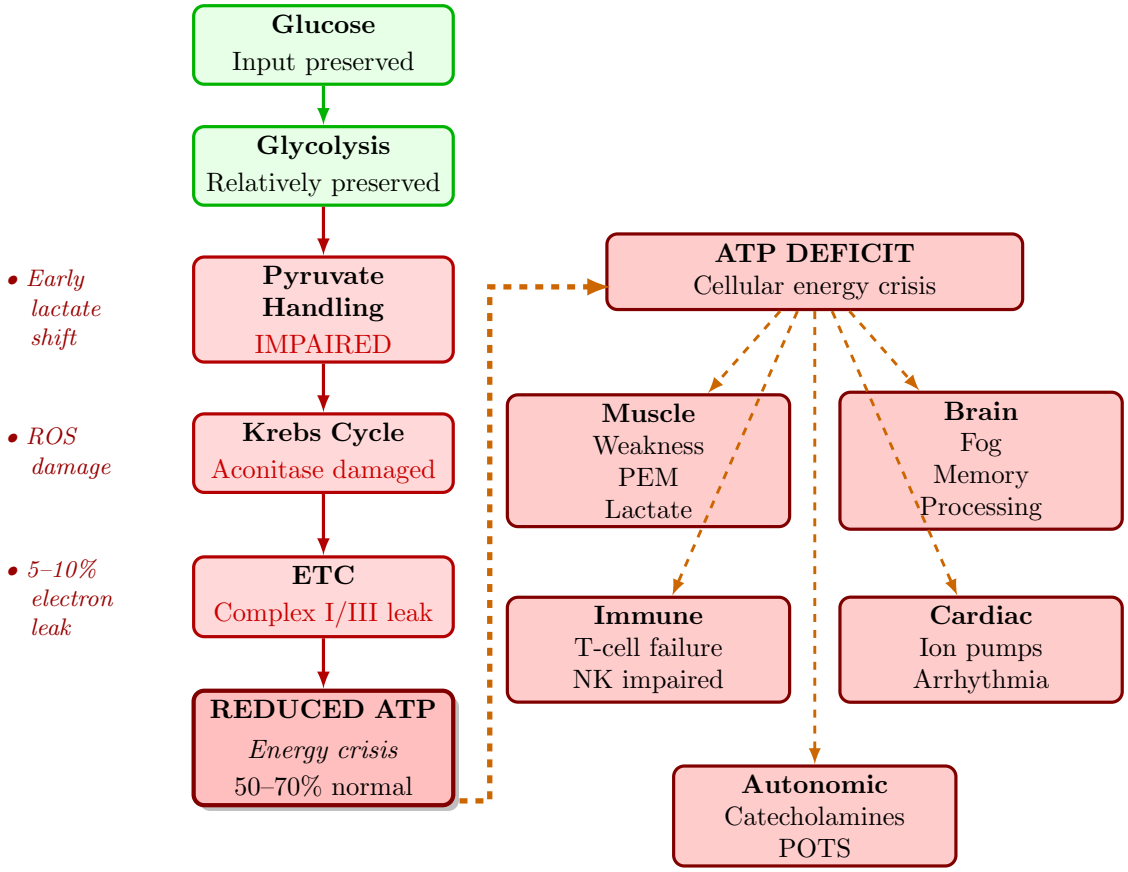


Key characteristics:

- Efficient conversion: 30–32 ATP per glucose molecule
- Minimal electron leakage (<2%) in healthy mitochondria
- NADH and $FADH_2$ efficiently deliver electrons to ETC
- Meets all cellular energy demands consistently

Figure 5: Normal cellular energy production pathway.

ME/CFS: Impaired Energy Production



Multiple dysfunction points:

- Early lactate shift: Pyruvate cannot efficiently enter mitochondria
- Krebs cycle impairment: Aconitase inactivation by oxidative stress
- ETC dysfunction: 5–10% electron leak (vs. <2% normal)

Result: 50–70% ATP reduction causes system-wide failures. This is not "tiredness" but an active cellular energy crisis affecting every ATP-dependent process.

Figure 6: ME/CFS energy production dysfunction and systemic consequences.

