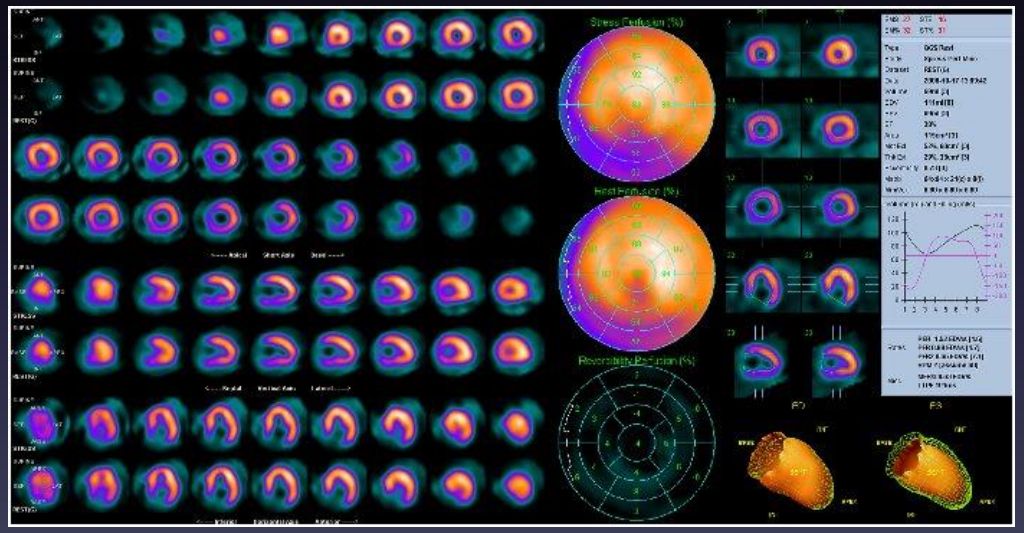
SPECT IMAGING AND MAIN MEDICAL APPLICATIONS



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Medical image and instrumentation. UGR Course 2015-2016

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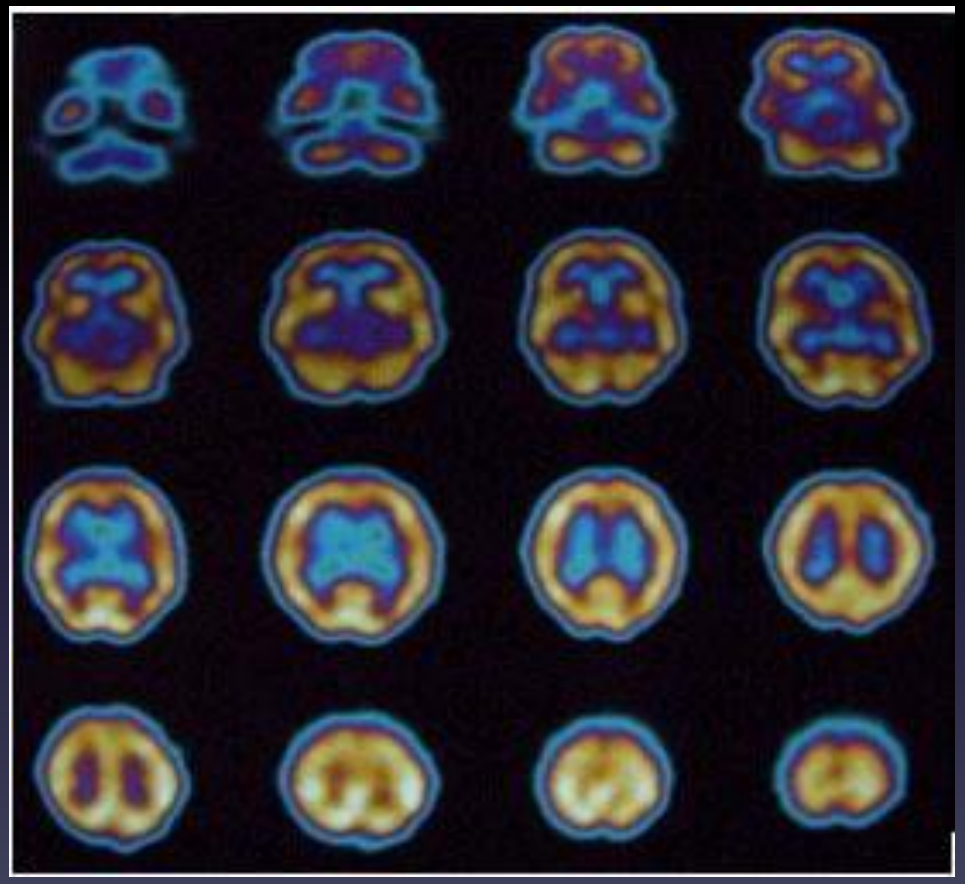


