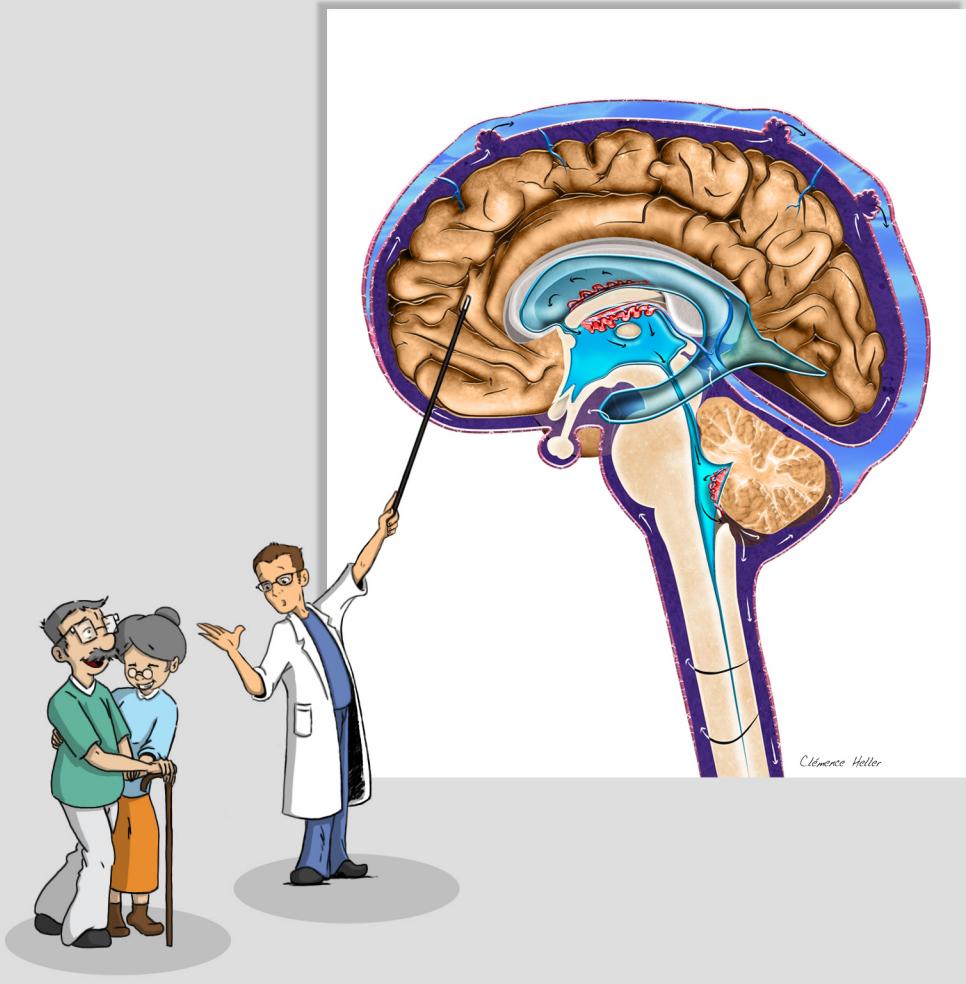


Understanding Chronic Adult Hydrocephalus



Author : Dr. Timothée Jacquesson*
Dr. Romain Manet*

Illustrator : Clémence Heller

*Department of Cranial Neurosurgery,
Neurological and Neurosurgical Hospital
Pierre Wertheimer, University Hospital of Lyon, France

Φ **SOPHYSA**
At the heart of the **brain**

Dear reader

You or someone close to you has **hydrocephalus...**

Beyond its unusual name, hydrocephalus is a difficult disease to understand :

- Why does it occur?
- How can it be treated?

In our neurosurgery department, we frequently care for patients with hydrocephalus, providing answers to questions about the disease, its origin, its surgical treatment and risks, and the post-operative follow up.

Through this cartoon adventure of Mr. B, we wanted to gather valuable information for patients and their loved ones. We tried to provide easy to understand details about the brain, the physiology of the cerebrospinal fluid in and around the brain, and the treatment options, with their respective advantages and disadvantages.

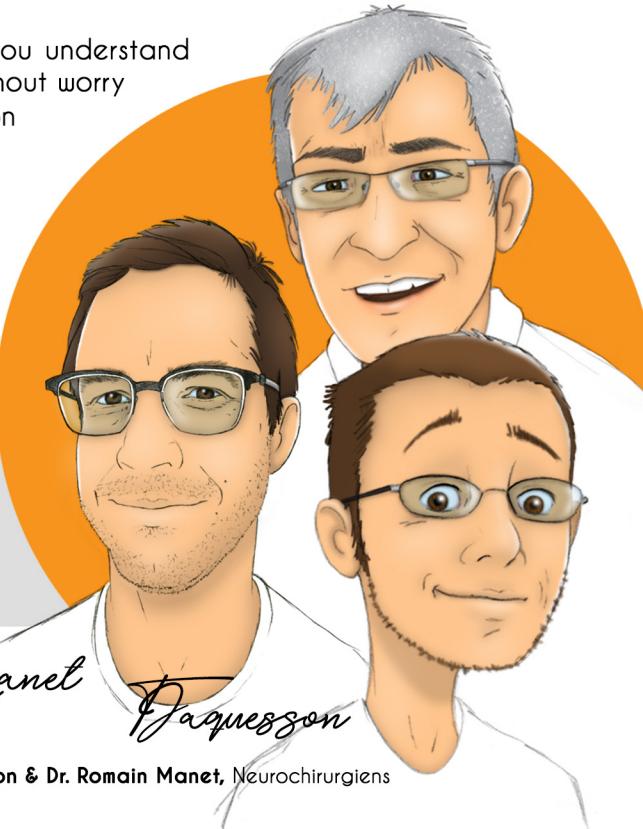
Finally, we explain the warning signs, and the necessary precautions.