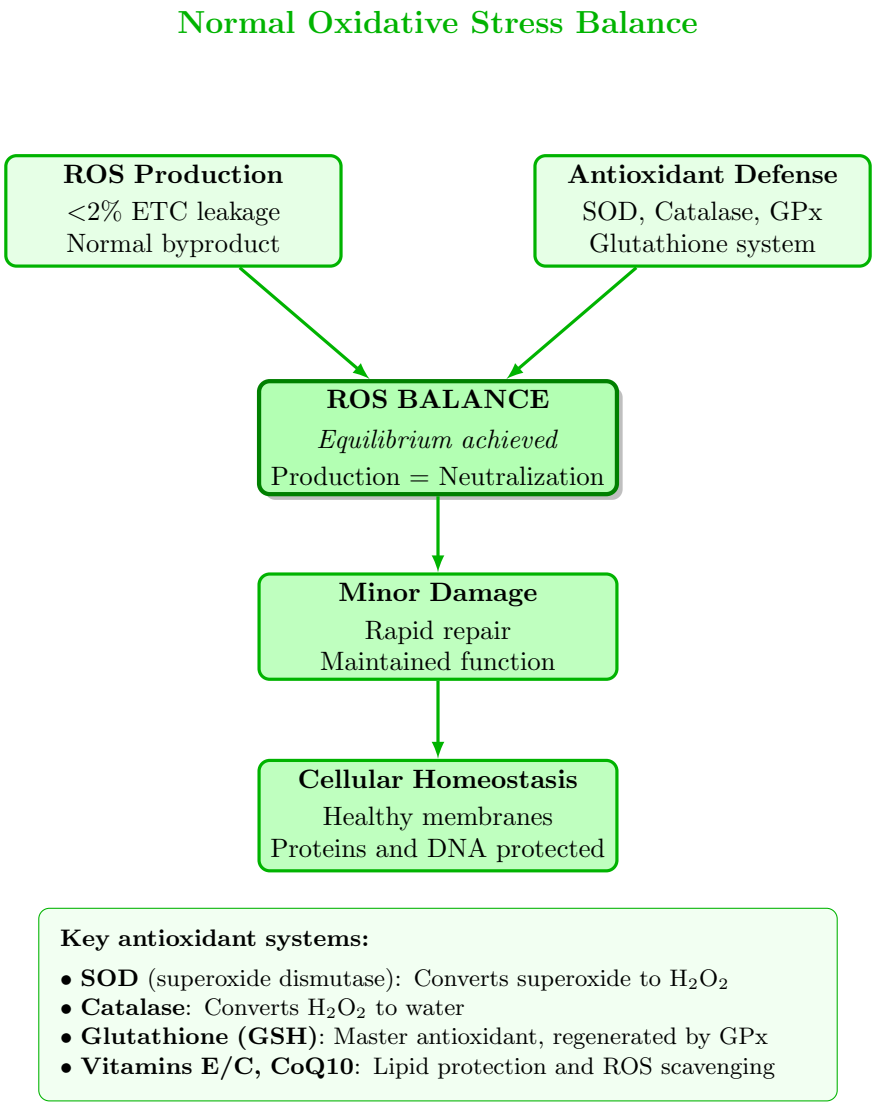


Figure 7: Normal oxidative stress homeostasis with balanced ROS production and neutralization.