INTRODUCTION: HISTORY

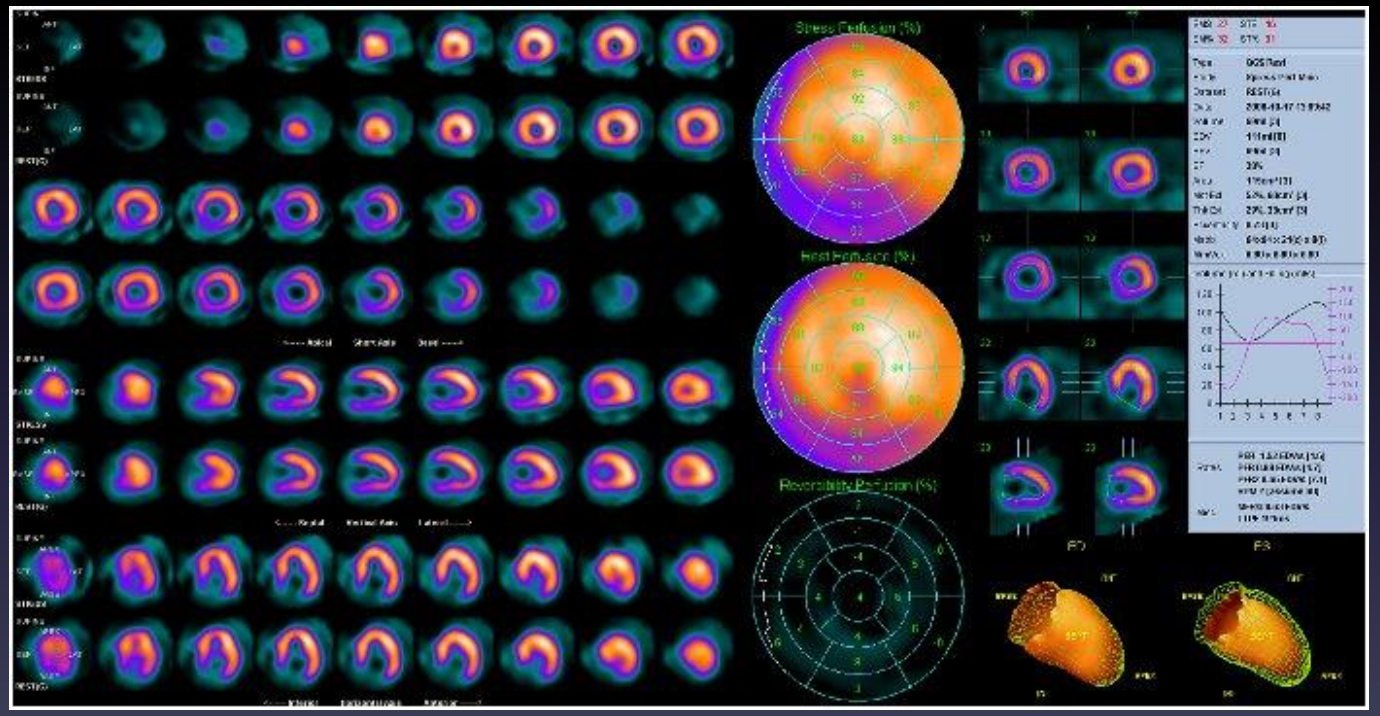
Hal. o anger

David kuhl

SPECT IS A TECNIQUE THAT IS USED IN THE FIELD OF NUCLEAR MEDICINE

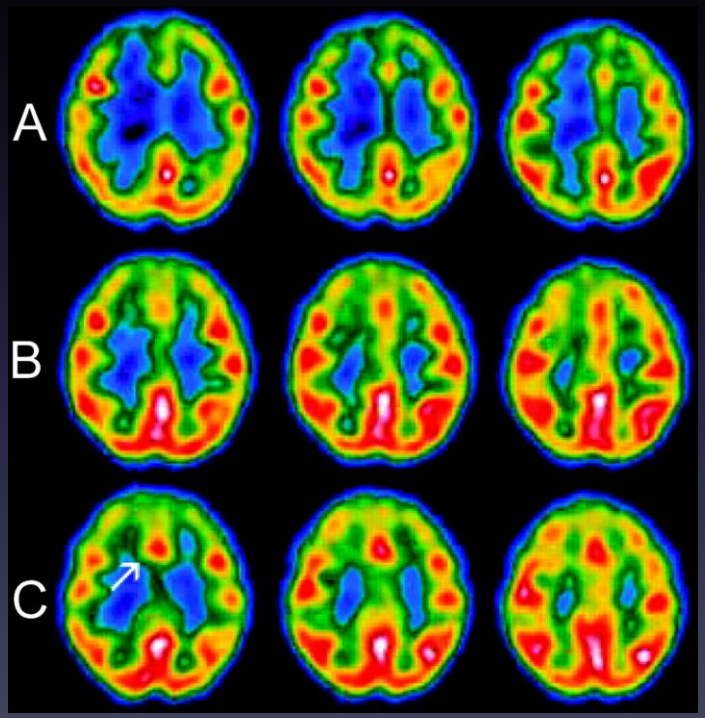
- George Moore (40´s) observed accumulation of fluorescence.
- Hal O Anger (50´s) the scintillation counter and the gamma-camera.
- In 1964 is used Tc^{99m}
- In 70's is developed TC and RNM
- Kuhl and Edwards (80´s) : SPECT is using a rotating gamma-camera.

WHAT IS SPECT?



Cardiac SPECT

SPECT :Single Photon Emission Computed Tomography



- Uses gamma radiation
- We obtain two-dimensional, and getting all of them together we can observed a three-dimensional image
- It is a very available technique in Nuclear Medicine services
- It's more affordable than PET
- It provides functional and metabolic information