We hope this booklet will help you understand hydrocephalus, and prepare without worry for your neurosurgical intervention

This booklet can also be a hydrocephalus reference source, for you to review in the future.

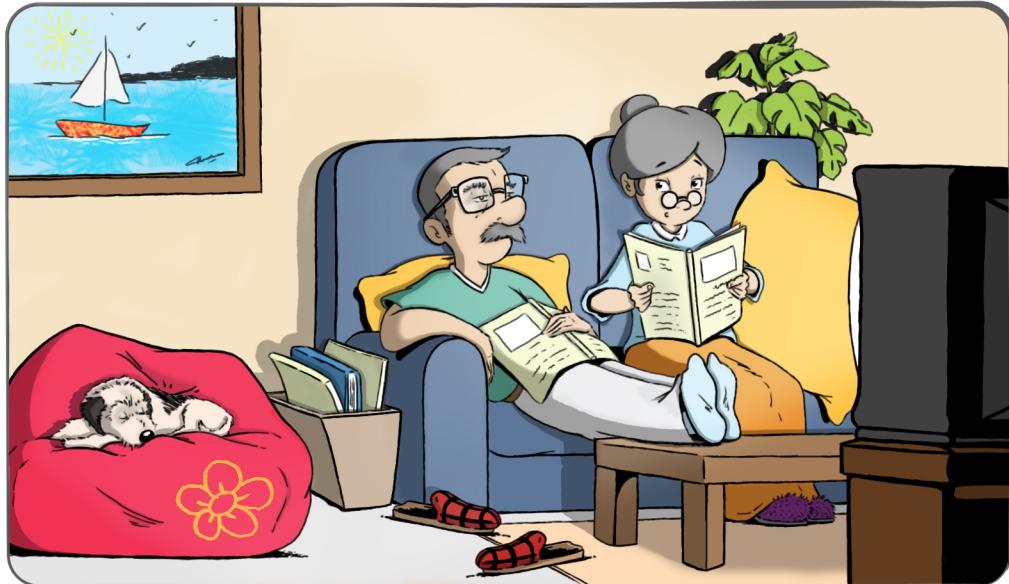
We thank **Sophysa** for supporting us in the realization of this project

Good reading !



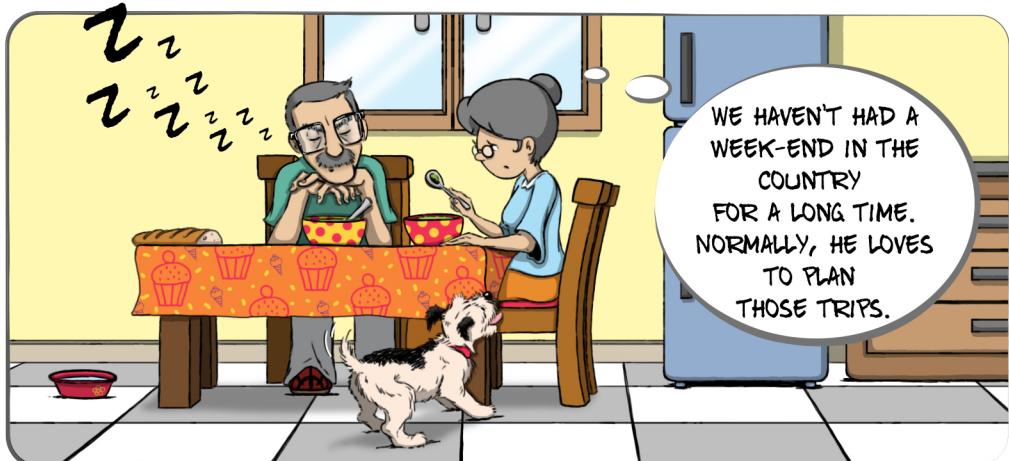
R. Manet
T. Jacquesson

Dr. Timothée Jacquesson & Dr. Romain Manet, Neurochirurgiens

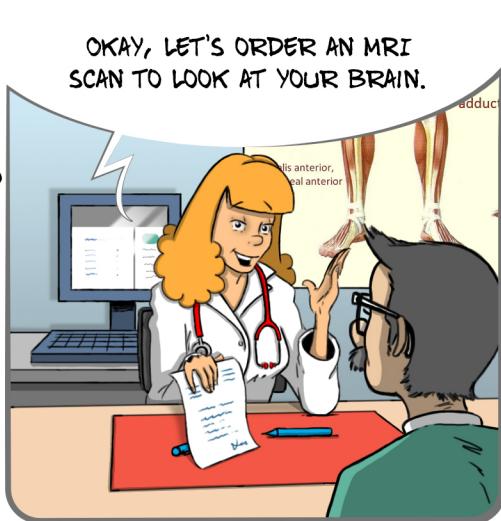
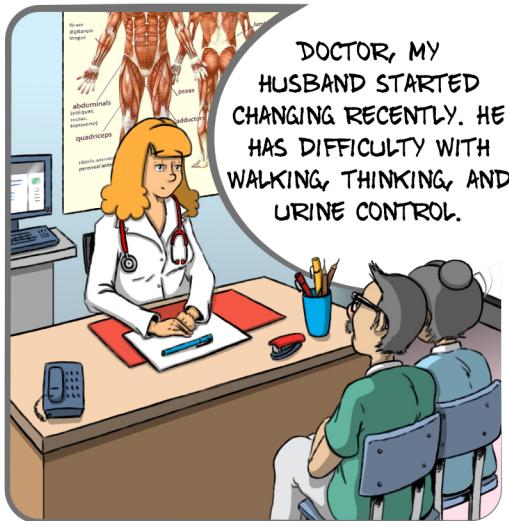


DARLING, YOU DON'T EXERCISE
OR EVEN DO CROSSWORDS ANYMORE
WHAT'S HAPPENING ?