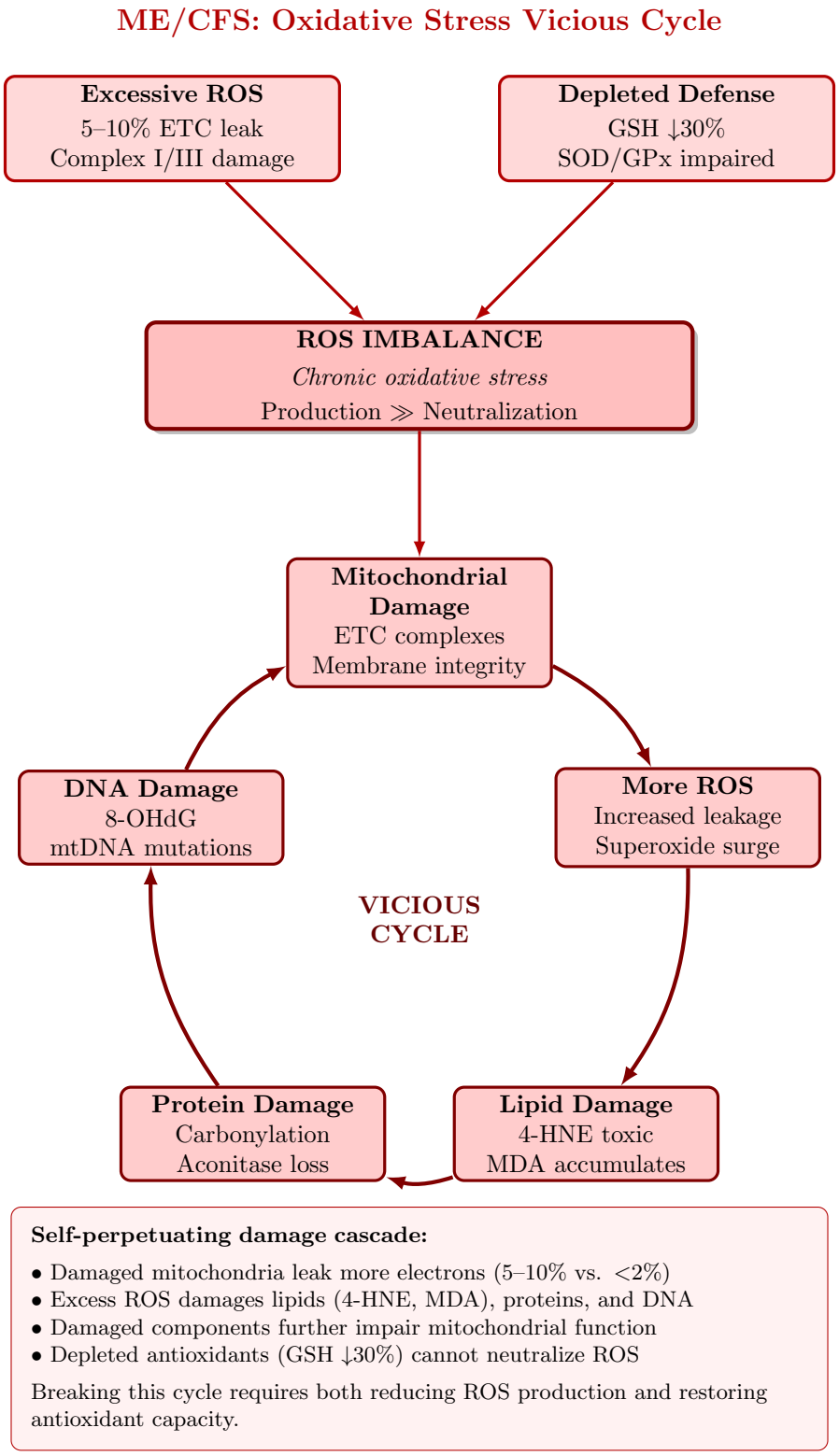


Figure 8: ME/CFS oxidative stress vicious cycle with self-perpetuating damage.

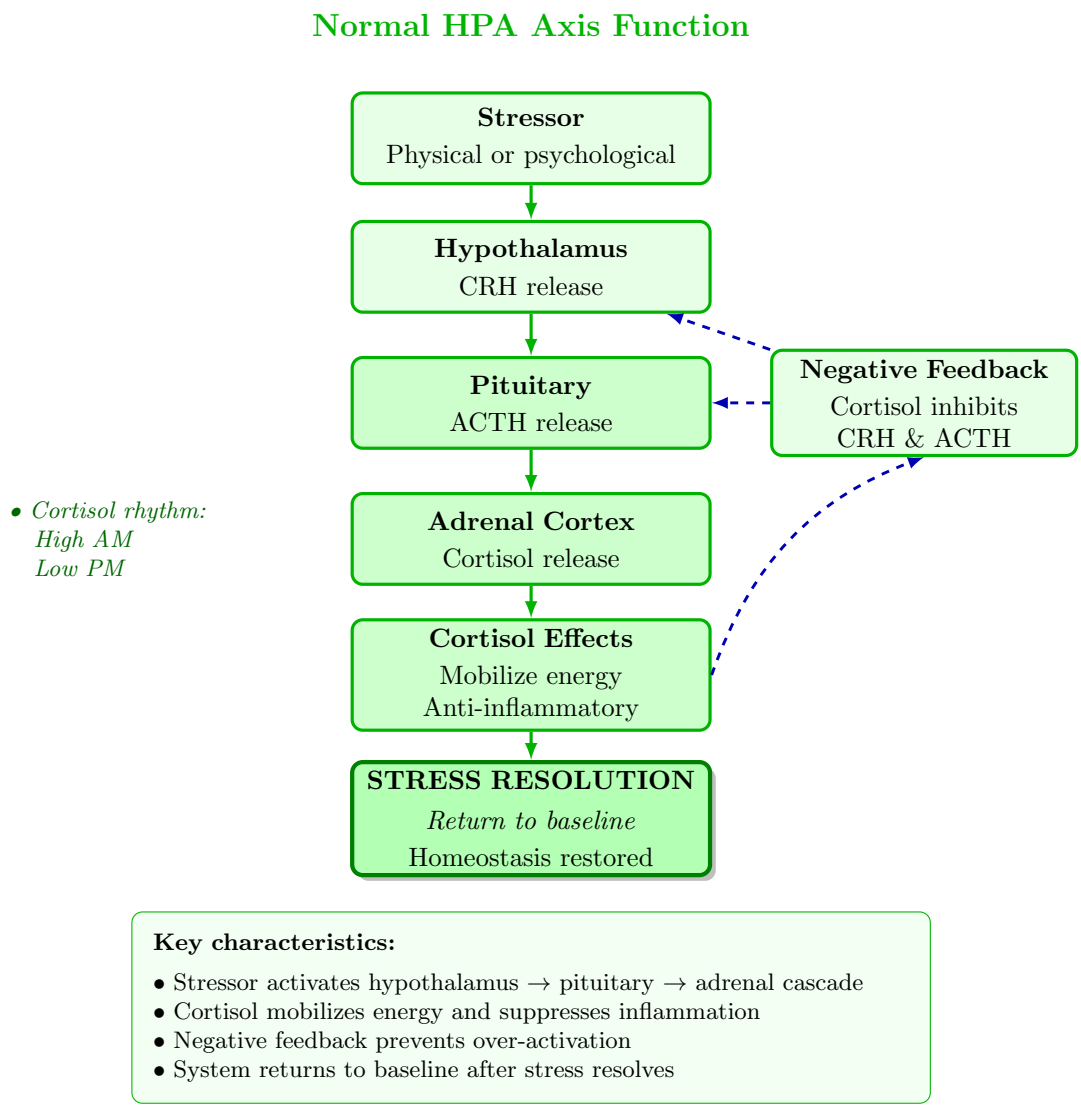


Figure 9: Normal HPA axis stress response with negative feedback control.