- It allows the study of images through the administration of a radiopharmaceutical.

How does a SPECT work?

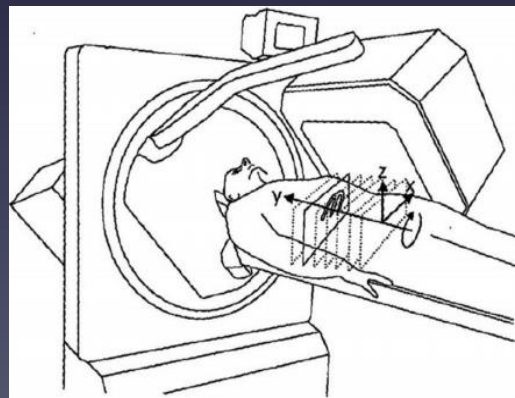
To get a SPECT study, we made a conventional gamma-camera rotate around the patient, recording an image on each angular step.

- ***How many angular projections should we get?***

We need the distance that enables us to describe a circle around the organ that we are studying.

- ***For how long should I acquire each projection?***

We just have to divide the total duration of the study between the number of angles.



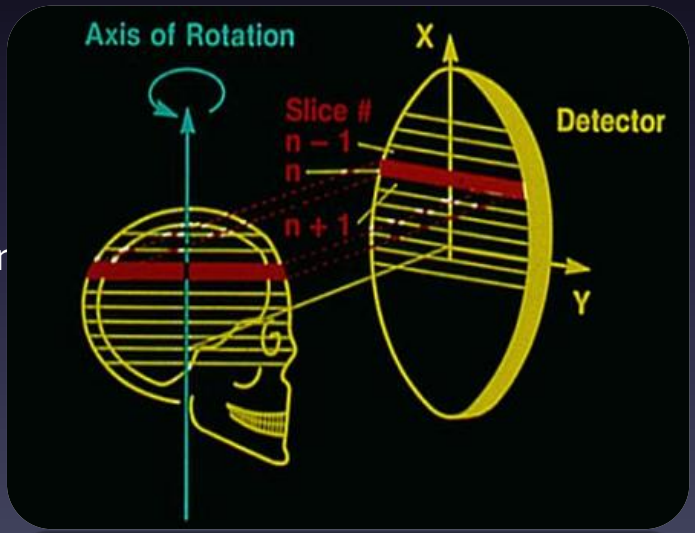
180º vs. 360º acquisition

- There are some situations in which it's better to get a 180º acquisition than a 360º (cardiac SPECT or bone SPECT)
- In a 180º acquisition we get more count in the same time and the resolution is too much better.