ACTUALLY, I HAVE
BEEN FEELING WEAK LATELY,
AND NOT VERY STEADY WALKING.

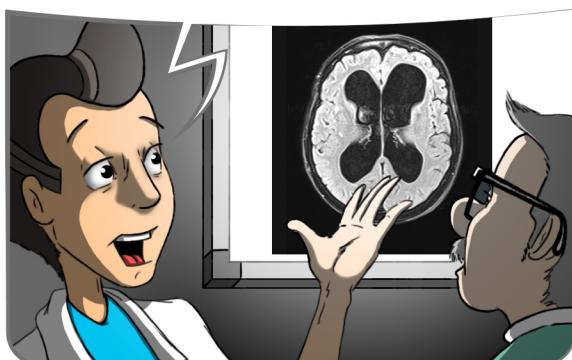


WE HAVEN'T HAD A
WEEK-END IN THE
COUNTRY
FOR A LONG TIME.
NORMALLY, HE LOVES
TO PLAN
THOSE TRIPS.

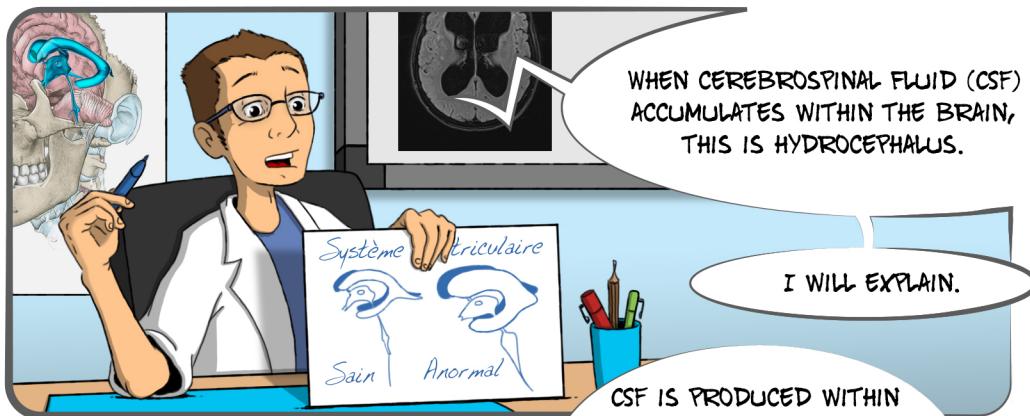


THIS IS THE MRI OF YOUR BRAIN. I DO NOT SEE ANY SIGNS OF STROKE, BUT YOUR VENTRICLES (THE CAVITIES WHICH CONTAIN THE CEREBROSPINAL FLUID) SEEM TO BE ENLARGED.

IT COULD BE HYDROCEPHALUS. YOU NEED TO MEET WITH A NEUROSURGEON.



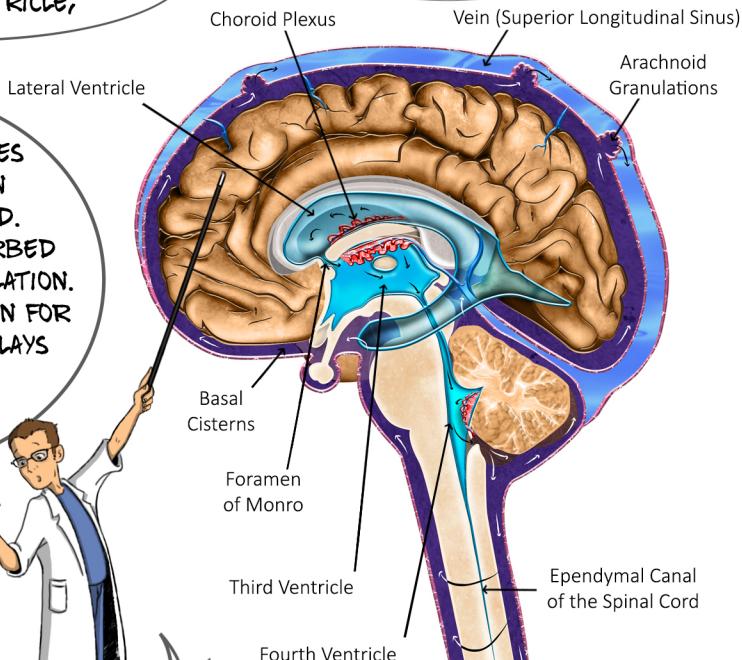
I HAVE MORE AND MORE MEMORY DIFFICULTIES.



THROUGH LATERAL VENTRICLES,
THE 3RD VENTRICLE, AND
THE 4TH VENTRICLE,
...

CSF IS PRODUCED WITHIN
THE VENTRICLES, BY VASCULAR
STRUCTURES KNOWN AS
CHOROID PLEXUS.
THEN THE CSF CIRCULATES
...

AND THEN IT DIFFUSES
AROUND THE BRAIN
AND THE SPINAL CORD.
FINALLY, IT IS REABSORBED
INTO THE VEINS CIRCULATION.
CSF PROVIDES PROTECTION FOR
THE BRAIN AND ALSO PLAYS
A ROLE IN BRAIN
METABOLISM.

