

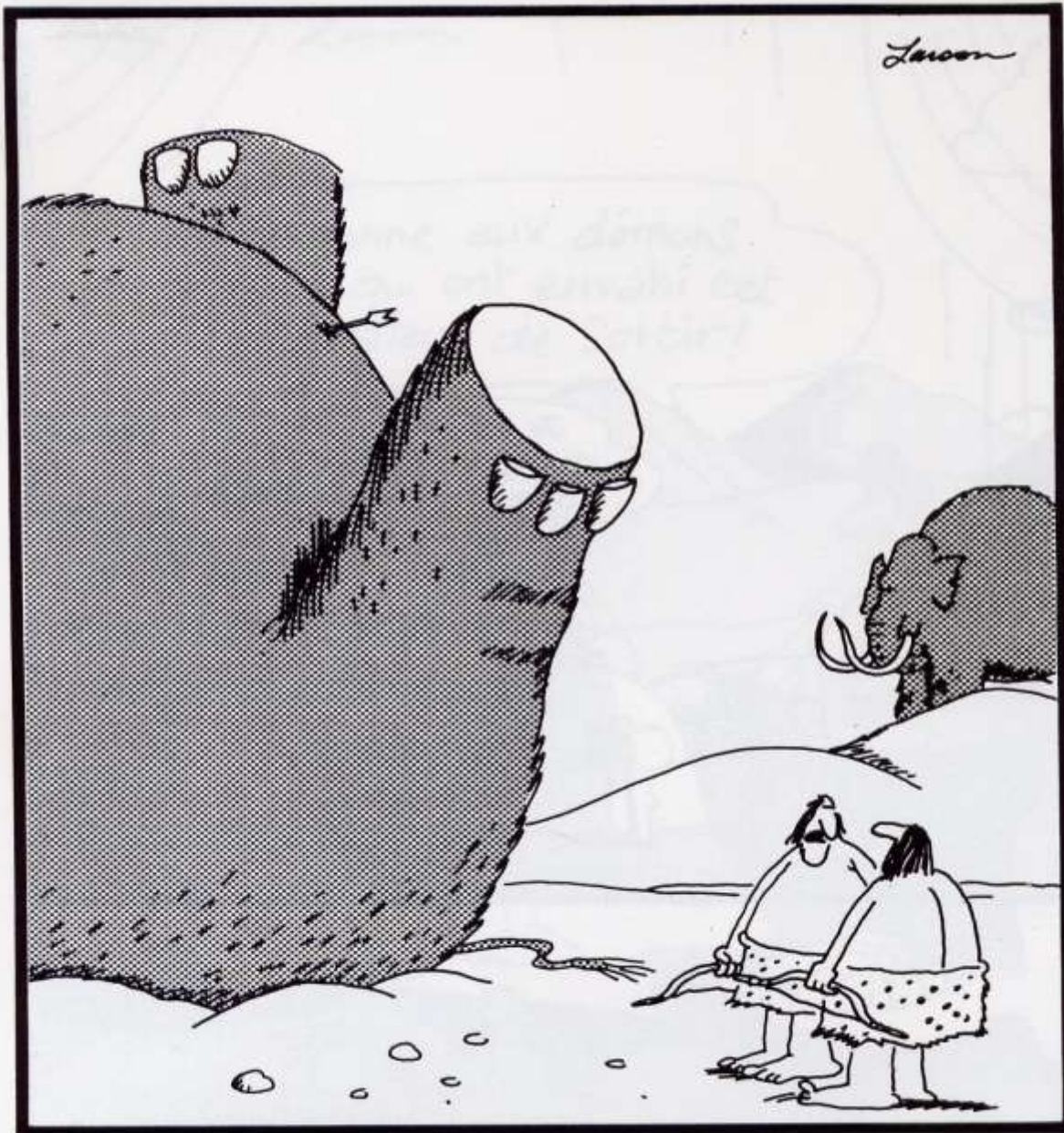
# Neurobiological Basis of Acupuncture

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# A misunderstanding between Western and Chinese medicine:

- Language
- Acupuncture was built empirically over millenia
- The medical theory of acupuncture was applied later on a already effective practical know how
- No necessity to change the theory as the therapy was effective



« we should perhaps remember this point... »

“On ferait peut-être bien de retenir cette zone.”

It's the reason why we still use today the same terms as two thousand years ago

- Insomnia is a fire of the hearth
- Migraine is a fire of the liver
- Depression is an emptiness of the lung
- A chronic backache is an emptiness of the kidney
- Tiredness is an emptiness of the spleen

This theory has no scientific claim!

- Coded language
- Gives us access to a quite logical way of thinking, which help us to find the right points in different clinical situation
- If it was not the case, we would have to know by hearth the indications of all the acupoints (more than 700!).

Another problem for the acceptance of acupuncture are the instruments of this therapy: points, meridians, energies have no scientific demonstrated existence

Felix Man, Textbook of acupuncture, 1977.

«

...In this book I will show that acupuncture points do not exist, meridians do not exist, and that most of the laws of acupuncture are laws about non-existent entities. Yet acupuncture works...

- It's probably the main reason why many western doctors still refuse to consider the value of acupuncture, despite a lot of clinical and scientific evidence.
- Thanks to neurosciences, we now partly know how acupuncture works, have found a common language, understandable by all.
- Chinese medicine is now part of the practice of many western doctor.

## Two complementary ways of considering acupuncture today:

- The tradition; brings us the practical experience accumulated over millennia.
- The neurosciences: gives us a common language, that all doctors, whatever their practice, can understand.
- Both are complementary, but I will treat today only the second one.