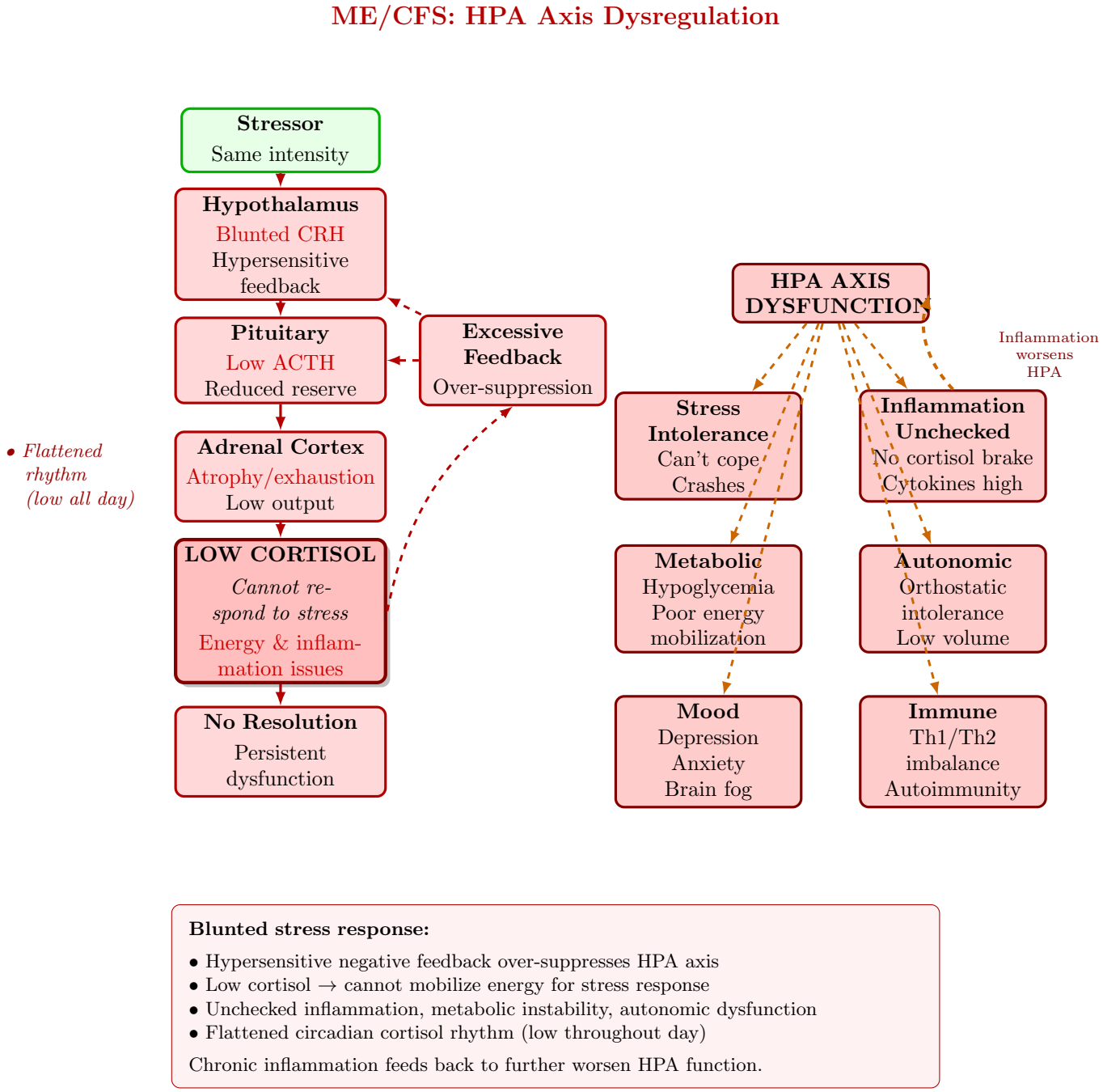
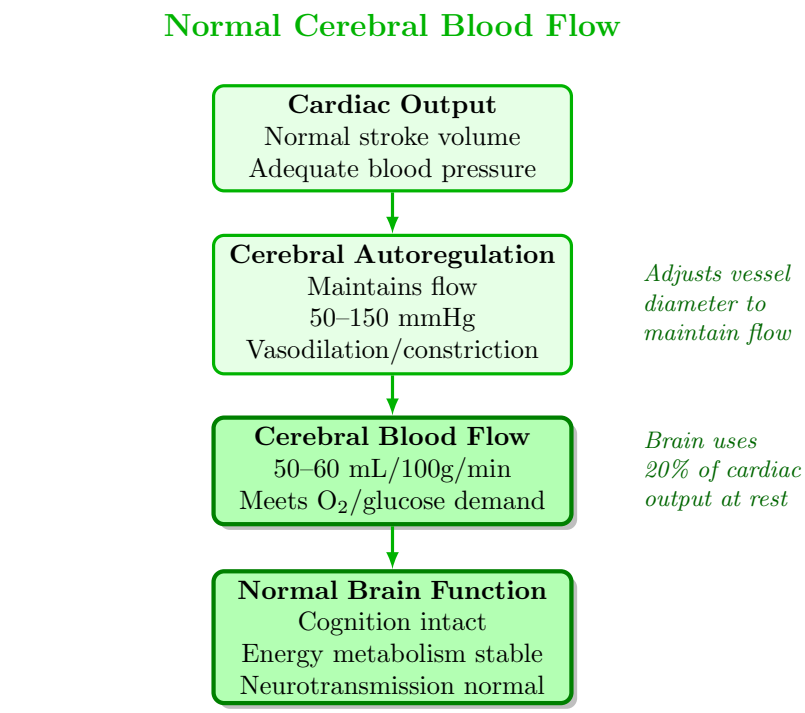


Figure 10: ME/CFS HPA axis dysregulation with blunted response and systemic consequences.



