

Introduction

The cerebrospinal fluid (CSF) is a system that influences local brain environments, while providing a pathway for regulatory substances. The CSF is contained in a system of ventricles and circulates in such a way that it carries chemical information into a predictable direction.

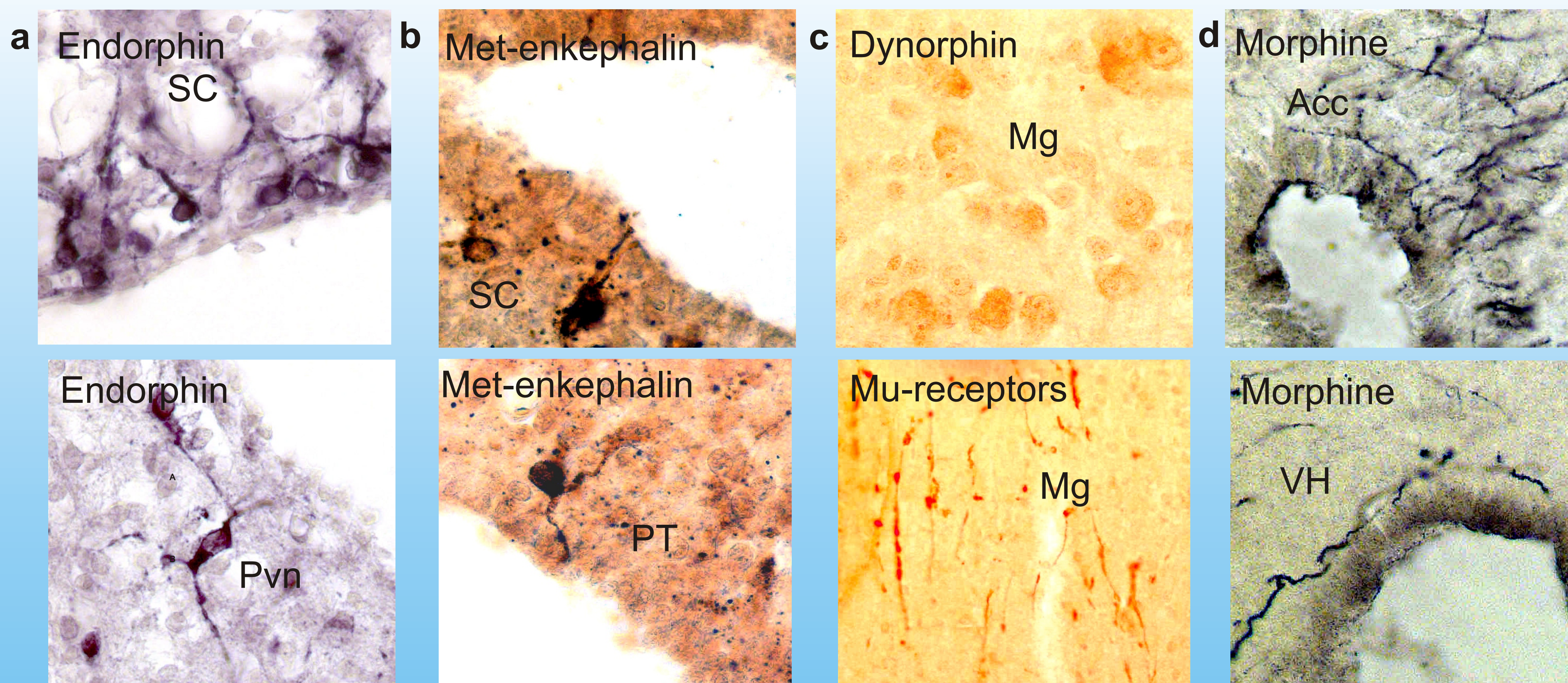
Aim

- 1- To determine the distribution of different neuroactive substances with special attention to brain areas that are close to the ventricles.
 - 2- To identify the possible release sites of substances into the CSF by cerebrospinal fluid-contacting neurones (CSF-cn).
- Emphasis is on opioids and endogenous morphine.