# Acupuncture is a paradox: we must explain how an acute pain can treat a chronic pain

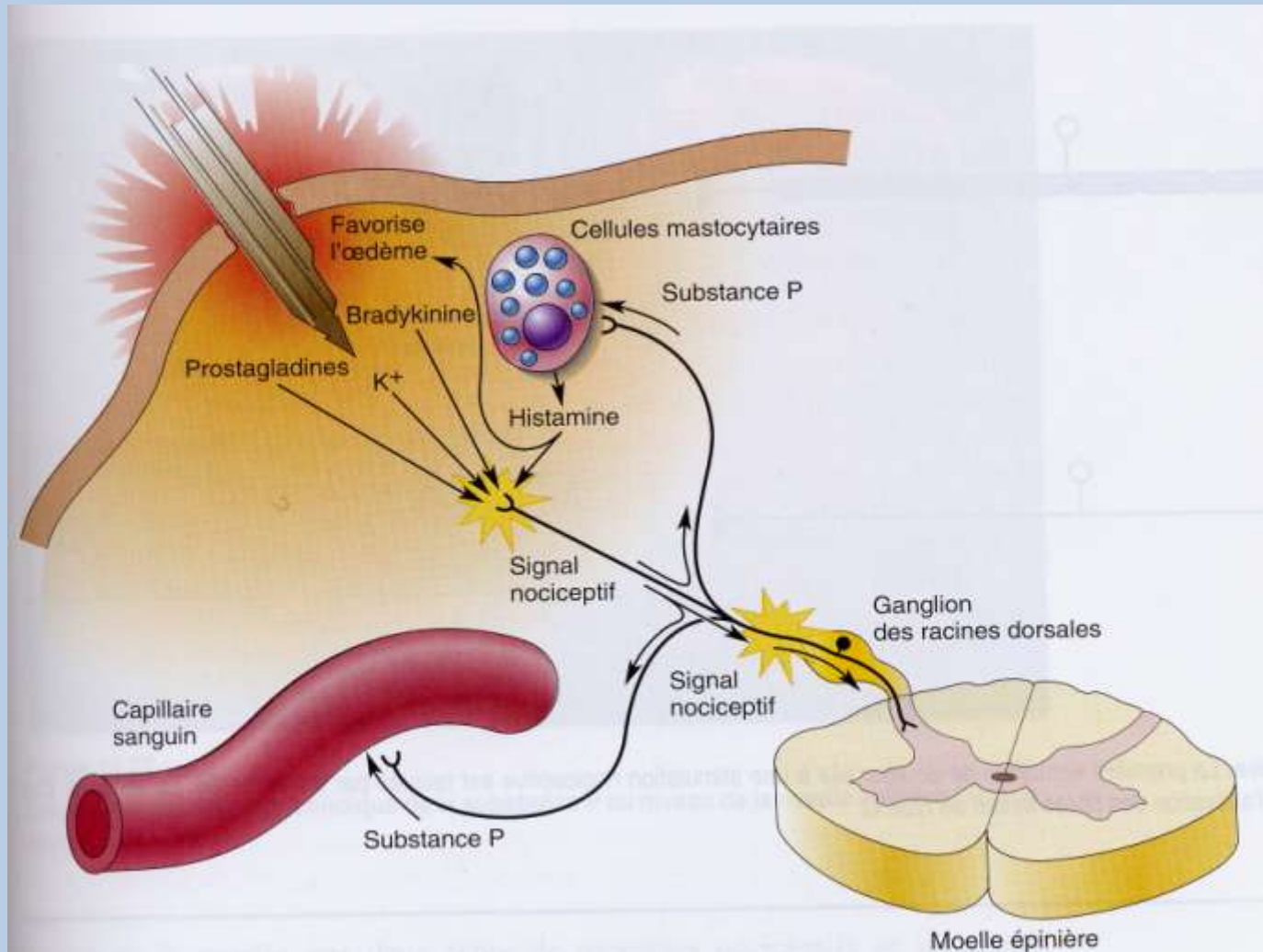
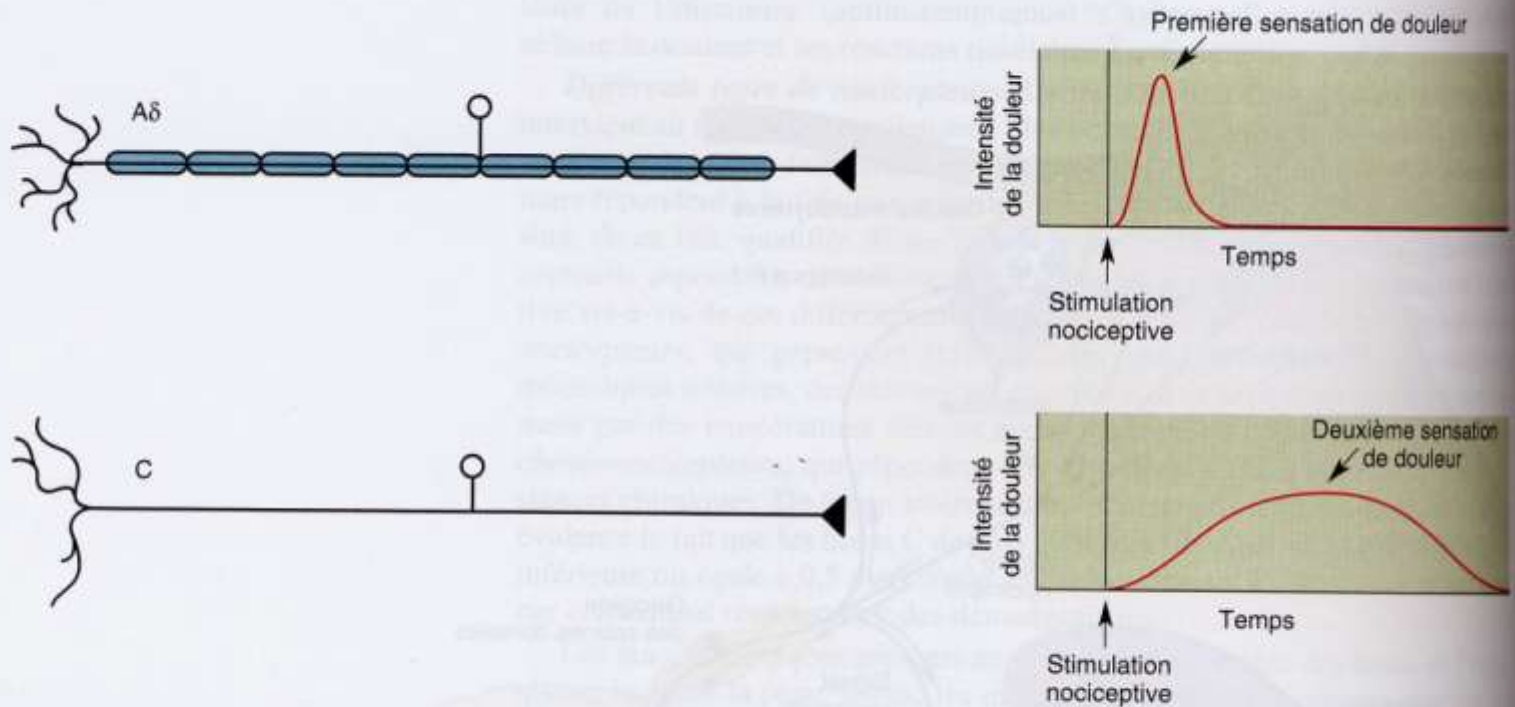


Figure 12.24

Méiateurs périphériques de la douleur et hyperalgie

## Two types of pain, or two modes of recording pain:

- Acute pain
- Chronic pain
- This two types of painful sensation are not transmitted to the brain by the same nerve fibers, and are treated differently in the central nervous system.

**Figure 12.25**

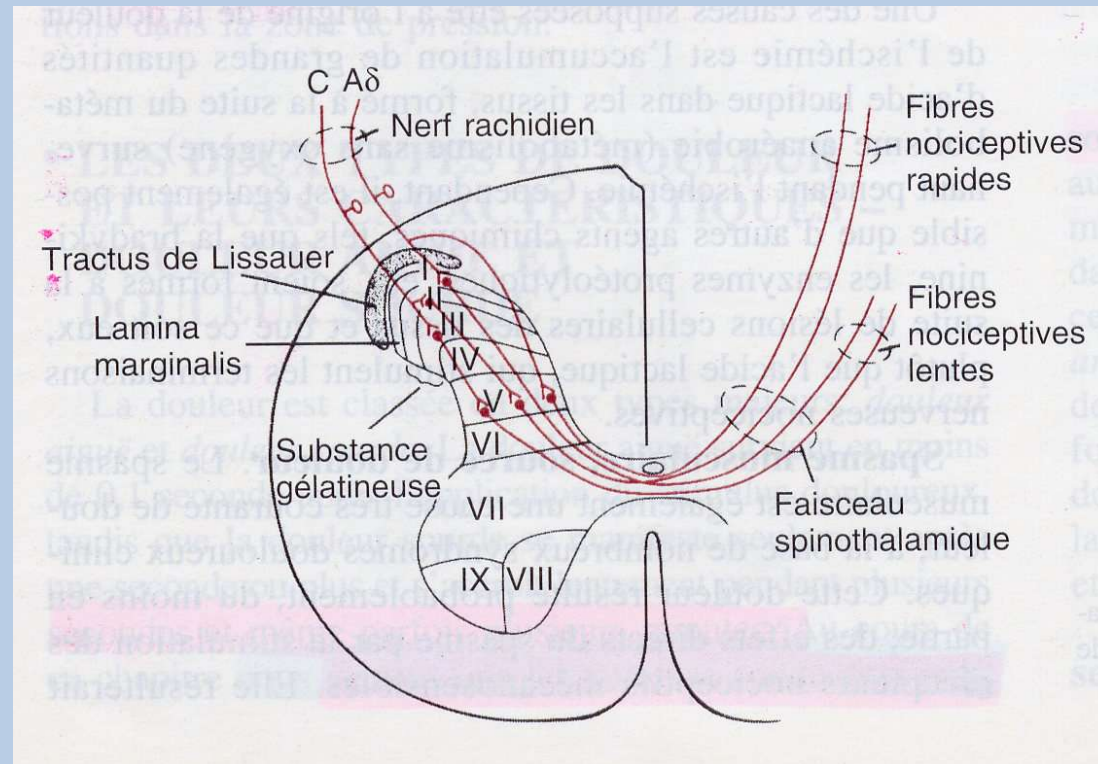
**Douleur primaire et secondaire.** La première sensation de douleur liée à une stimulation nociceptive est relayée par les fibres A $\delta$ . La seconde, plus durable, est liée quant à elle à l'activation des fibres lentes de type C.