Cameras of a detector vs. multidetectors

- Nowadays is very common the use of multidetectors.
- The different detectors work independently so they ar

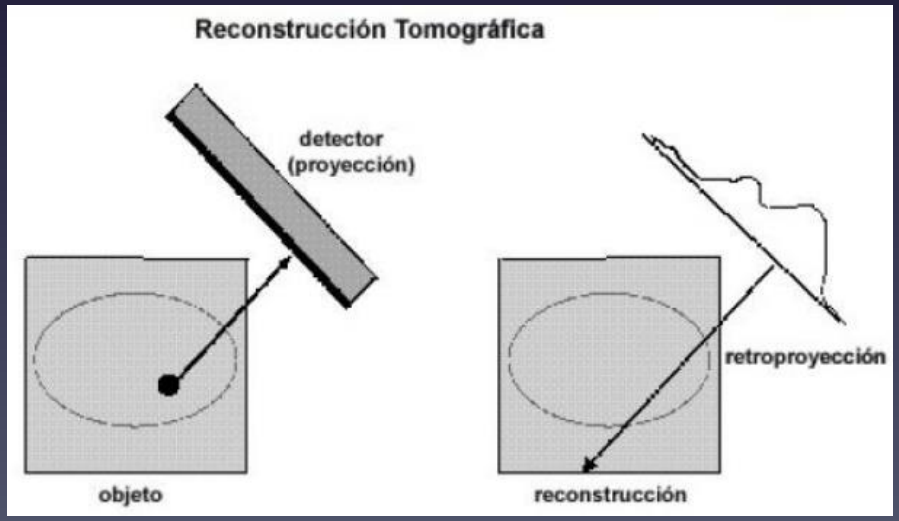
getting different projections at the same time.



Back-projection reconstruction

- Back-projection involves taking the count of the projection and emiting them backwards in the same direction where they came from.

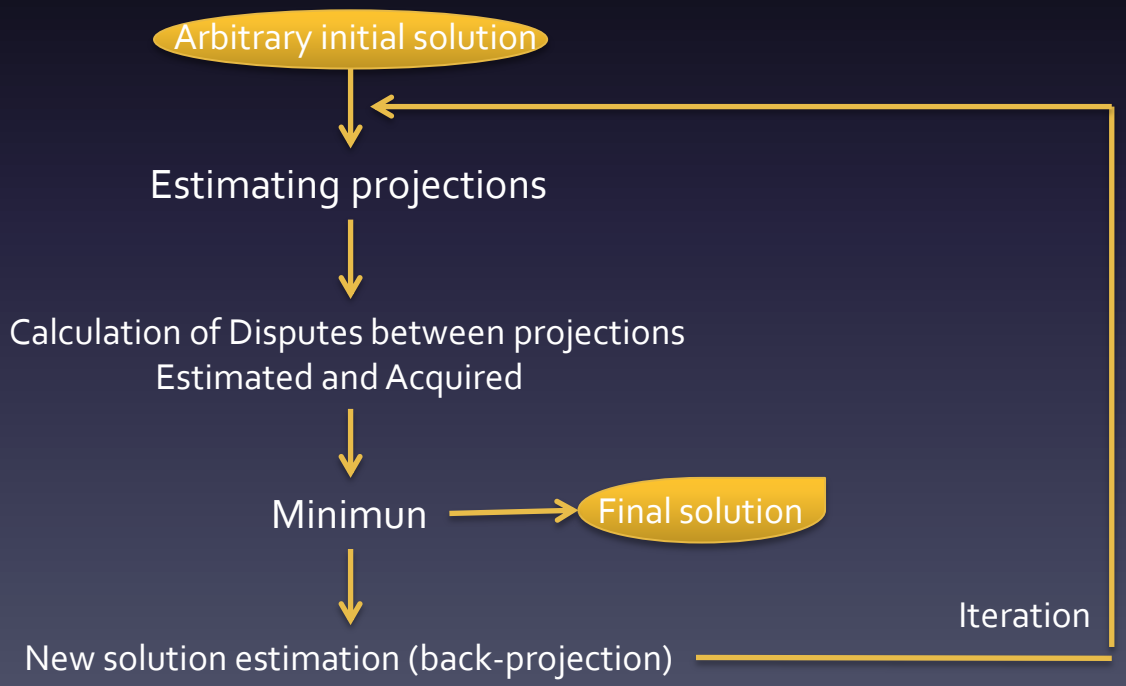
- We get a group of images around the patient, but there are counts everywhere so we need to correct that problem.
- The way to do that is to use a filter, then we talk about a back-projection filtered.