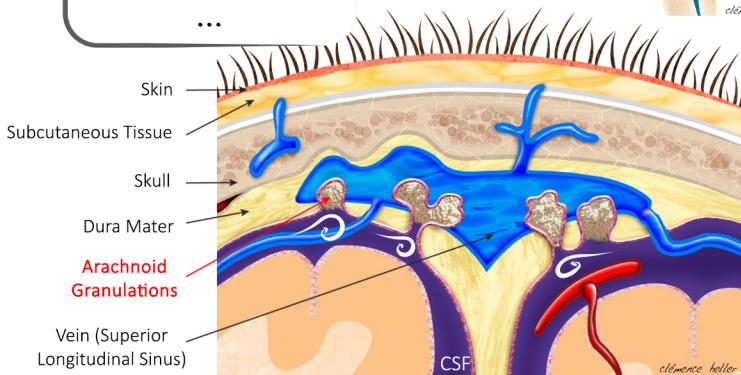
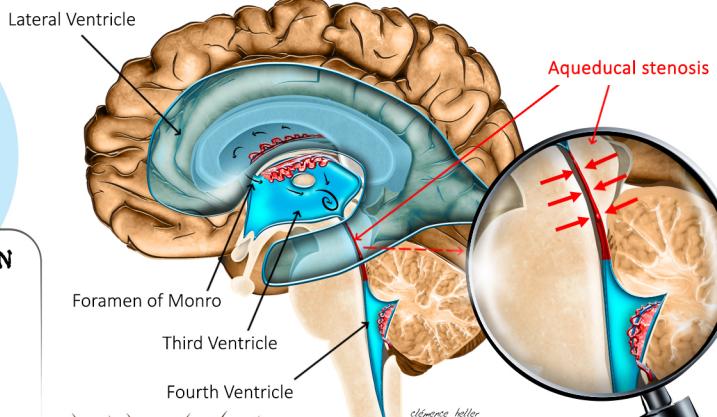


CONFIRMING THE DIAGNOSIS
OF HYDROCEPHALUS REQUIRES
A LUMBAR PUNCTURE,
TO MEASURE PRESSURE
AND WITHDRAW CSF.



HYDROCEPHALUS CAN
RESULT FROM AN
OBSTRUCTION OF
NORMAL CSF
CIRCULATION,

...



...OR FROM IMPAIRMENT
OF REABSORPTION
WITHIN THE VEINOUS
SYSTEM. IN BOTH
CASES, THIS PROBLEM
LEADS TO VENTRICULAR
DILATATION AND
BRAIN COMPRESSION.

WHAT ARE THE CONSEQUENCES
OF HYDROCEPHALUS?



INPH TYPICALLY
PRESENTS WITH A CLINICAL
TRIAD: WALKING AND
BALANCE DIFFICULTIES,
URINARY EMERGENCIES AND
LEAKS, AND COGNITIVE
DYSFUNCTIONS, SUCH AS
MEMORY LOSS AND FATIGUE.

BUT THAT'S EXACTLY WHAT I HAVE!

I'VE FALLEN SEVERAL
TIMES RECENTLY, FOR NO
REASON. I ALWAYS FEEL WEAK.
AND, I'VE BEEN HAVING
URINARY PROBLEMS.



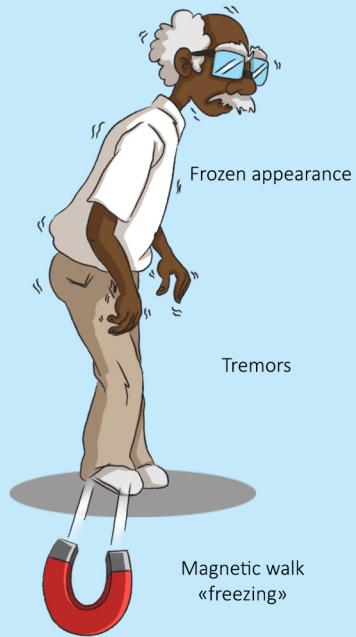


SIMILAR CLINICAL SIGNS MAY BE ASSOCIATED
WITH OTHER CONDITIONS,
POSSIBLY ASSOCIATED WITH HYDROCEPHALUS

ABNORMAL MOVEMENTS,
PARKINSON'S
DISEASE AND SIMILAR DISORDERS

DEGENERATIVE SKELETAL DISEASES:

- NARROW LUMBAR CANAL
- CERVICAL MYELOPATHY
- OSTEOARTHRITIS OF THE HIP AND KNEE



WHAT CAN WE DO DOCTOR?



THERE ARE TWO TYPES OF SURGICAL SOLUTIONS TO TREAT HYDROCEPHALUS:

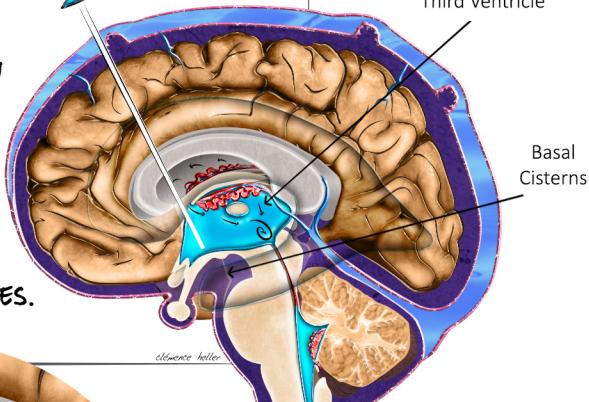


IF YOUR HYDROCEPHALUS IS DUE TO AN OBSTRUCTION OF CSF CIRCULATION, WE CAN PERFORM AN ENDOSCOPIC THIRD VENTRICULOSTOMY.