# Chronic pain

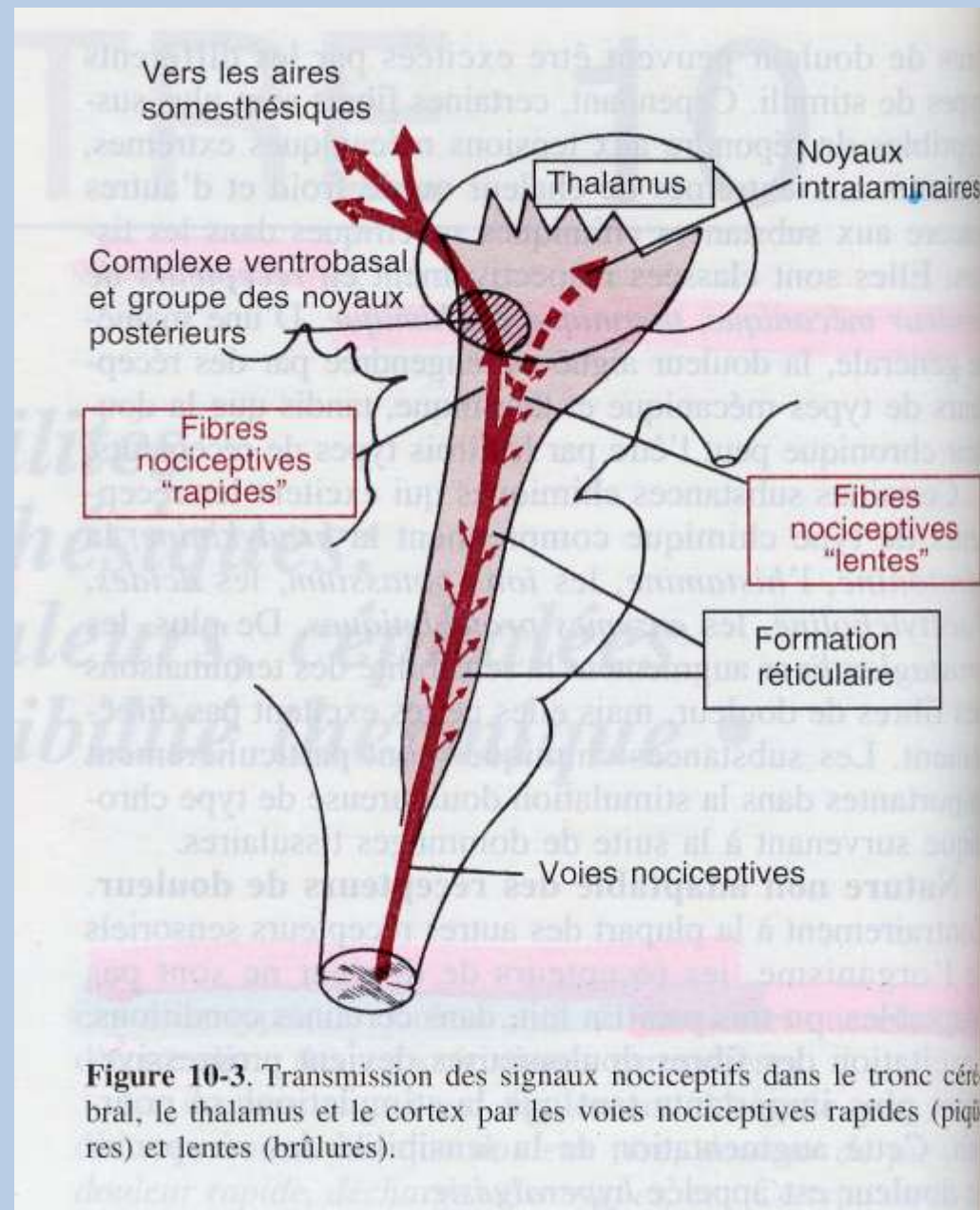
- Transmitted through C fibers, not myelinated.
- Old system, slow conduction.
- Free nerve endings under the skin and in deep structures, including viscera.
- Activated through nociceptive stimuli, heat, chemical compounds (for example heart infarction).
- Pain typically dull, aching, chronic, with an important emotional impact.
- Poor localisation capacity; indicates a tissue destruction.

# Chronic pain: trip of C fibers

- Enter the posterior horn of the medulla, in the substantia gelatinosa.
- Cross after several synapses to the opposite side and travel in the spinothalamic tract of the brain.



- Most of the C fibers travel through the reticular substance, the intralaminary nuclei of the thalamus and other structures of the base of the brain.
- Poor localization capacity but by those connections with the reticular substance and the limbic system, C fiber activation has a strong emotional impact and arousal effect.