Iterative reconstruction

- The iterative reconstruction involves two steps: the back-projection and the opposite process, known as forward projection.

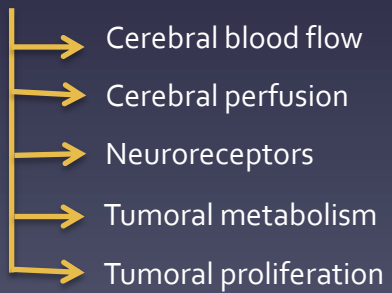
- The iterative reconstruction steps are:



Main medical applications

- It is more used in neurology and cardiology: brain SPECT and myocardial SPECT.

- They use radiotracers: radioactive isotope replacing a stable chemical element in a compound (said to be radiolabeled) and so able to be followed or tracked through one or more reactions or systems by means of a radiation detector.
  - Depending on their affinity:



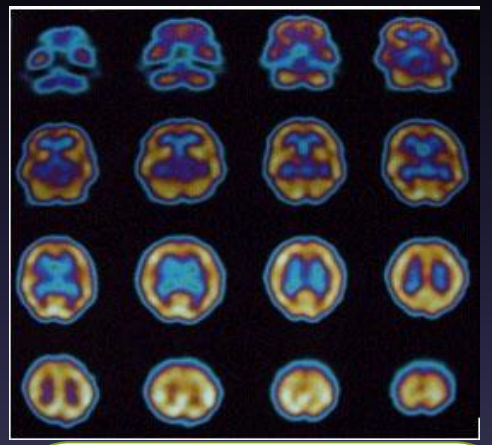
Brain SPECT

Radiotracers cross the BBB and are distributed in different structures in proportion to regional blood flow

There is a parallelism between neuronal activity, metabolism, and cerebral bool flow. The hypoperfused areas will be the reflect of the hypometabolism they present.

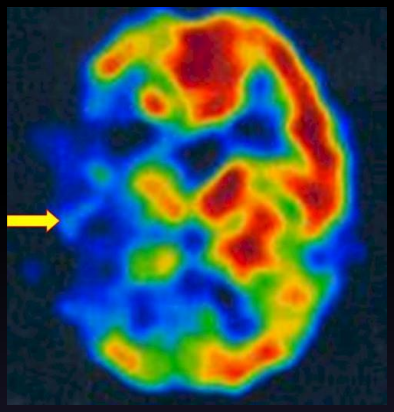
APPLICATIONS

- **Cerebrovascular diseases:** SPECT allows observation of cerebral ischemia in the beginning and the study "in vivo" of its pathogenesis.
- **Dementias**: we find characteristic patterns depending on the type of dementia. Example> Alzheimer temporo-parietal hypoperfusion
- **Epilepsy**: Observe hyperperfusion or hypoperfusion areas depending on when we meet, this will permit us to locate the epileptogenic focus.
- **Psychiatry**: There are specific patterns in the different disorders such as schizophrenia, depression or OCD