Key points: The brain requires constant, high blood flow due to its enormous metabolic demands. Autoregulation maintains stable perfusion across a wide range of blood pressures. Adequate O_2 and glucose delivery, plus CO_2/lactate removal, enable normal cognitive function.

Figure 11: Normal cerebral blood flow regulation meeting brain metabolic demands.

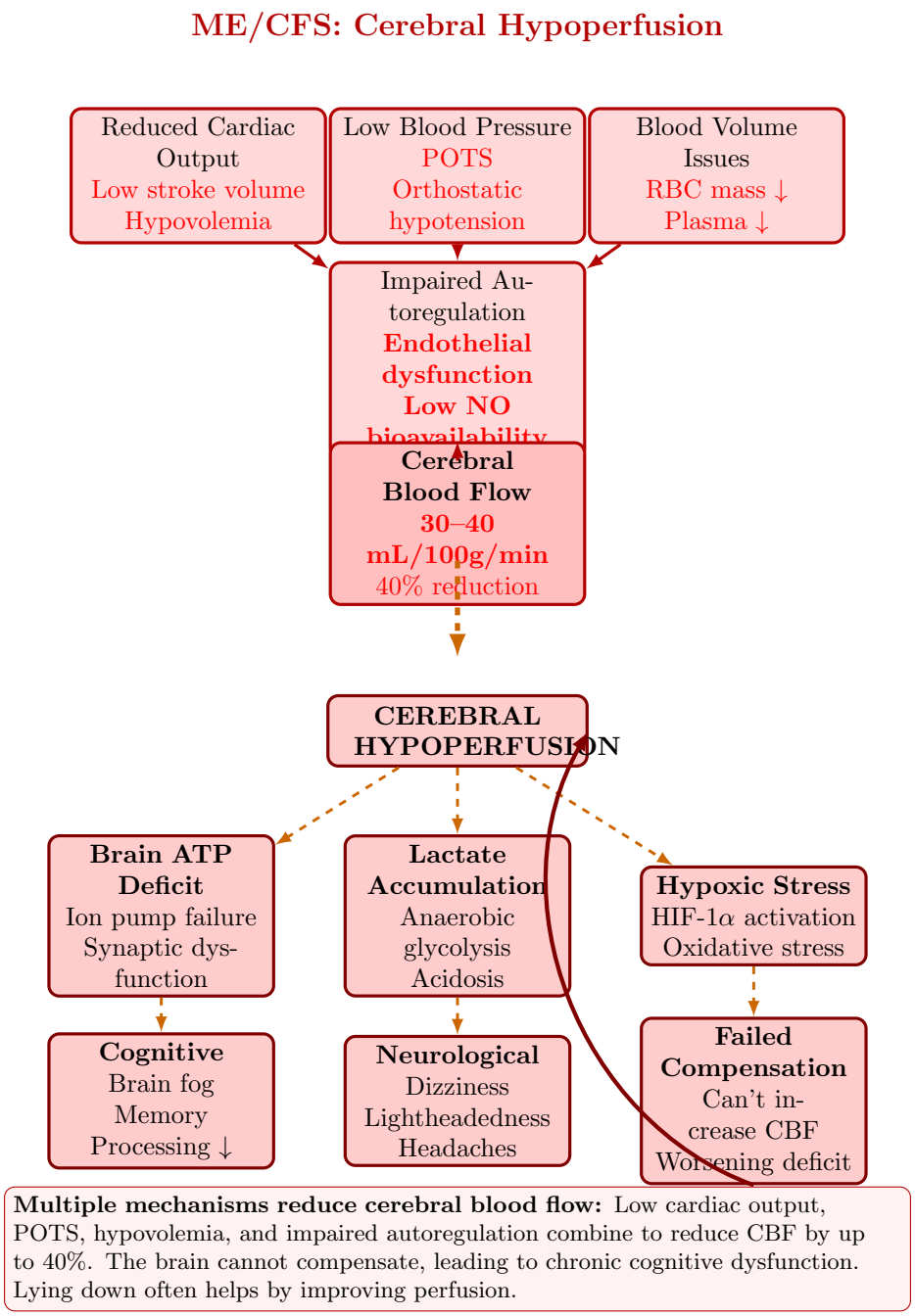


Figure 12: ME/CFS cerebral hypoperfusion cascade causing cognitive dysfunction.