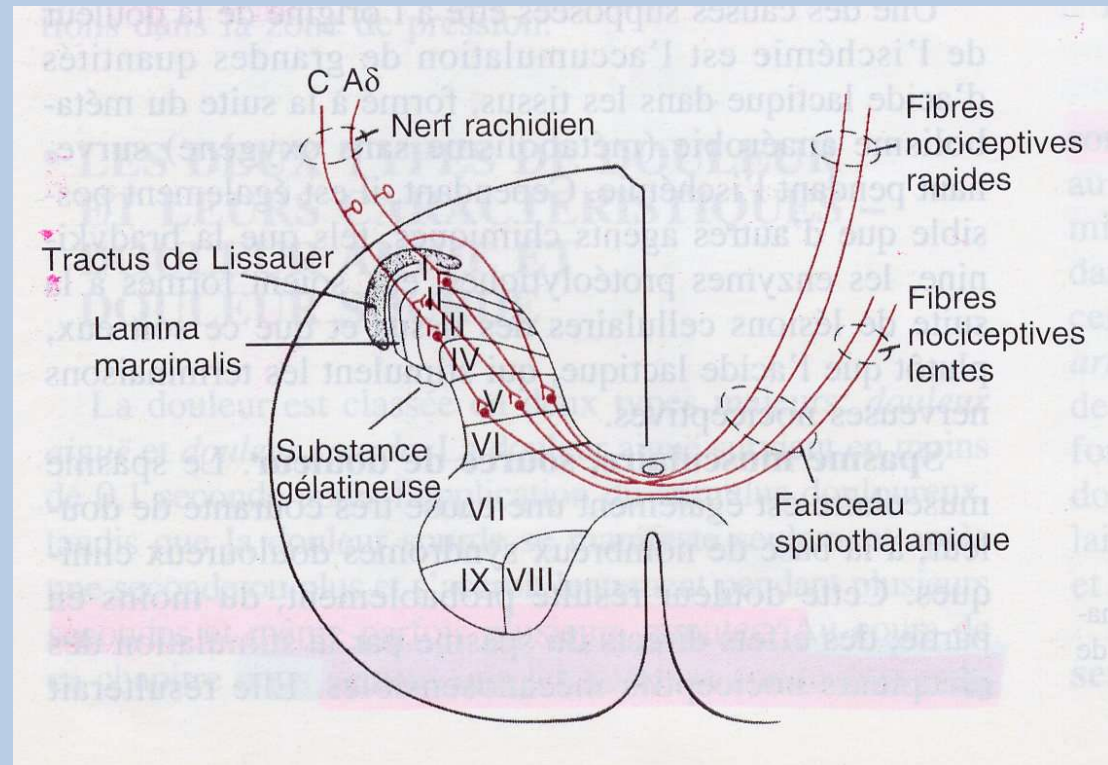


## Acute pain

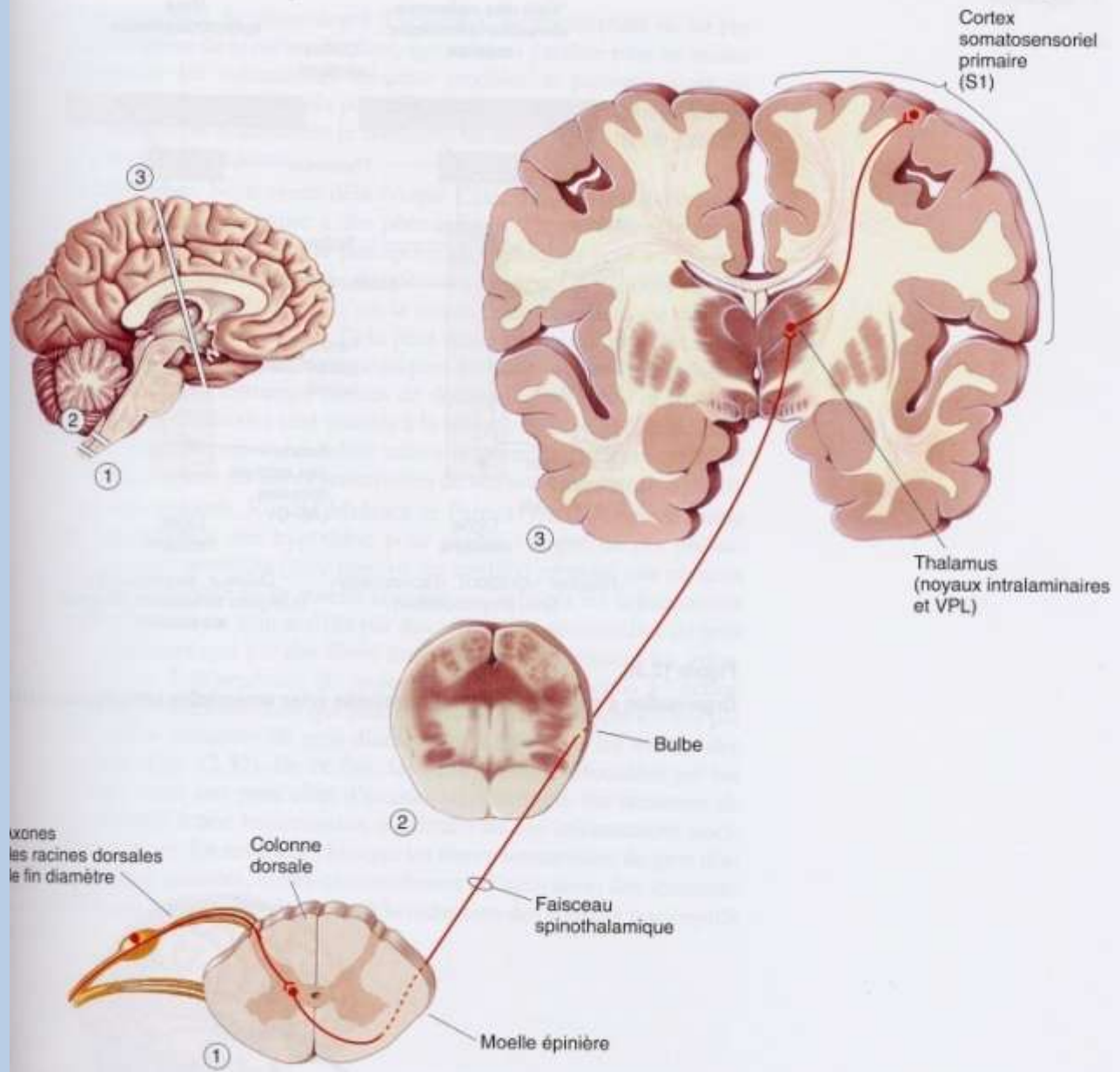
- A Delta fibers.
- Myelinated, fast conduction.
- Free nerve endings in the skin, muscles, periost, but not in the viscera.
- Activated by acute nociceptive and thermal stimuli, and also by strong pressure.

# Acute pain: trip of the A delta Fibers

- Posterior horn of the medulla
- Cross after one single synapse
- ascend to the brain in the opposite antero-lateral funiculus.



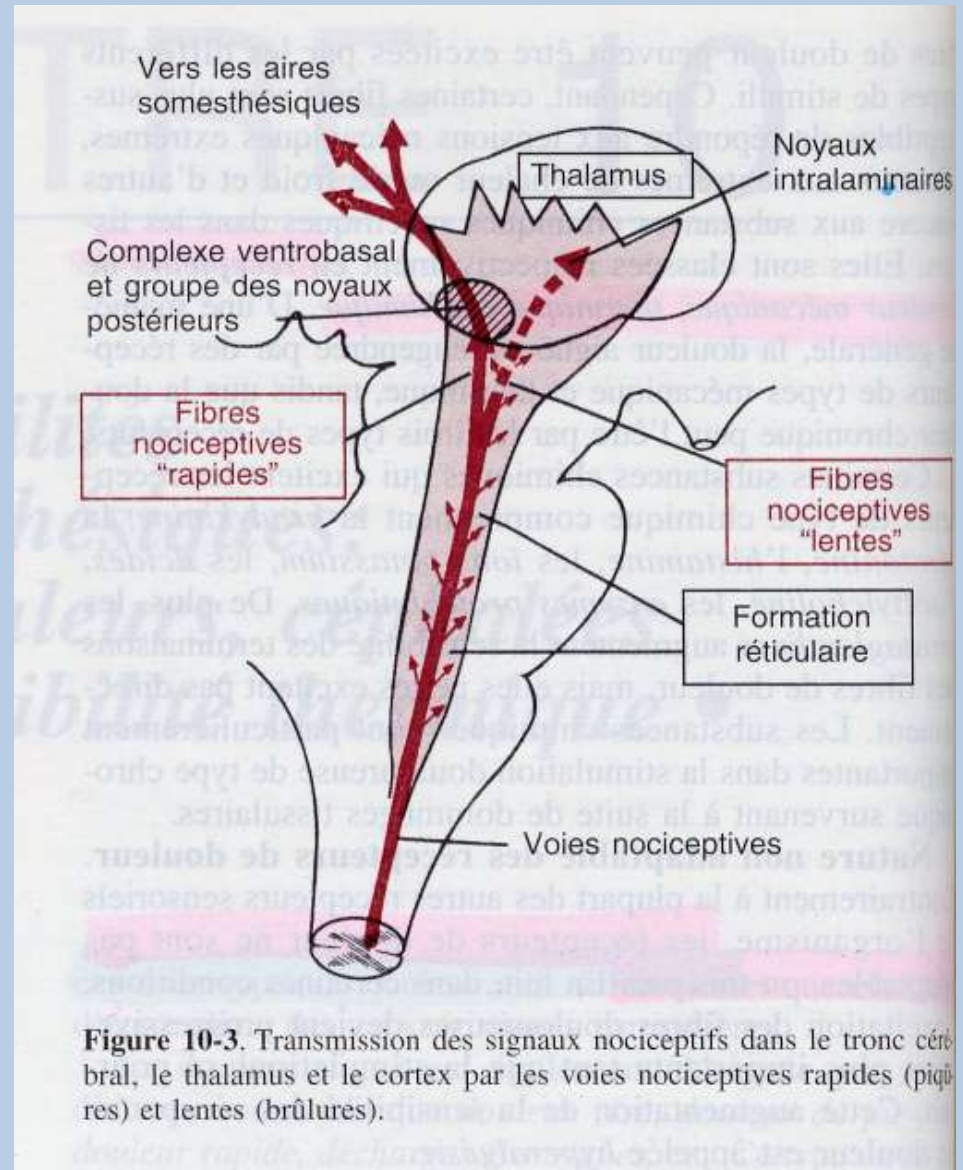




12.29

spinothalamique. C'est la voie principale qui conduit au cortex cérébral les informations périphériques relatives à la douleur et à la température

- On their way, they give collaterals to the reticular substance, the nucleus arcuatus, and the prefrontal lobe.
- But most of the fibers pass through the ventro basal nuclei of the thalamus to join the somesthetic cortex.
- Allow a rapid localisation of the painful stimulus with few emotional impact.



