Plotting Orexin Within the Olfactory Bulb

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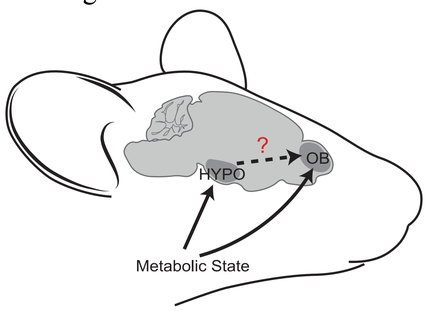
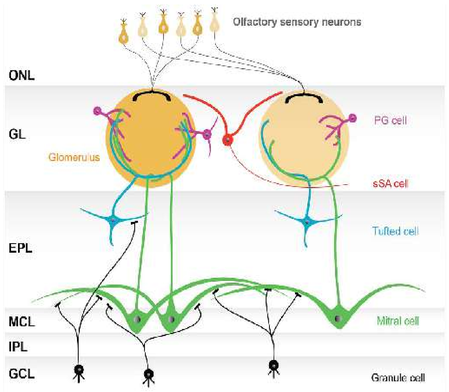
Background

The olfactory bulb plays an essential role in the processing and perception of olfactory sensory information. It contains a complex network that shapes sensory signals transmitted into the bulb. This network includes many types of different cells and transmitters. Neurotransmitters carry signals from one neuron to another, allowing communication between far reaching and proximal regions of the brain.



The olfactory bulb recieves transmitted signals from several regions of the brain, many of which release neurochemicals. One of these neurochemicals is orexin, which is released by a cluster of neurons from the hypothalamus, forming connections within the bulb. Orexin is a neuropeptide which aids in the regulation of arousal and appetitie.

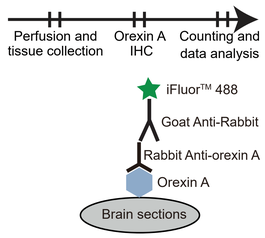


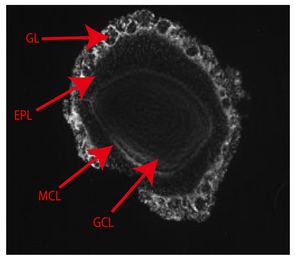
Nagayama, S, et. al, Basic Model of the Olfactory Bulb Network

While past studies have shown that orexin appears in the olfactory bulb, the exact location of its occurrence remains unclear. Therefore, it is crucial to determine its locale to fully understand its functional interactions and impact. The presence of orexin in the olfactory bulb also suggests that chemospecific populations occur throughout the brain, not only in specific locales, which has implications for broader neuroscience research.

Methods

Flourescent immunohistochemistry was used to visualize the orexin-A procceses in different preparations. The sections were prepared by slicing the brain samples at 40µm. GFP, a flourescent dye, was used to stain the orexin processes within each segment. This dye can be visualized under a certain range of wavelengths, optimally 510 nm. Each individual section was then visualized using the software Stereo Investigator. We created contours at 10x magnification around the glomerular, mitral cell, granule cell, and external plexiform layers in addition to the entire section. The orexin populations were then plotted at 40x magnification and converted into quantitative plots of the orexin populations.