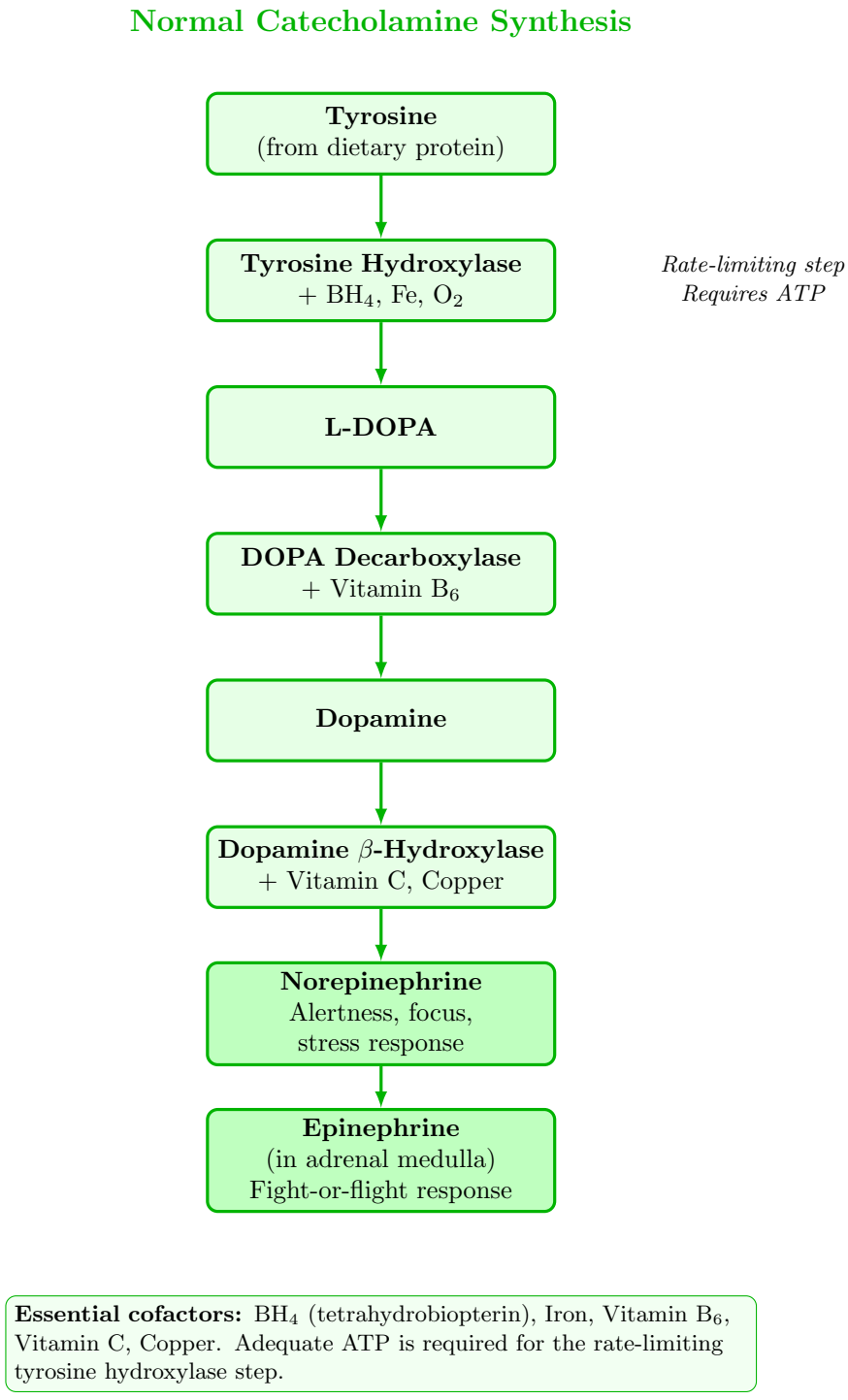


Figure 13: Normal catecholamine synthesis pathway from tyrosine to norepinephrine and epinephrine.