## To summarize:

- One system mediated by A Delta nerve fibers, which allows a rapid and precise localisation of the painful stimulus, with a fast adaptative answer.
- And one system, mediated by the C nerve fibers, which is concerned more by the chronic and emotional aspect of pain.
- This organisation allows the fast pain recording system to remain free for new painful sensations.

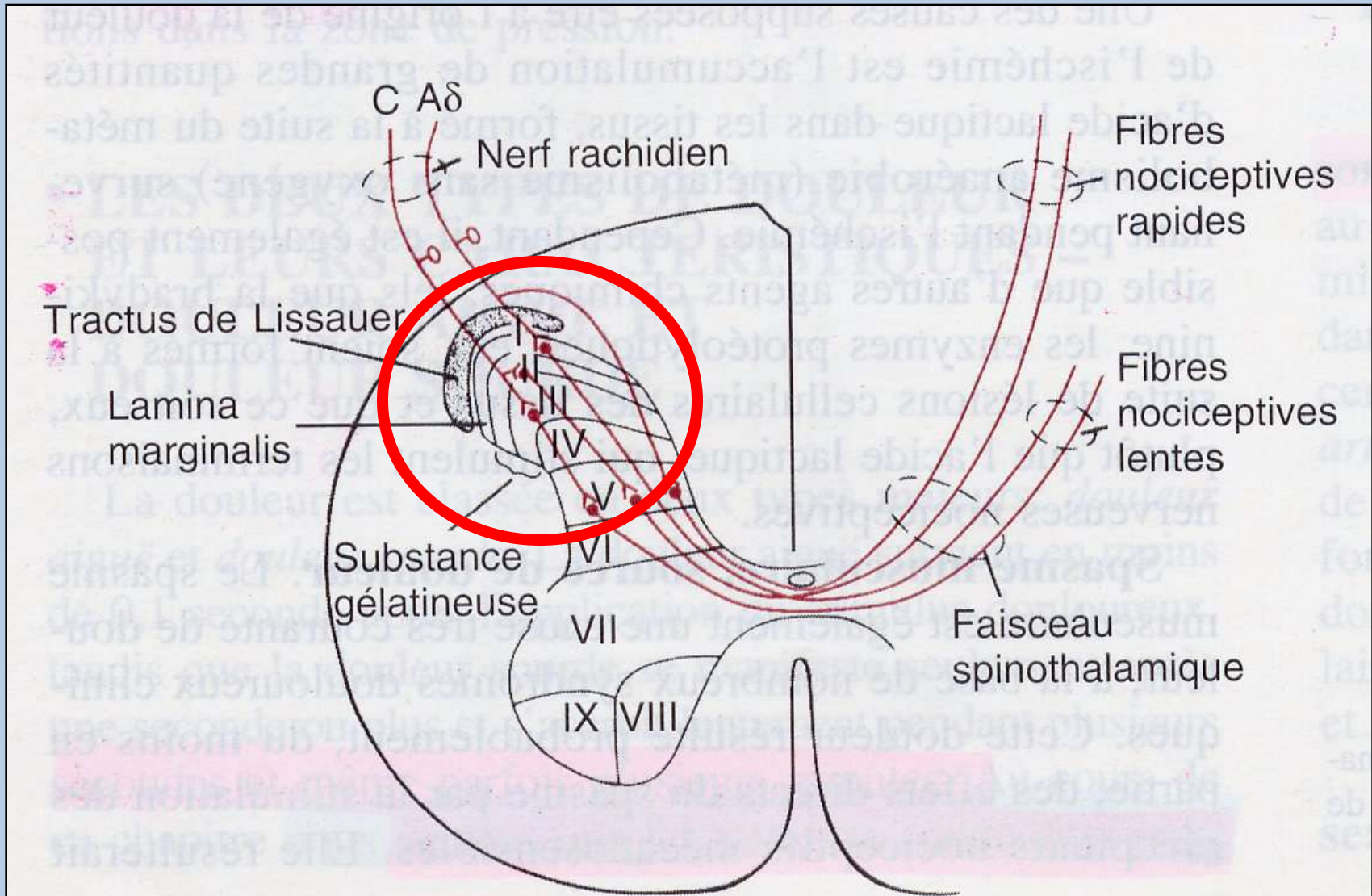
# Pain modulation

- The perception of painful stimuli can be enhanced or diminished, and the pain which is finally felt is the sum of stimulating or inhibiting influences exerted on the C fibers during their way to the central nervous system.

## Utility of a pain modulating system:

- Generally, pain has a protective effect, by calling an adaptative answer.
- But in some situations, like fighting, the perception of pain can be a disadvantage for survival.
- In such situations the central nervous system is able to suppress totally the sensation of pain.

It is principally in the dorsal horn, in the layers 1,2,3,5 and 8 that the control of the transmission of the painful stimuli is exerted, through complex interactions between local and central influences.



- The central pain control systems can be activated from the hypothalamus and from the prefrontal lobe.
- It explains why we cannot voluntarily command the suppression of the pain; but in urgent situations, the autonomic nervous system takes the control.
- We can also understand, with all the interconnections this mechanisms have with the limbic system, how emotions can work on the perception of pain.

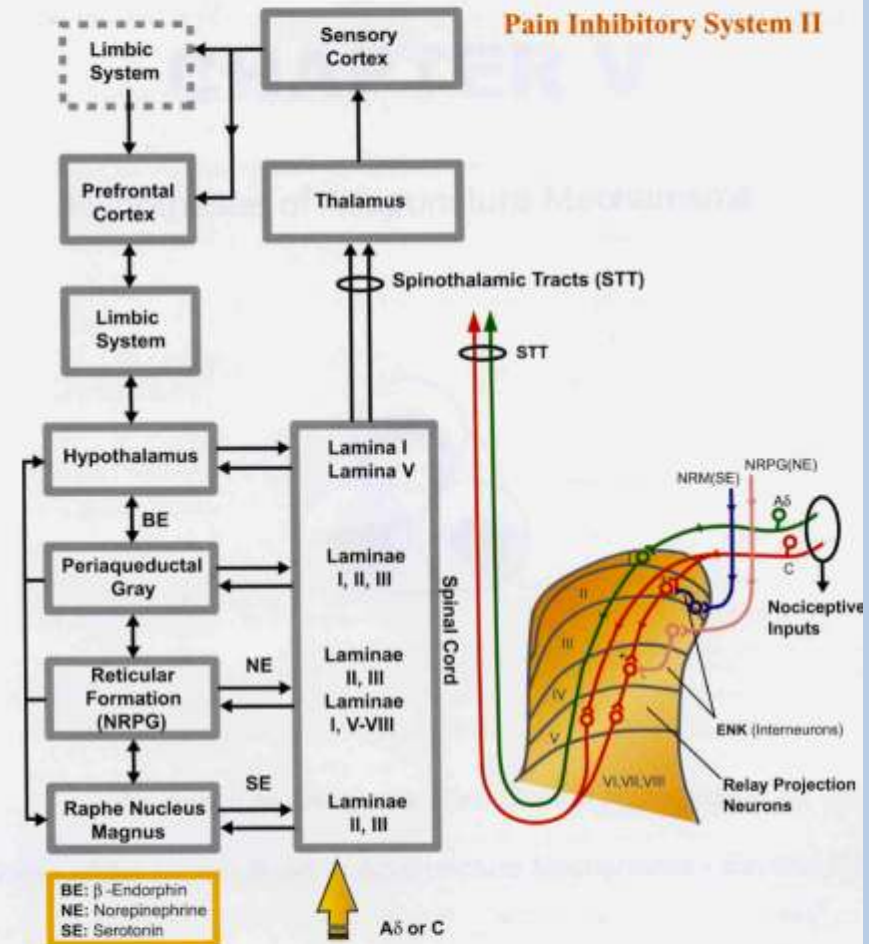


Fig. 52 (b). Overview of pain perception and pain control pathways illustrated in the form of a block diagram.