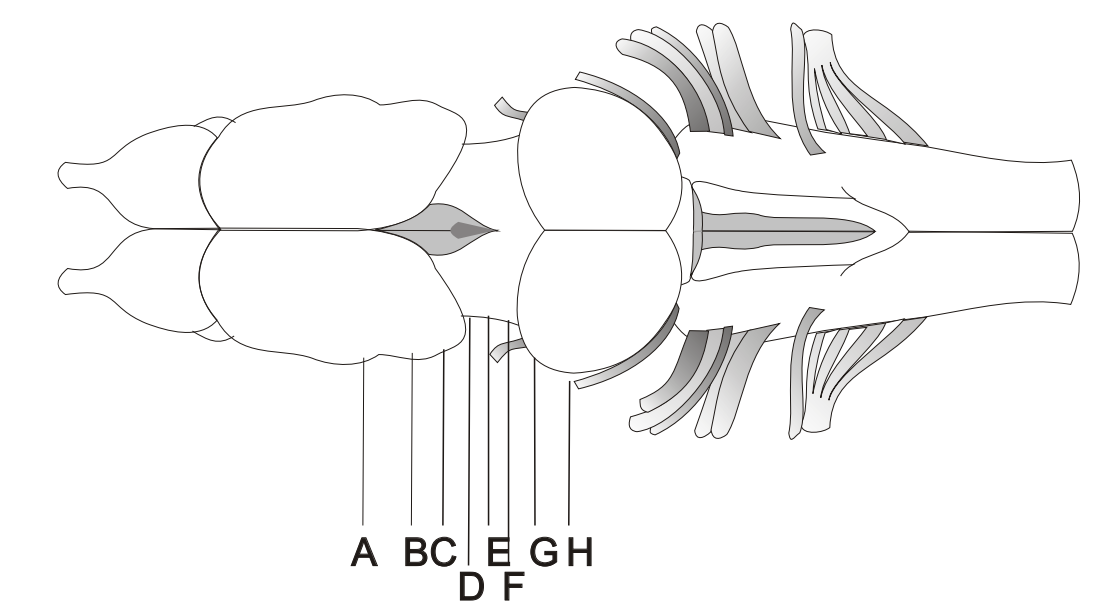
Materials and methods

- 1- The distribution of different opioid peptides has been studied in the *Xenopus laevis* brain, by immunocytochemistry.
- 2- CSF-cn were characterized in brain areas by electron microscopy; with the ultrastructural tannic acid (TA) method, exocytosis of secretory material into the CSF was investigated.