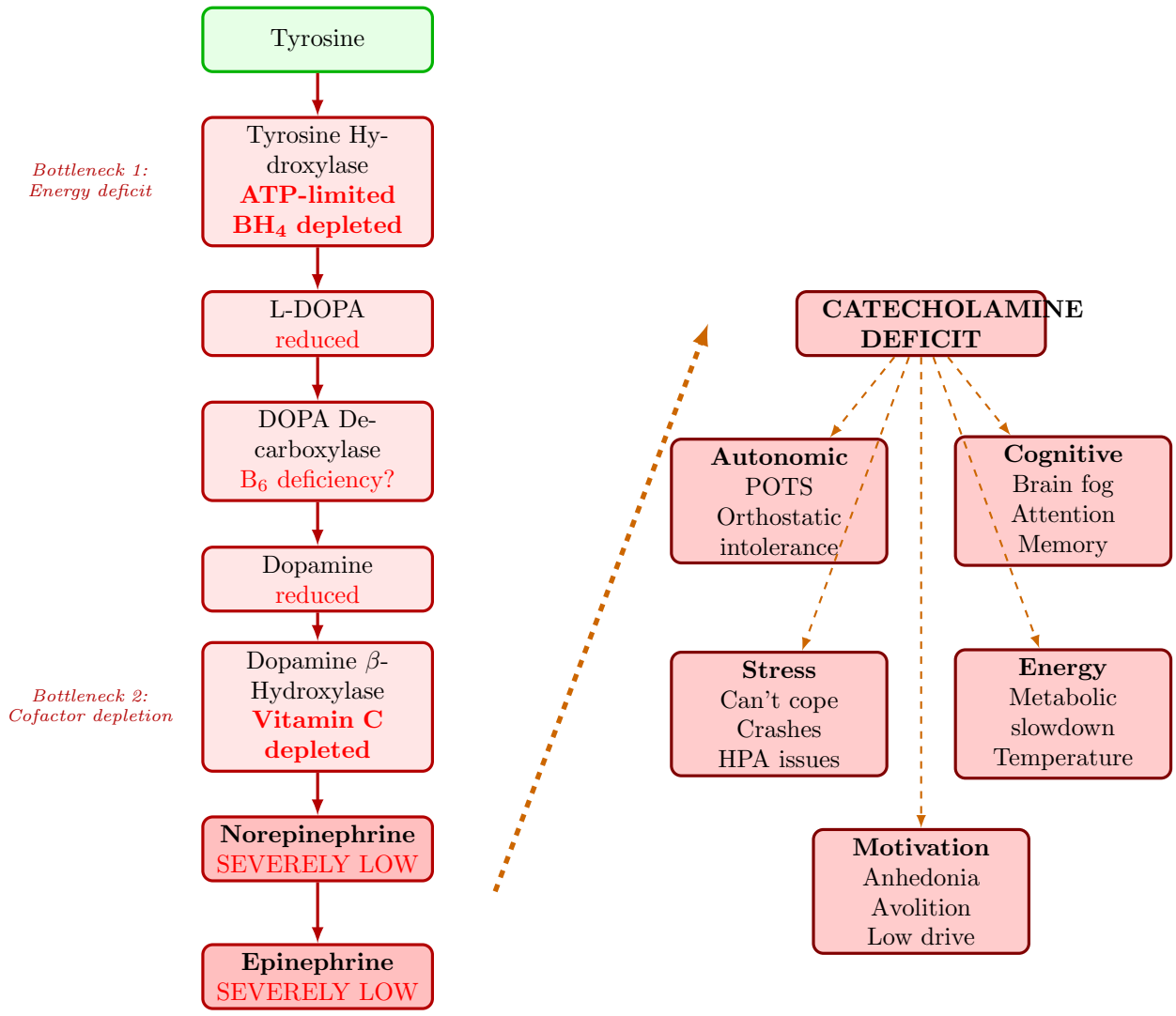


Figure 14: ME/CFS catecholamine synthesis failure and systemic consequences.

