A WALK THROUGH THE HISTORY OF THE SYNAPSE

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INTRODUCTION

This review wants to take a look at how the concept of synapses and the possible involvement of astrocytes in CNS have changed throughout history; the study mainly focuses on the debate among authors who defend the tripartite synapse and those who are against it and have found controversial issues.

METHODS

Bibliographic research of papers and reviews by introducing keywords, such as tripartite synapse, synapse, history of synapse, gliotransmission, astrocyte calcium signaling, into mainly three databases: PubMed (NCBI), ScienceDirect and Trobador (UAB).

1 SYNAPSE BIPARTITE

According to the classical view, the nervous system was composed of neurons and with an inferior role, glial cells. Astrocytes are the most abundant glial cell type in the central nervous system and were historically considered as supportive cells that did not contribute to information processing and only had a structural and metabolic function. The synapses process is performed by the presynaptic neuron that sends information to postsynaptic neuron.

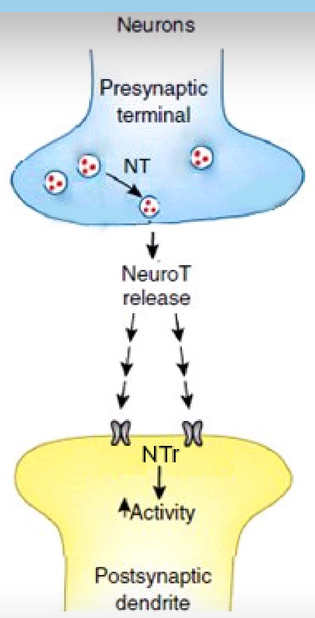

Figure 1 Synapse bipartite. Information, in form of neurotransmitters (NT) flows from presynaptic terminal to the postsynaptic dendrite activating it. Modfied from [3].

2 SYNAPSE TRIPARTITE

The determination that transient elevations of internal calcium concentration take place on the astrocyte, which triggers the release of chemical transmitters that act on neurons and vascular smooth muscle, gives rise to the thought that astrocytes are implicated in controlling synaptic plasticity and brain blood flow. The method of action of astrocytes was divided into two phases: (1) the increase of intracellular calcium and (2) the transmission of neurotransmitters, the gliotransmission.

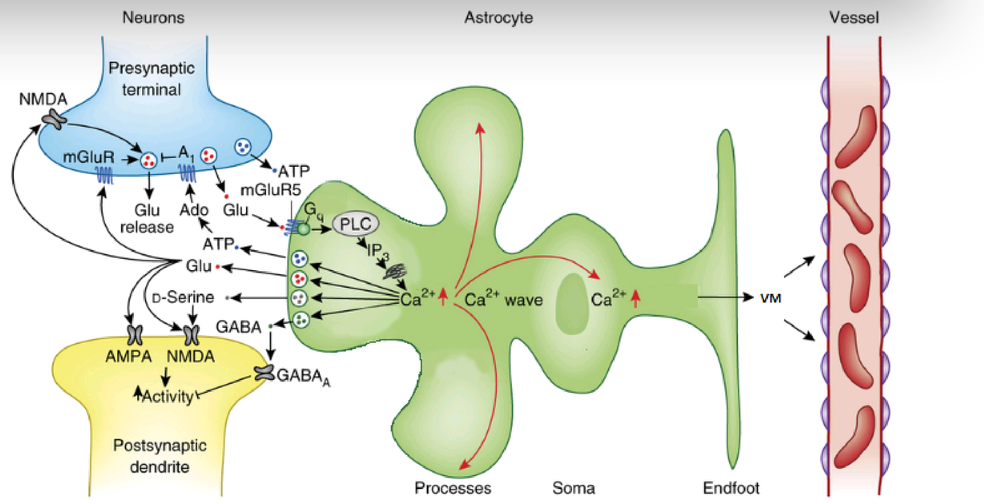

Figure 2 Synapse tripartite. Astrocyte responds to neurotransmitters releasing gliotransmitters and vasoactive messengers (VM) which affect on synaptic transmission and increase blood flow, respectively. Modified from [3].

3 CONTROVERSIES

While investigators were studying the role of astrocytes in the synapse, conceptual problems on the previous theories were arising. These controversies were mainly appearing with (1) the mechanisms by the internal calcium waves increased in astrocytes, (2) the increasing wave time and (3) the ways by which gliotransmitters are liberated. Most of the controversies arose in part from the methods applied to study the synapse.