# Segmental control of pain: « Gate Control » (Melzack et Wall)

We have at any time in the dorsal horn a balance between nerve impulses from the myelinated fibers A (alpha, beta or delta), who have an inhibitory effect on pain, and the nerve impulses originating from C fibers, who carry the painful sensations.

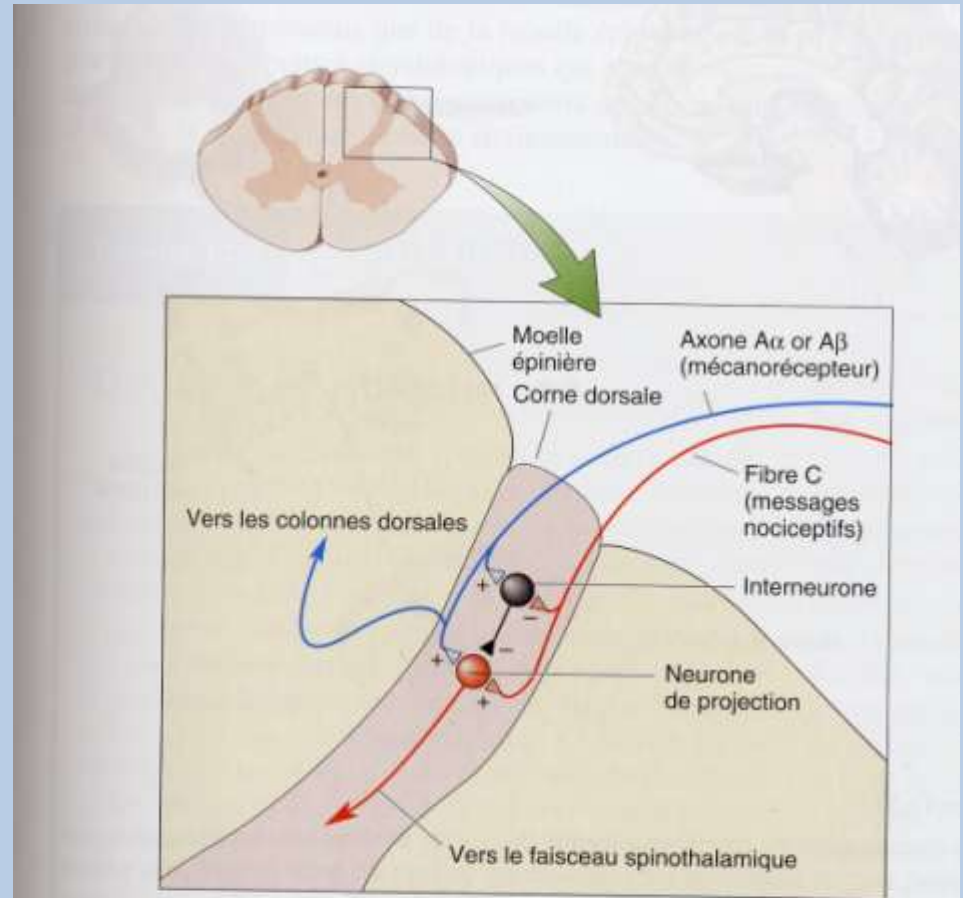


Figure 12.32

Théorie du *gate control* de Melzack et Wall



- A alpha fibers come from the neuro-muscular fuseau; A beta fibers are activated by touch and vibrations, and by proprioceptive impulses coming from the joints and tendons; A Delta fibers a activated by acupuncture.
- This explains how massages, joint manipulations, and exercise have a good effect on pain.
- The pain threshold is determined by the balance between A and C impulses ; so pain can be due to a diminution of the A fibers activity or an augmentation of the C fibers activity.
- The antalgic effect from A fibers is not only local; they can also activate the central mechanisms of pain control.

So we can now have a first explanation for the effects of acupuncture on pain:

- The needle activate A delta nerve endings.
- The nerve impulses from A delta Fibers first have an inhibitory effects on the activity of C fibers in the dorsal horn (gate control effect).
- And a second effect higher in the central nervous system, activating the descending pain inhibitory mechanisms.

But acupuncture also has other important effects:

- Release by the hypophysis of proopiomelanocortin, which splits in three products: beta endorphine, ACTH, and MSH.
- And still higher in the brain, we probably have reflex responses originating from the somesthetic cortex.

The activation by acupuncture of hypothalamic structures is quite interesting

It means that acupuncture effects are not limited to the treatment of pain, but also concern endocrinologic, neuro-vegetative and emotional problems.

# The problem of specificity:

- Only two mechanisms can act specifically: at the segmental level, and at the somesthetic cortex level, where the origin of the painful stimulus from the needle can be located very precisely.
- It's only at these both ends, entry and final destination of the nociceptive stimulus that we can have a specific response.
- The other effects seems to be less specific: all points will more or less activate the descending pain controlling systems and release proopiomelanocortin.

- But the possibility of an endocrinologic more specific action is not unreasonable
- Release of oxytocin by the hypophysis in response of the stimulation of a little area of skin, the nipple, by the suckling baby.
- In this field a lot of research has to be done; but there is no money for that, because the pharmaceutical industry is not interested.
- Meanwhile, we must rely on the tradition, which has established empirically over millennia the right points.

# Acupuncture has also effects on the internal organs

- Visceral pain control
- Regulation of the visceral activity through the effects of needles on the autonomic nervous system