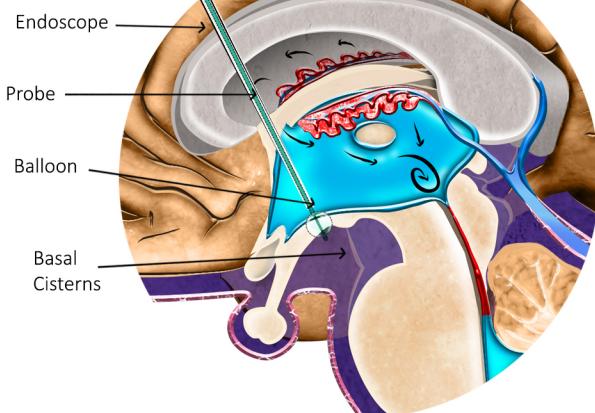
IT INVOLVES SHUNTING THE CSF CIRCULATION, BY CREATING A NEW COMMUNICATION BETWEEN THE VENTRICLES AND EXTERNAL CSF PATHWAYS. IT IS PERFORMED THROUGH A SMALL SKIN INCISION AT THE TOP OF THE HEAD, WHICH ALLOWS THE INTRODUCTION OF A CAMERA THROUGH THE VENTRICLES.



Endoscope



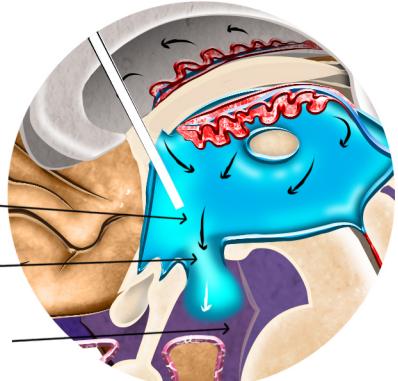
Third Ventricle
Basal Cisterns



...OUT OF THE VENTRICLES, TOWARDS EXTERNAL CSF SPACES. THE PROCEDURE TAKES 30 MINUTES, AND RISKS ARE RELATIVELY LOW, SUCH AS INSUFFICIENT EFFECT, HEMATOMA, OR INFECTION.

WITH A SMALL PROBE, AND A MICRO-BALLOON, THE FLOOR OF THE THIRD VENTRICLE IS OPENED, TO ALLOW THE CSF TO FLOW,

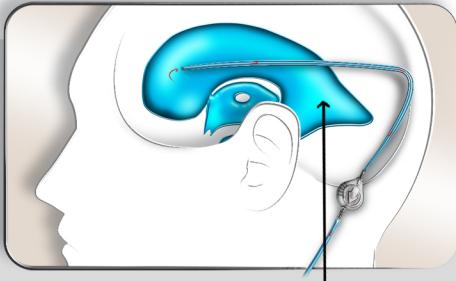
Reestablished Circulation
Surgical Opening
Basal Cisterns



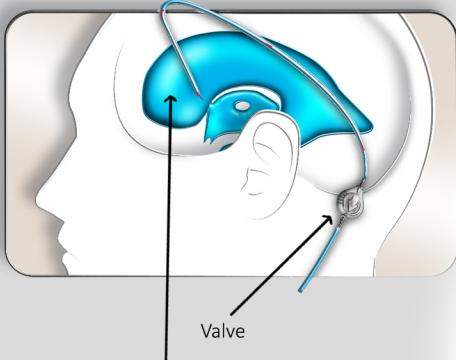
ON THE OTHER HAND, IF YOUR HYDROCEPHALUS IS DUE TO AN IMPAIRMENT OF CSF REABSORPTION, THEN WE PERFORM A VENTRICULOPERITONEAL SHUNT. A SMALL CATHETER IS INSERTED WITHIN ONE OF THE LATERAL VENTRICLES, AND IT IS CONNECTED TO A VALVE, THAT CONTROLS THE FLOW OF CSF.



Typical Ventricular Punctures:



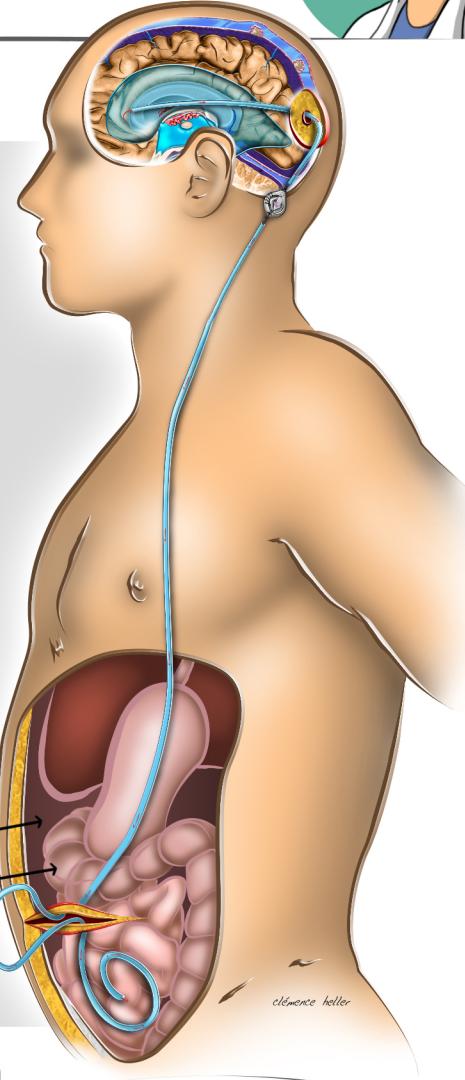
Ventricular Atrium (Occipital Horn of Lateral Ventricle)