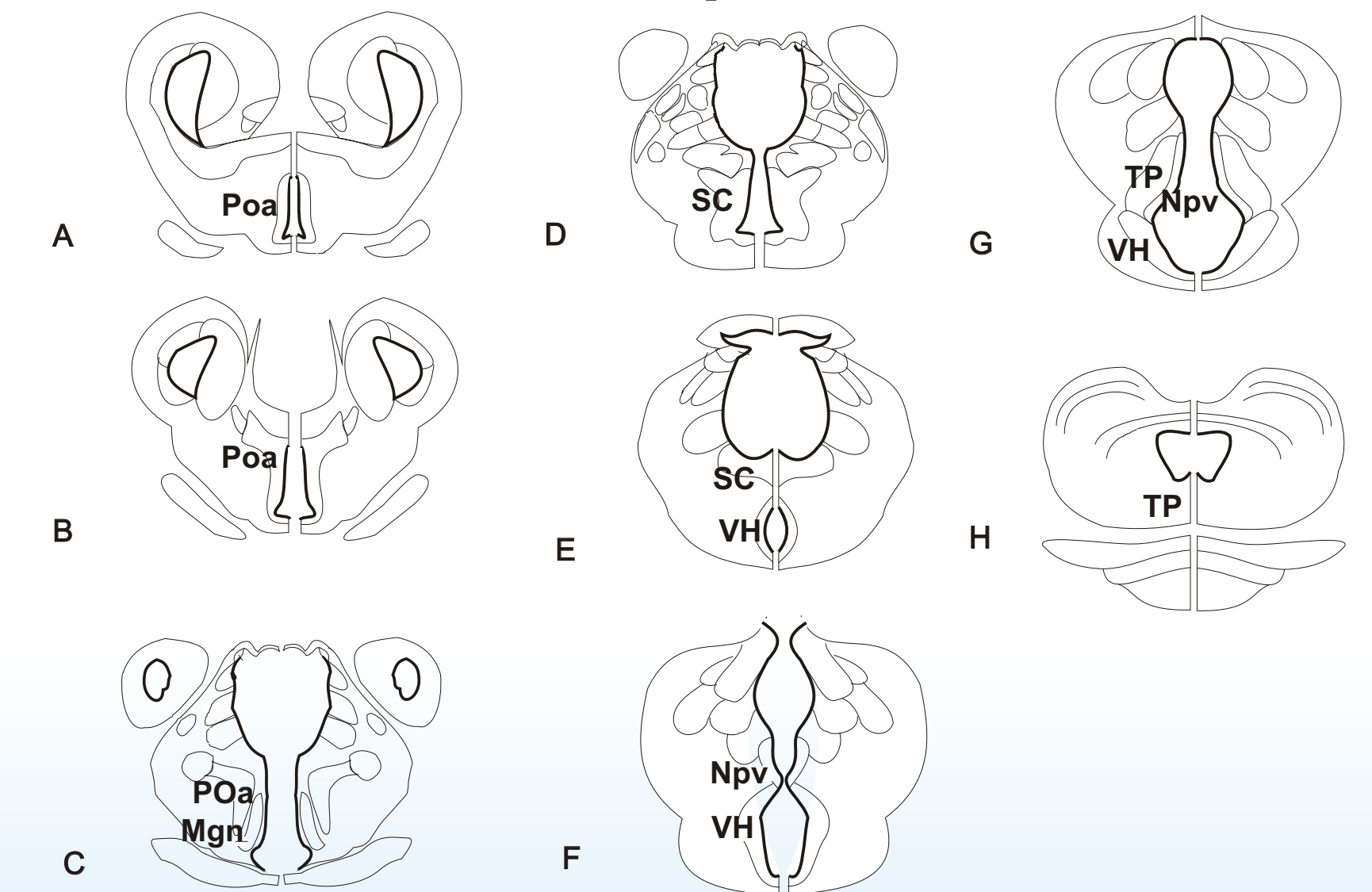
1) Results from immunocytochemistry



Xenopus laevis atlas



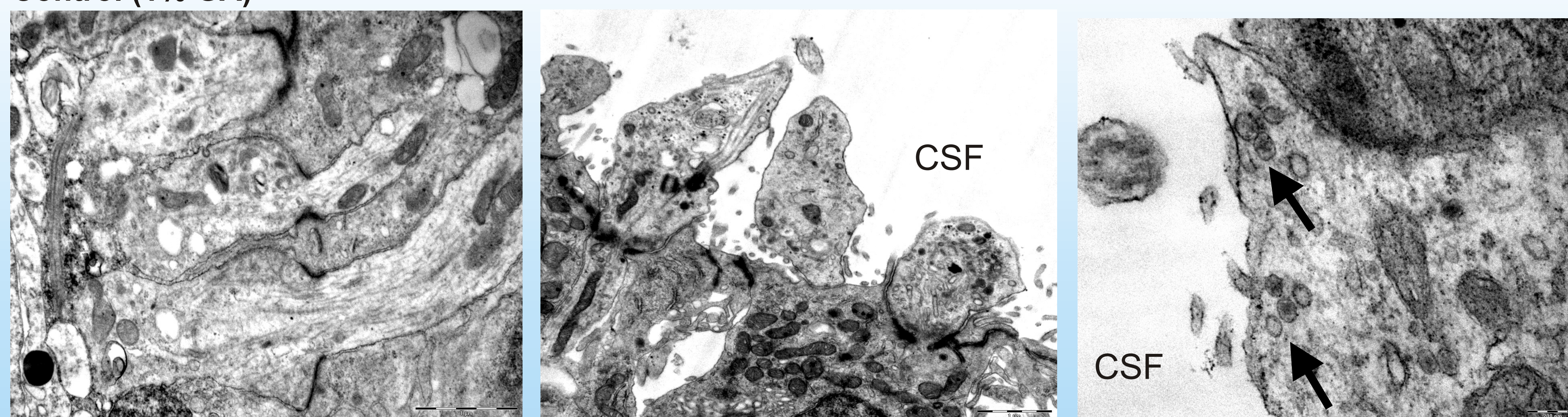
Diencephalon



- a) Endorphin-positivity is in the preoptic area (Poa), suprachiasmatic nucleus (SC), posterior tubercle (PT), paraventricular organ (Pvn) and ventral hypothalamic nucleus (VH). CSF-cn are in the Pvn.
- b) Met-enkephalin-positivity is in the SC, PT and ventral hypothalamus. CSF-cn are in the PT.
- c) Dynorphin-positivity is in the magnocellular nucleus (Mg). Mu-opioid-receptors are in fibers in the Mg.
- d) Preliminary results on the presence of endogenous morphine in the *Xenopus* brain: morphine is present in different areas nucleus accumbens (Acc), Poa, SC, Pvn, PT and VH, in large fibres.

2) Results from ultrastructural experiments

Control (1% GA)



The *Xenopus* brain shows many CSF-cn in the Poa, Pvn and VH. Note the presence of vesicles close to the CSF (arrows).

TA method (0.12% TA)



With the TA-method examples of exocytosis (arrows) in the CSF.

Conclusions

- 1) CSF-cn containing opioid peptides, in particularly endorphin and met-enkephalin, are present in *Xenopus* brain areas close to the third ventricle.
- 2) These neurones may release opioids into the CSF.
- 3) Preliminary results suggest that endogenous morphine is made in the *Xenopus* brain.