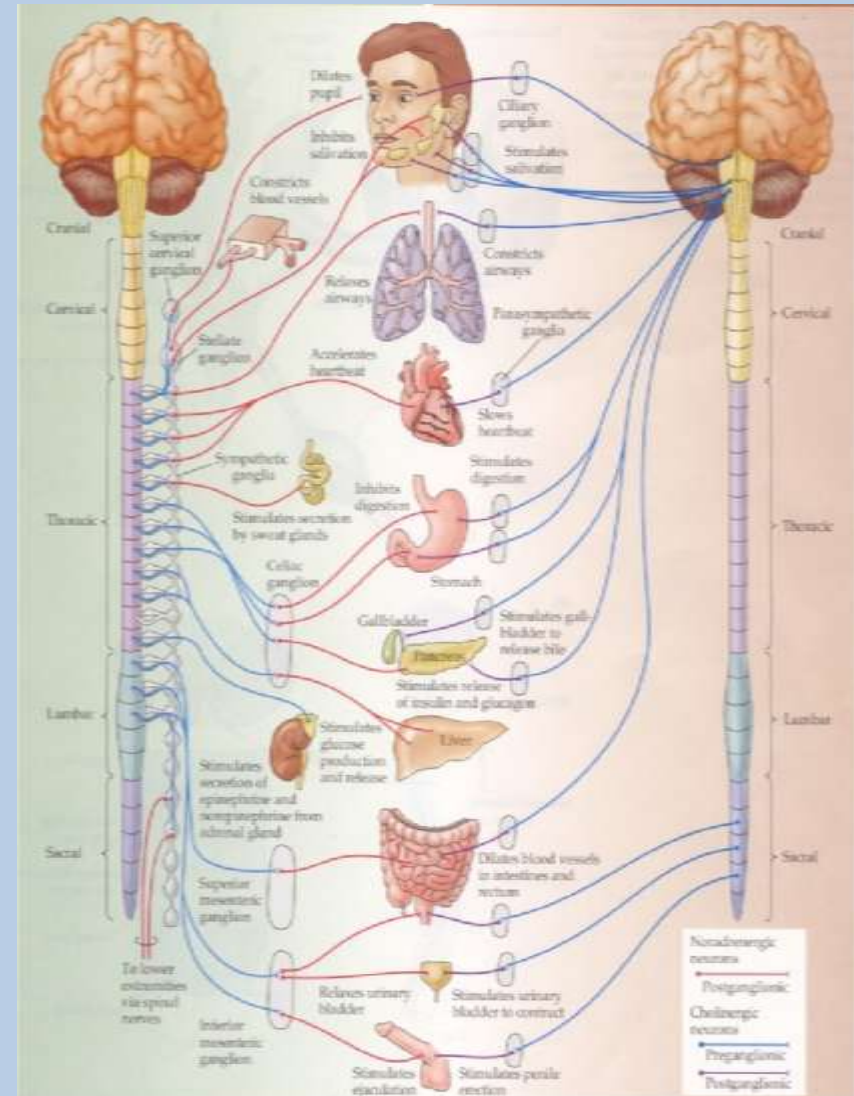


Figure 21.1 Overview of the sympathetic (left side of the figure)

## Visceral pain

The visceral pain is due to the activation of the C nerve endings located in the viscera; the principle of pain treatment will be the same as for somatic pain, with segmentary and central effects.

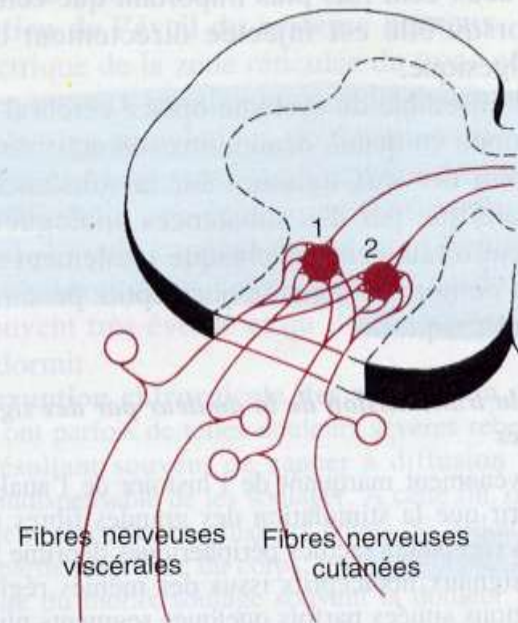


Figure 10-5. Mécanisme de la douleur projetée et de l'hyperalgesie.



# Effects of acupuncture on the autonomous nervous system

- The afferences of the autonomous nervous system are the A Delta fibers and the sympathetic fibers: there are medullary connections between A Delta Fibers and autonomic neurons.
- The sympathetic autonomous fibers are everywhere, in the vessels walls and the sweat glands.
- No parasympathetic fibers on the surface.

In fact it's impossible to put a needle without stimulating both A Delta fibers and sympathetic fibers

- Besides the segmental effect, we also have a central action on visceral pain and visceral activity.
- This central effect on the autonomic nervous system explains two more mechanisms of acupuncture:
  - The effects of acupuncture on emotions
  - The activation of the cholinergic anti inflammatory system

# Acupuncture and emotions

- This is a special chapter which would need a whole lesson.
- Briefly: it's impossible to have an emotion without a reflex response of muscles and the autonomous nervous system.
- In the opposite direction, you can not act on muscles or the autonomous nervous system without having an emotional modification.

# The cholinergic antiinflammatory system:

- Reflex loop mediated by the vagus nerve.
- Inflammation releases cytokines; cytokines activate vagus nerve afferents, and the vagus nerve will respond by the release of acetylcholine, which will act on the nicotinic receptors of the inflammatory cells, inhibiting the release of cytokines.
- The response can be global or local.
- Acupuncture has a cholinergic effect.



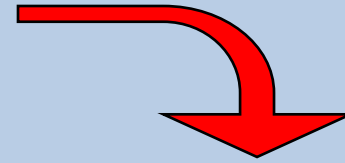
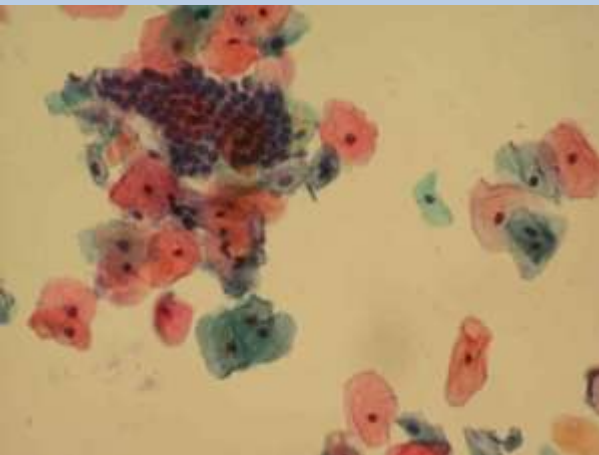
Stimulation des afférences  
vagales



libération de cytokines



Inflammation



Efférences vagales



Acetyl Choline



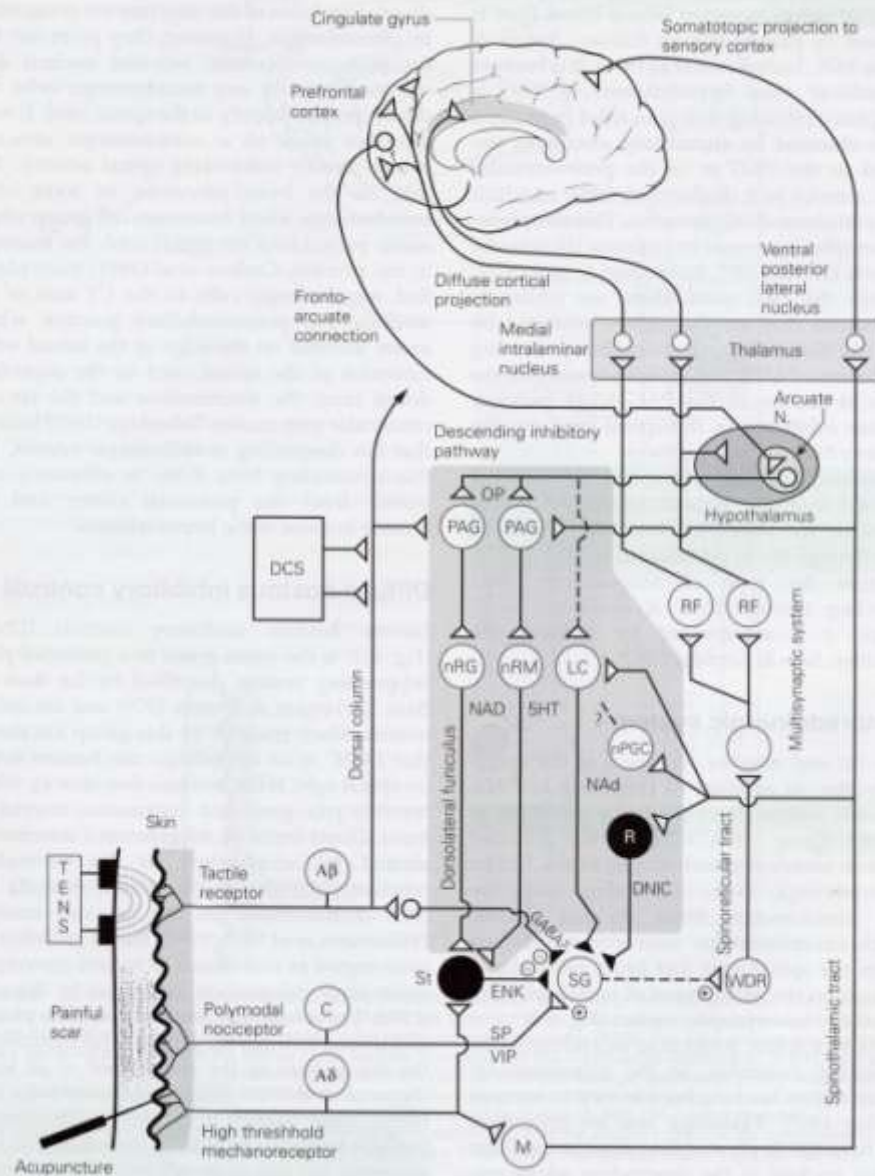
Récepteurs nicotiques des  
cellules inflammatoires