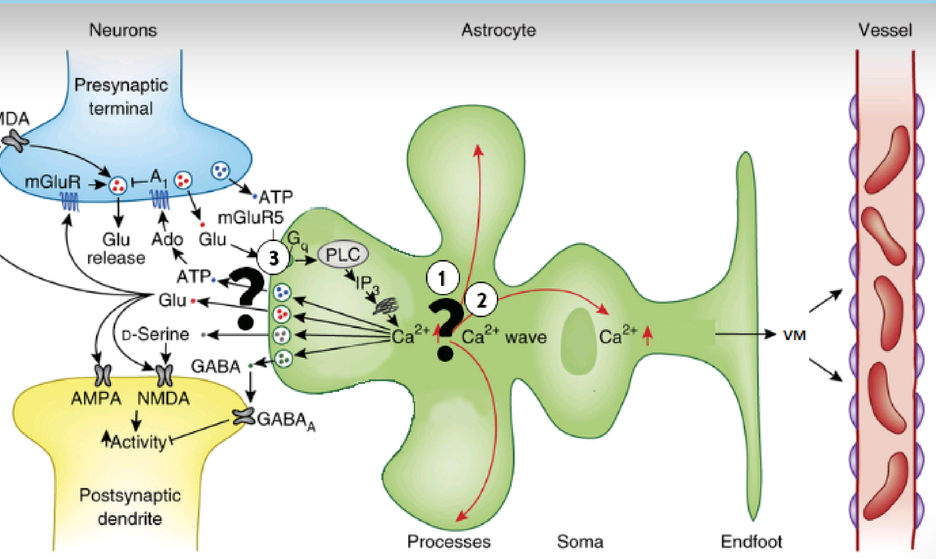

Figure 3 Scheme of the controversies: (1) the mechanisms by the calcium intracellular are raised in astrocyte, (2) the time of that elevations lasted and (3) the mechanisms by gliotransmitters are liberated to the cells. Modified from [3].

4 THE PARTIAL RESOLUTION

To comprehend the effect of internal calcium waves, it was accepted the compartmentation of astrocyte, and some controversies were resolved. The fact that the controversies have not been resolved completely will inspire researchers to further study the issue and get to the bottom of it.

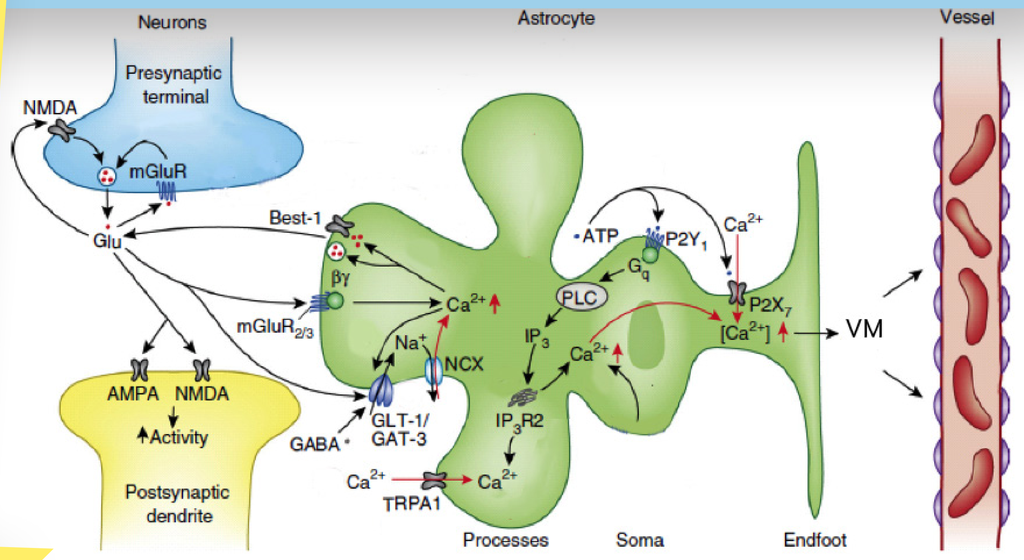

Figure 4 Scheme of the partial resolution of the controversies. The astrocytes must be considered as different cellular subdivisions (processes, soma and endfood). In each part of them the increase Modified from [3].

CONCLUSIONS

- The synapse seems to be a threefold concept; there is an involvement of astrocytes in addition to pre- and post-synaptic neurons.
- Astrocytes are compartmented cells that have temporal dynamism.
- There are some questions to resolve in the coming years as a perspective for the future.
- It's crucial in scientific research not to give any issue as a dogma, so theories in the course of history can be changed; the experimental methodology have to contemplate all the possible scenarios to afford results difficult to be counteracted.

REFERENCES

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