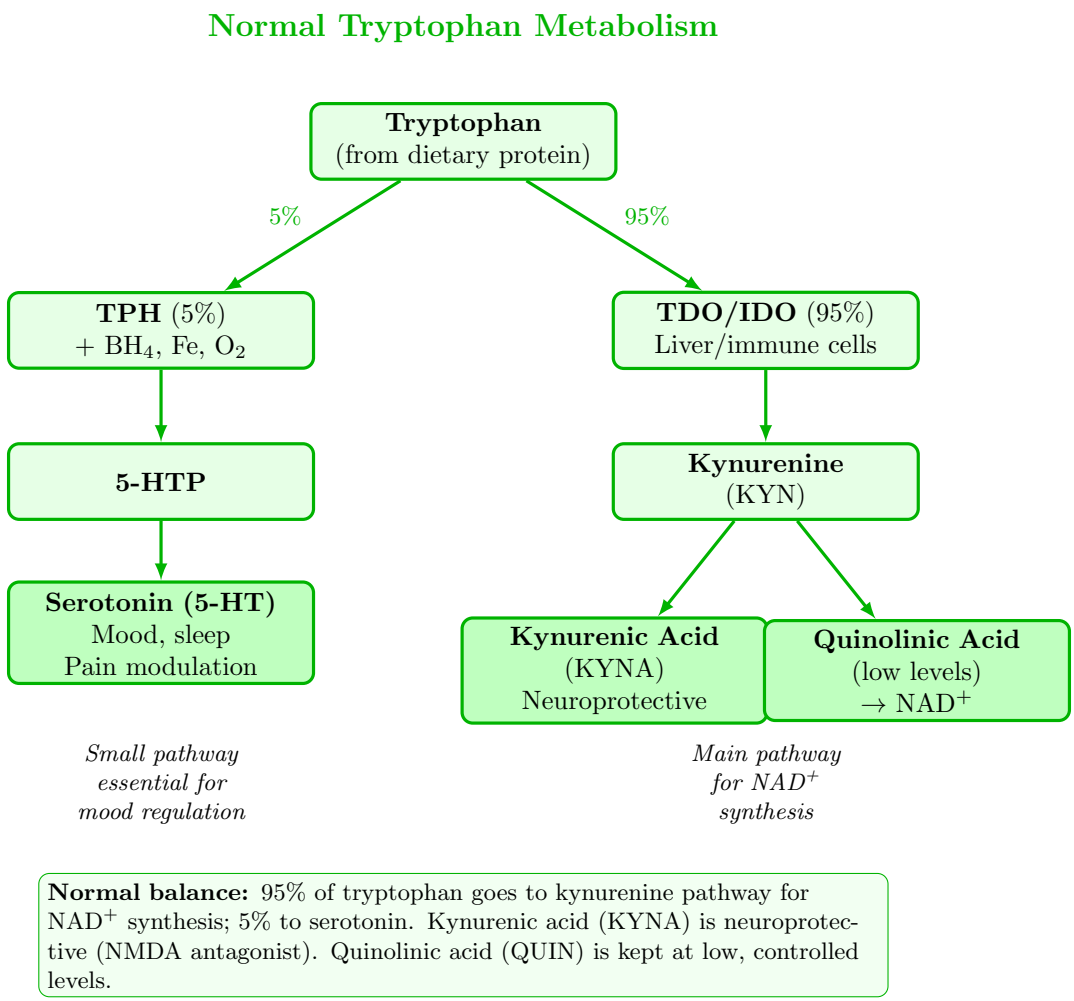


Figure 15: Normal tryptophan metabolism with balanced serotonin and kynurenine pathways.

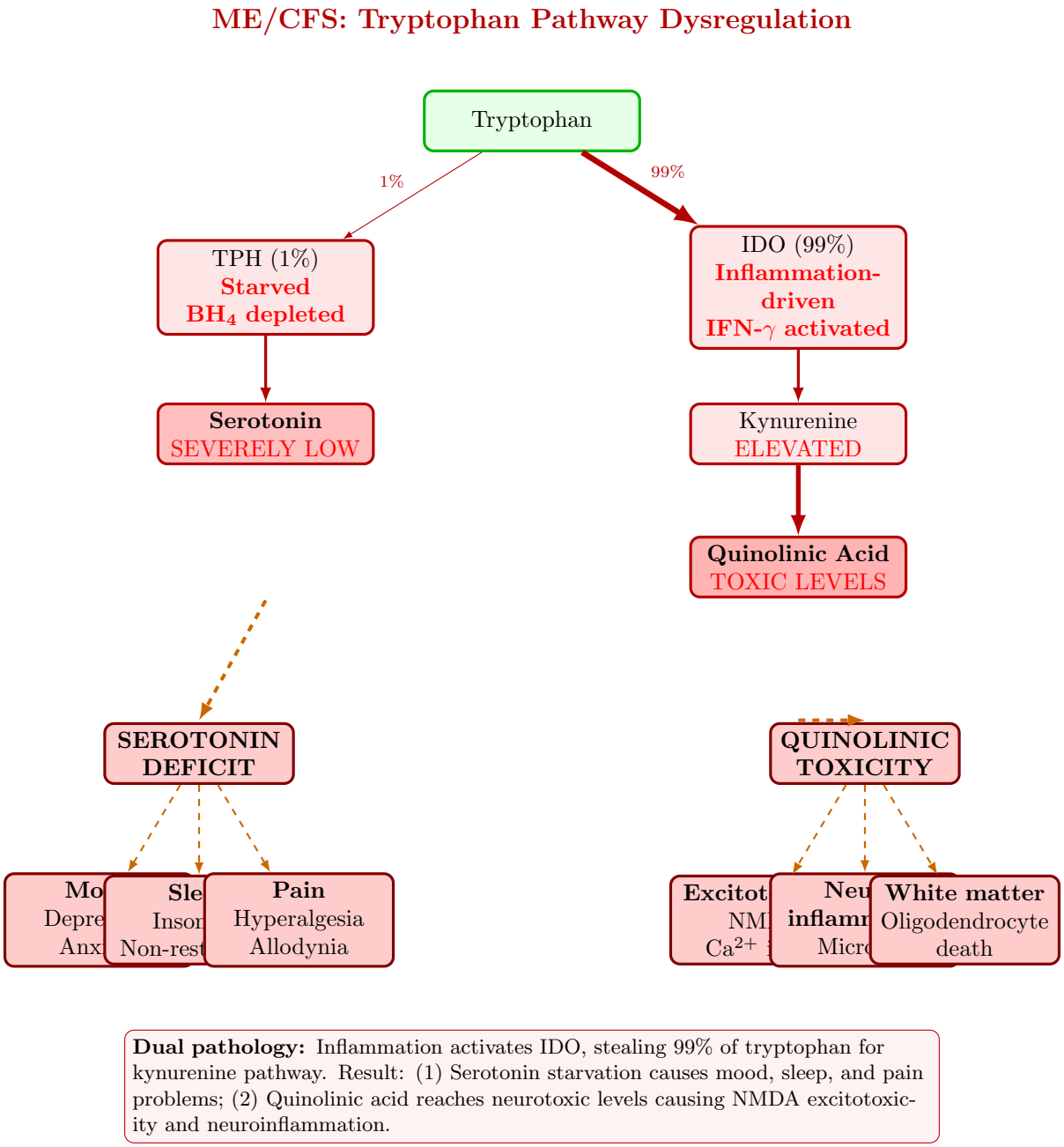


Figure 16: ME/CFS tryptophan dysregulation causing serotonin deficit and quinolinic acid toxicity.