Frontal Horn of Lateral Ventricle

Abdominal Cavity

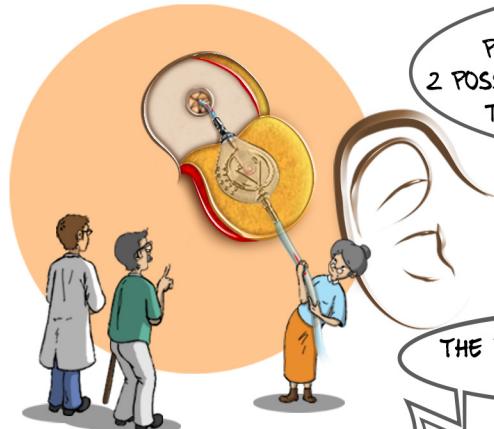
Digestive Tract



ANOTHER LONGER CATHETER IS THEN GUIDED UNDER THE SKIN TO THE ABDOMINAL CAVITY, WHERE ITS TIP IS INSERTED.

FOR THIS PROCEDURE, WE MAKE ONE OR TWO INCISIONS ON THE HEAD, AND ONE NEAR THE UMBILICUS. THIS PROCEDURE TAKES 45 MINUTES, AND THE RISKS ARE ALSO RELATIVELY MINOR.

IF THE ABDOMINAL CAVITY IS NOT ACCESSIBLE, NOTABLY DUE TO SURGICAL SCARRING, THE CEREBROSPINAL FLUID CAN THEN BE DIVERTED INTO THE VENOUS SYSTEM BY MEANS OF A VENTRICULO-ATRIAL SHUNT.



AS WITH A VENTRICULO-PERITONEAL SHUNT, THERE ARE 2 POSSIBLE PUNCTURE SITES FOR ACCESS TO THE VENTRICULAR SYSTEM...

... AND THE VALVE IS ALSO PLACED BEHIND THE EAR, UNDER THE SKIN.

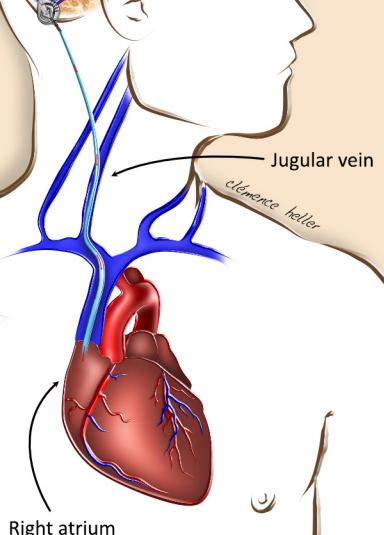
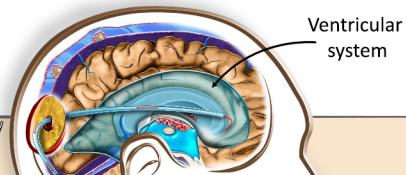
THE DIFFERENCE WITH THIS TYPE OF SHUNT:

THE TUBE PLACED UNDER THE SKIN CONNECTS THE VENTRICLES TO THE JUGULAR VEIN...

THEN TO THE RIGHT ATRIUM OF THE HEART.

HOW LONG DOES THE PROCEDURE TAKE?

PLACEMENT OF A VENTRICULO-ATRIAL SHUNT TAKES LESS THAN 1 HOUR. IT CAN ALSO BE PERFORMED UNDER LOCAL ANESTHESIA, WHICH REPRESENTS FEWER RISKS FOR CERTAIN PATIENTS AND ALLOWS A FASTER RETURN TO INDEPENDENCE.





AND IF
WE CANNOT GO THROUGH
THE BRAIN,
HOW WILL THIS BE DONE?



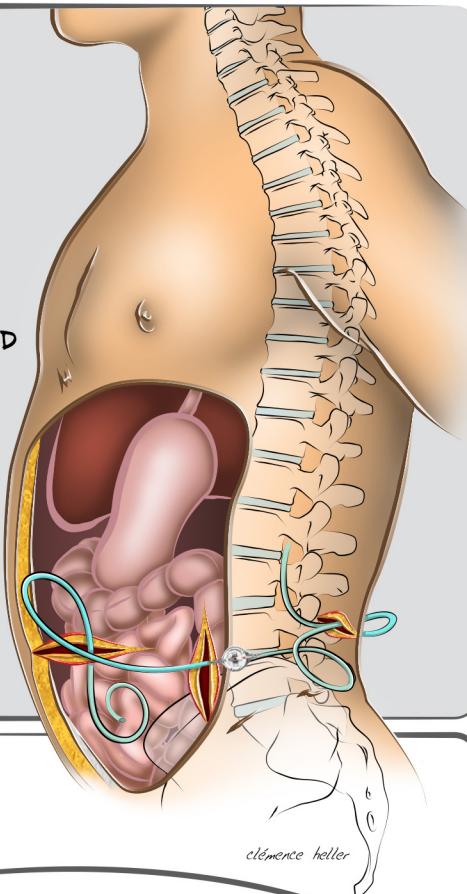
THERE IS A THIRD TECHNIQUE:
THE LUMBO-PERITONEAL SHUNT.

THE CEREBROSPINAL FLUID IS COLLECTED
FROM THE LOWER BACK,

THEN DIVERTED TO THE ABDOMEN.

THE VALVE IS IMPLANTED ON
THE ILIAC CREST OR ON A RIB,
AND THE CATHETER THEN EXTENDS INTO
THE PERITONEUM TO DRAIN THE EXCESS
CEREBROSPINAL FLUID.