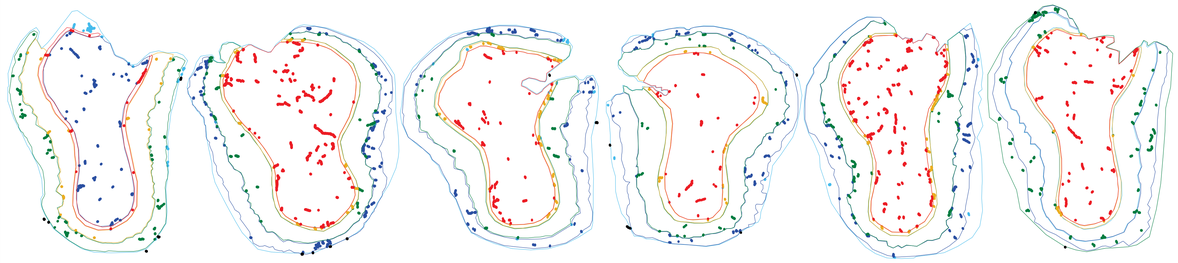




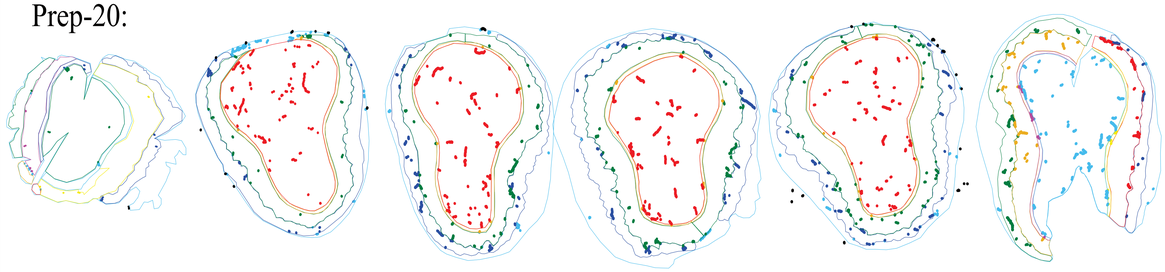
Result

Two preparations', 19 and 20, quantitative plots of olfactory bulb sections. The figures below visualize both the contours and locations of orexin processes in different sections of each preparation.

Prep-19:

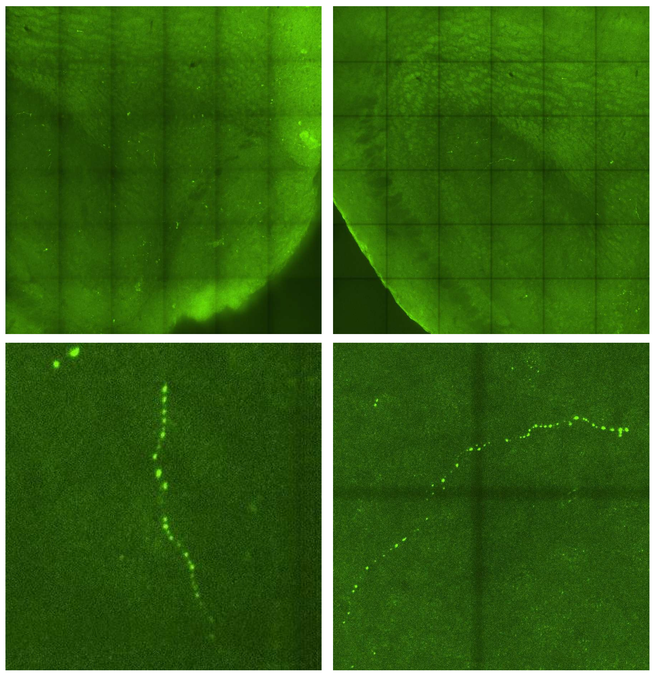


Prep-20:



Result

Orexin-A processes are present throughout the olfactory bulb. The figures below show small portions of the bulb sections visualized under a Nikon CSU-W1 microscope. The superior figures exhibit more complete images of the bulb sections. The inferior figures focus on specific orexin-A processes.



Conclusions

Our data suggests that orexin populations are dispersed throughout every layer of the olfactory bulb, not only the glomerular layer which is the location at which most connections are formed. These results support the concept that orexin aids in the regulation of the olfactory bulb's input and output signals.

Acknowledgements

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References

Gascuel, J., Lemoine, A., Rigault, C., Datiche, F., Benani, A., Penicaud, L., & Lopez-Mascaraque, L. (2012). Hypothalamus-olfactory system crosstalk: Orexin a Immunostaining in mice. Frontiers in Neuroanatomy, 6. https://doi.org/10.3389/fnana.2012.0004 Shepherd, G. M., & Greer, C. A. (1998). Nagayama, S., Homma, R., & Imamura, F. (2014). Neuronal organization of olfactory bulb circuits. Frontiers in Neural Circuits, 8. https://doi.org/10.3389/fncir.2014.00098

Suzuki, H., & Ueta, Y. (2008). Distribution of orexins-containing fibers and contents of orexins in the rat olfactory bulb. Neuroscience Research, 61(1), 99-105. https://-doi.org/10.1016/j.neures.2008.01.017