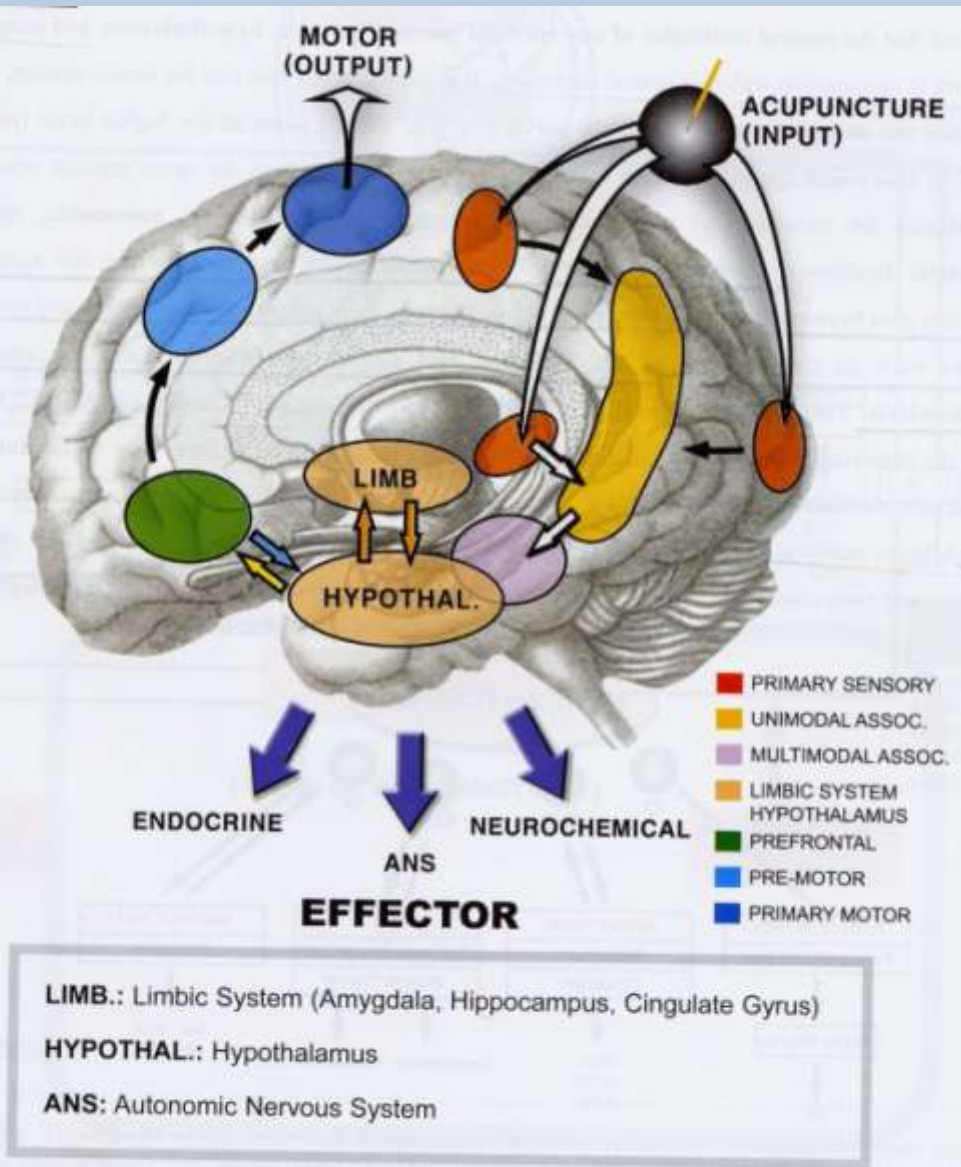


Freinage de la fabrication des  
cytokines

## Summary of the effects of acupuncture

- Somatic and visceral pain control by segmental and central effects.
- Release of proopiomelanocortin and other hormones.
- Visceral regulation.
- Psychic effects.
- Activation of the cholinergic antiinflammatory system.



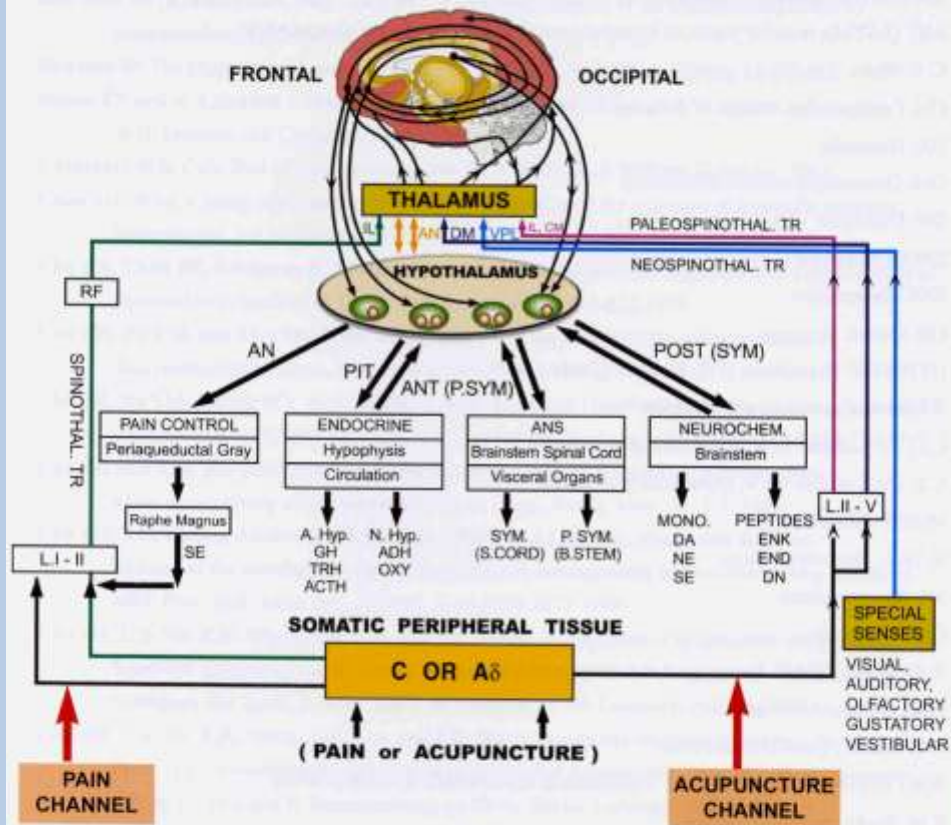


**LIMB.:** Limbic System (Amygdala, Hippocampus, Cingulate Gyrus)  
**HYPOTHAL.:** Hypothalamus  
**ANS:** Autonomic Nervous System

Fig. 55 (b). An illustration of the block diagram shown in Fig. 55 (a) overlaid on a model of the human brain.



controller of the human brain and body.



Chapter V. Hypothesis of Acupuncture Mechanisms

Fig. 56 (b). Hypothesis of the integrated Acupuncture-Disease-Treatment Mechanism. Note that pain control is only a small part of the broader survival-related functions of acupuncture disease treatment, including endocrine, autonomic and neurochemical functions. These are mainly controlled by the hypothalamus, the central integrator and controller of the body and the brain.