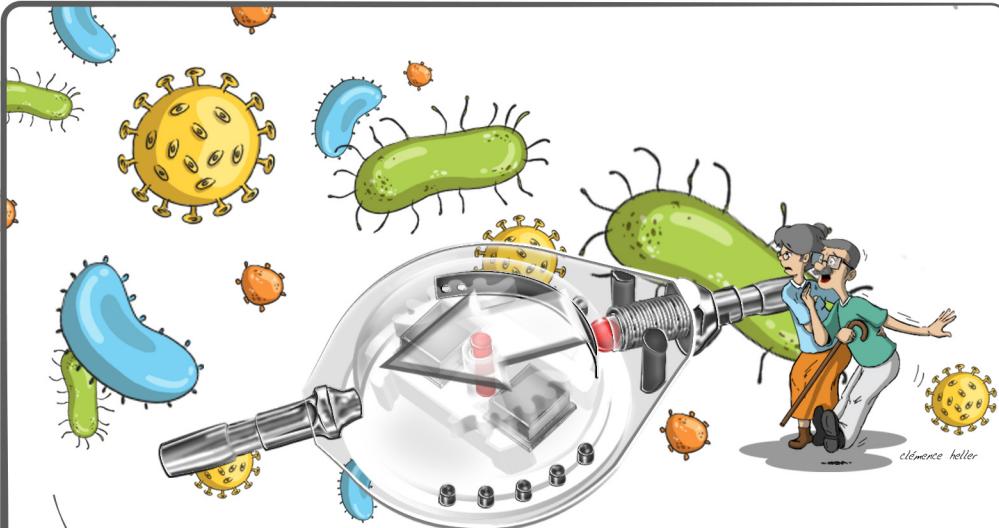
IS IT JUST AS EFFECTIVE?



YES, THIS METHOD
IS JUST AS EFFECTIVE AS THE OTHERS.
LIKE ALL TECHNIQUES, IT HAS ITS
ADVANTAGES AND DISADVANTAGES
FOR PATIENTS.

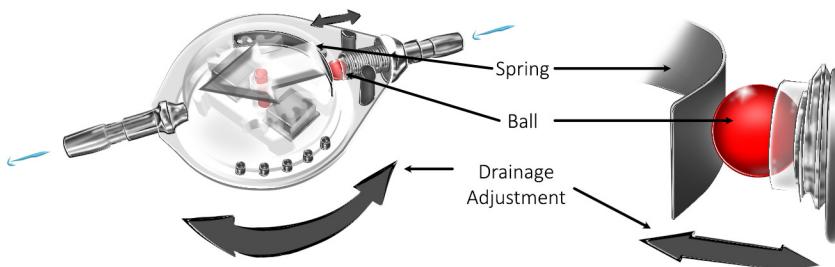
HOWEVER, IT CAN HAVE
COMPLICATIONS.

BUT WHICH ONES ?!!!

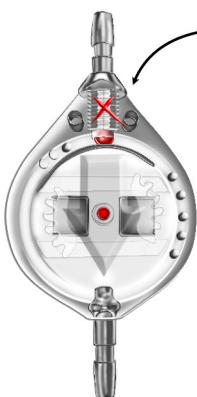


THE HIGHEST RISK
IS INFECTION, AS THIS INVOLVES
FOREIGN MATERIAL, BUT ALL PRECAUTIONS
ARE TAKEN IN THE OPERATING ROOM
TO ENSURE STERILE CONDITIONS!

DIAGRAM OF THE VALVE



ANOTHER RISK IS MALFUNCTION
DUE TO OVERDRAINAGE OR INSUFFICIENT DRAINAGE



Bloking
by Debris

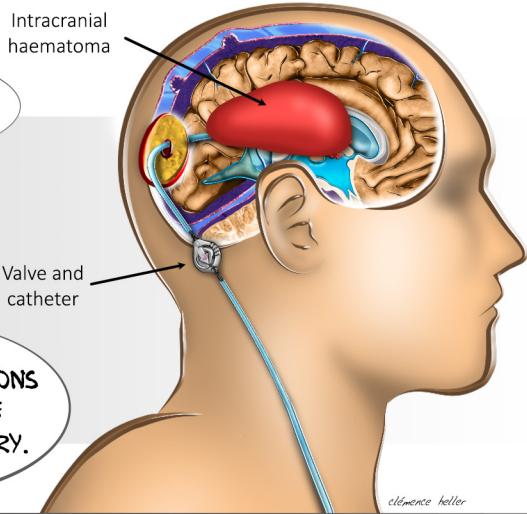
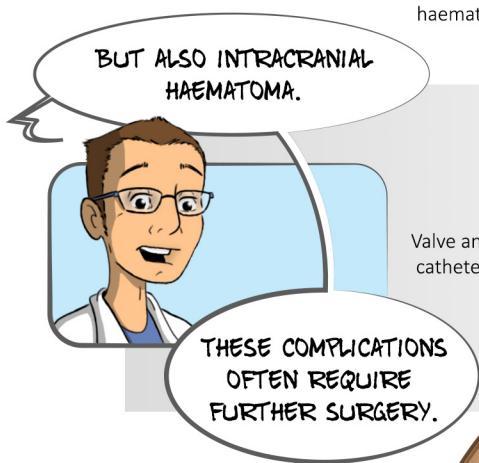


Insufficient Drainage



Abnormal
Opening
by Debris

Over Drainage



THERE MAY BE OTHER COMPLICATIONS SUCH AS:

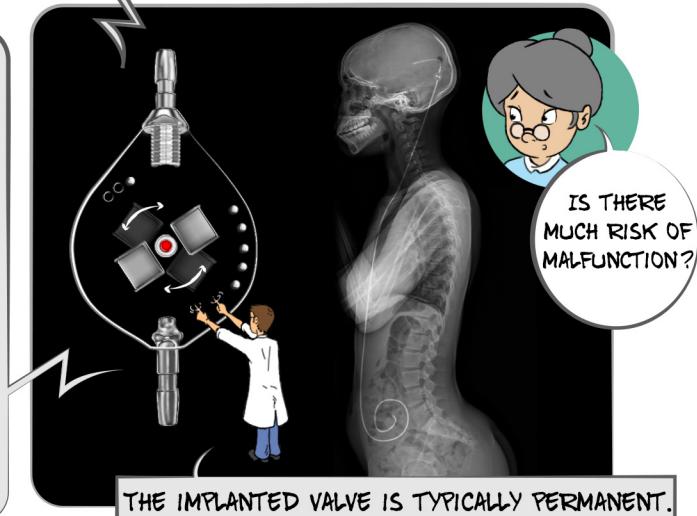
- MIGRATION OF THE SHUNT
- A (VERY RARE) EPILEPSY



IS THERE ANY
SPECIAL POST-OP
FOLLOW-UP?

YES. IN THE EARLY POST-OPERATIVE PERIOD,
WE WILL PERFORM A CT SCAN OR MRI, AND A SIMPLE
X-RAY, TO CHECK THE POSITION OF THE SHUNT.

OLDER ADJUSTABLE
VALVES SOMETIMES HAD
PROBLEMS WITH MAGNETIC
FIELDS, BUT THE NEWEST
ADJUSTABLE VALVES ARE
MRI STABLE. THEY ARE
DESIGNED TO KEEP THEIR
SETTINGS, EVEN WHEN EX-
POSED TO STRONG
MAGNETS, LIKE AN MRI,
OR WEAK MAGNETS, LIKE
AIRPORT SECURITY GATES.



MR B JUST HAD SURGERY

THE SURGERY WENT
VERY WELL. YOU WILL BE
DISCHARGED IN 2 DAYS.

IT WILL BE NECESSARY TO CONTINUE CARING FOR
YOUR WOUNDS DAILY, WITH IODINE SCRUBS, UNTIL
COMPLETE HEALING, WHICH USUALLY TAKES 7 TO 10
DAYS. THE SURGICAL SUTURES WILL BE REMOVED AT
DAY 10. BE CAREFUL TO FOLLOW ALL OF THE
POST-OPERATIVE INSTRUCTIONS: NO BATHING FOR 1
MONTH AFTER SURGERY AND PROTECT THE SURGICAL
SCAR FROM THE SUN FOR AT LEAST 1 YEAR.

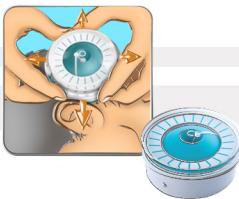
DURING YOUR FOLLOW-UP,
WE MAY CHANGE THE SETTING
OF YOUR VALVE WITH
THIS DEVICE.



UNFORTUNATELY, YES.
OVERALL, LONG-LASTING SUCCESS
RATES RANGE FROM 30% TO 90%.

CAN THE DISEASE
COME BACK ?

IF ANY OF YOUR SYMPTOMS RETURN, LET US KNOW.
WE WILL CHECK TO SEE IF THE DEVICE IS FUNCTIONING PROPERLY.



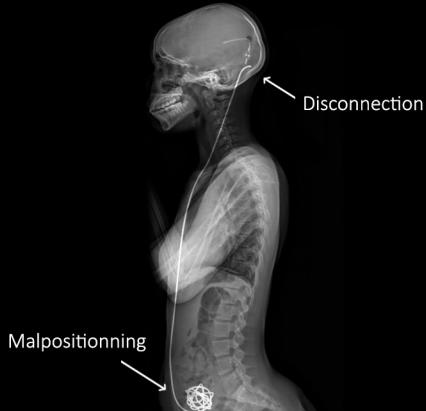
A compass is placed
above the center of the valve



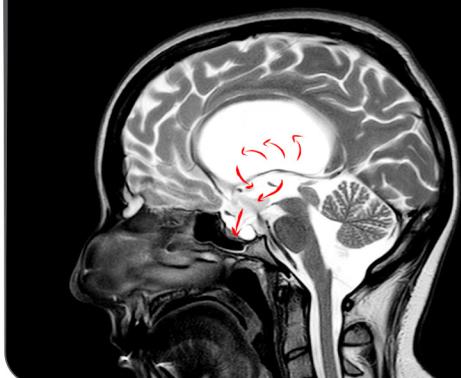
The valve is adjusted
with a magnet

AND, IF WE EVER DECIDE TO
ADJUST THE VALVE'S SETTING,
IT IS VERY SIMPLE, AND TO-
TALLY NON-INVASIVE. IT ONLY
REQUIRES A BRIEF CLINIC
VISIT, AND WE CAN ADJUST
YOUR VALVE SETTING TO MATCH
YOUR CLINICAL NEEDS.

WITH A SIMPLE X-RAY SERIES WE
WILL BE ABLE TO CONFIRM THE
ABSENCE OF COMPLICATIONS, SUCH
AS ANY DISCONNECTIONS, NOR-
MALPOSITIONING OF THE CATHETERS



IN THE CASE OF THIRD VENTRICULOS-
TOMY, WE WILL CONFIRM THE PROPER
FLOW OF CSF THROUGH THE VENTRICLE
OPENING, USING SPECIFIC MRI SE-
QUENCES.



3 MONTHS LATER...

GREAT TO SEE YOU BACK HIKING !

clémence heller

Φ **SOPHYSA**
At the heart of the **brain**