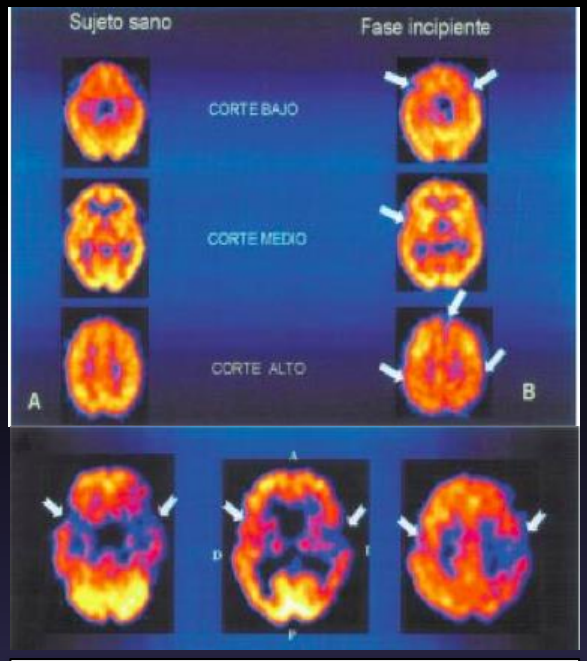


Normal brain SPECT: Clearly defined cortical and subcortical gray matter with a higher perfusion than white matter.

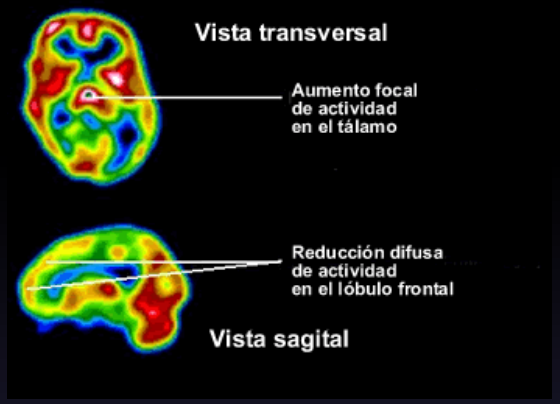
Brain SPECT examples



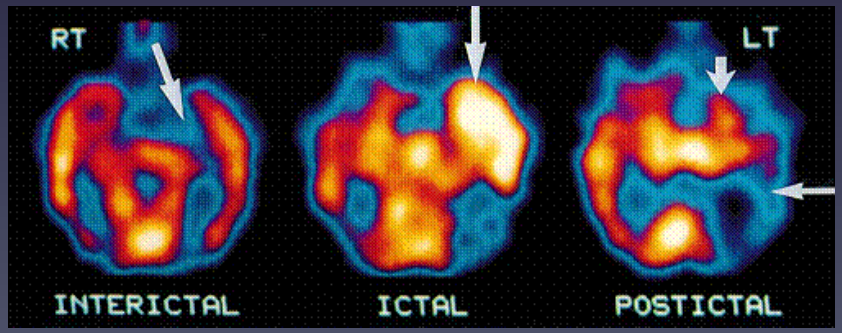
Cerebrovascular disease



Alzheimer's patient



Epilepsy

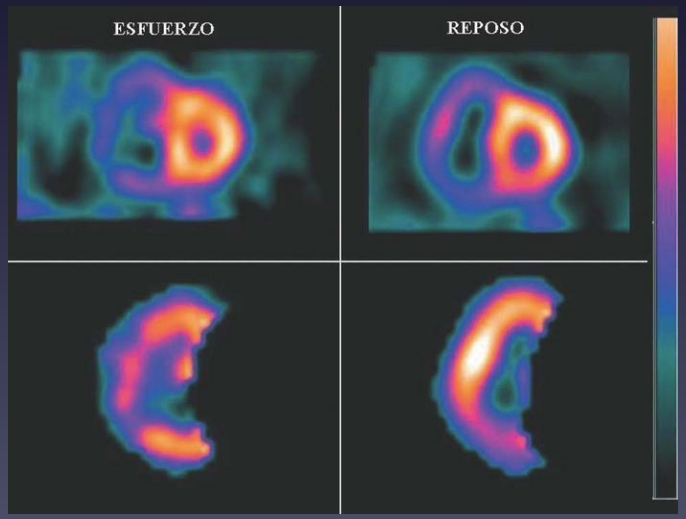


Depression

Nuclear cardiology
Myocardial perfusion SPECT

- Nuclear cardiology has a key role in the detection of coronary heart disease (CHD).

- The possibility of obtaining perfusion images synchronized with the electrocardiogram (ECG) allows studying in the same exploration the state of myocardial perfusion and ventricular function



Acute ventricle and right atrium infarct

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