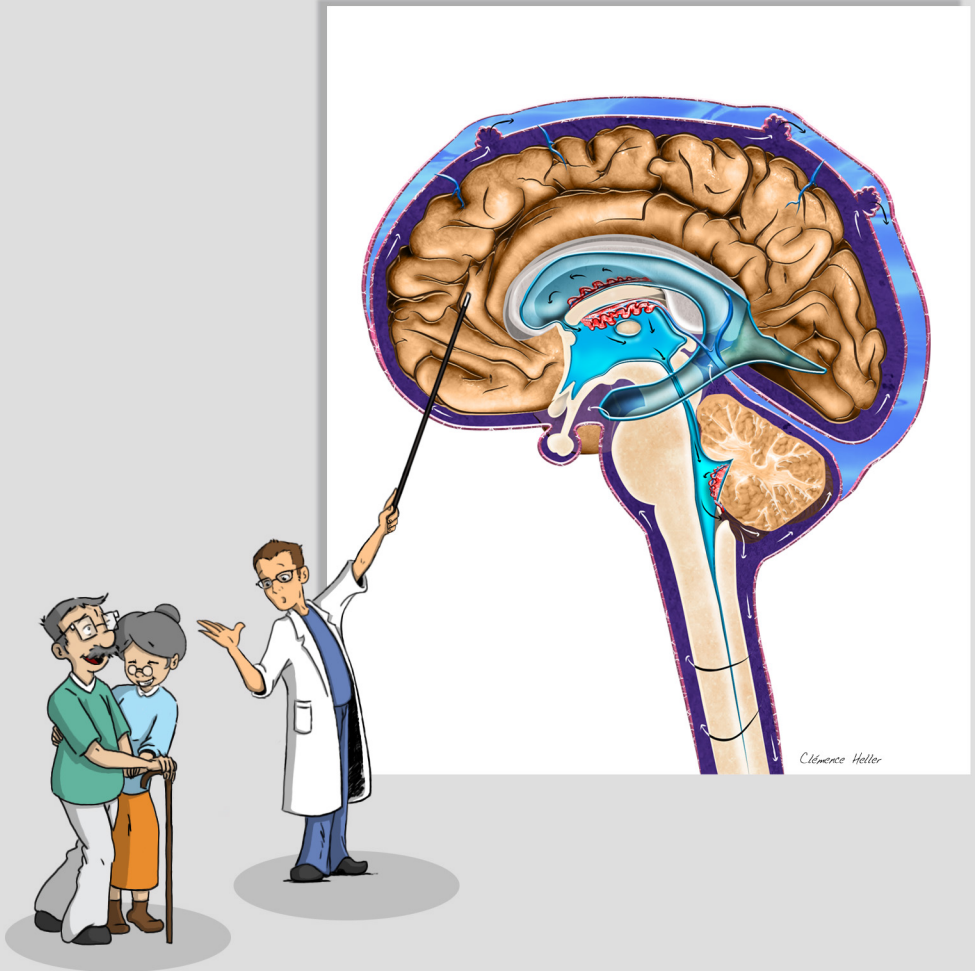


# Understanding Chronic Adult Hydrocephalus



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 **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.

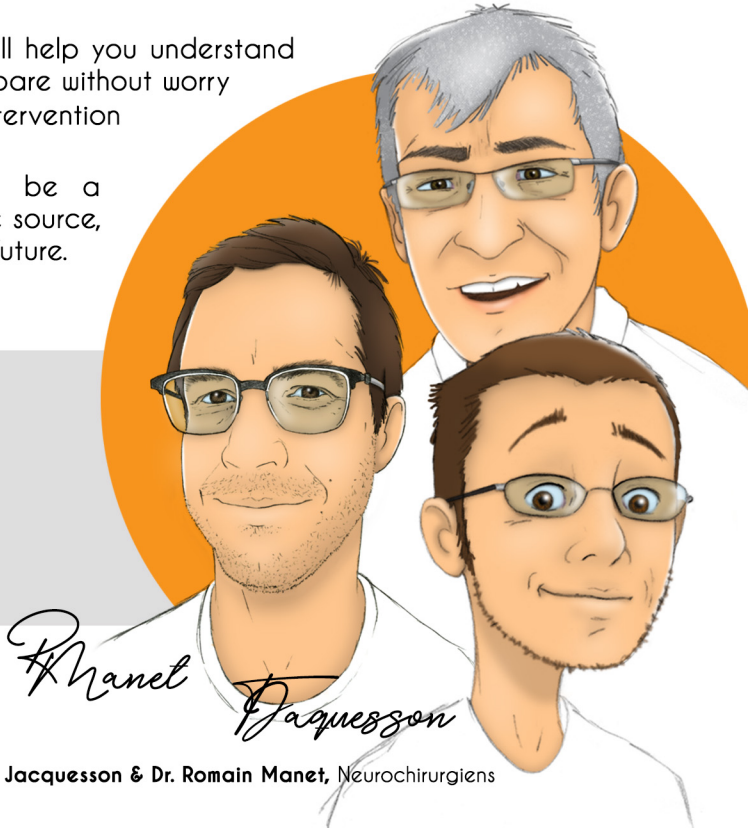
Finally, we explain the warning signs, and the necessary precautions.

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

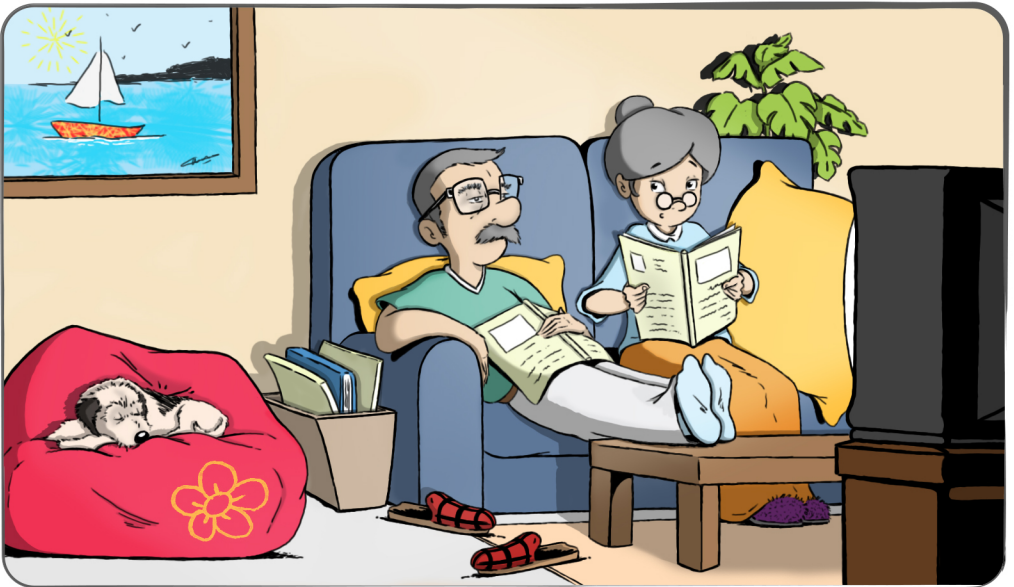
This booklet can also be a hydrocephalus reference source, for you to review in the future.

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

Good reading !

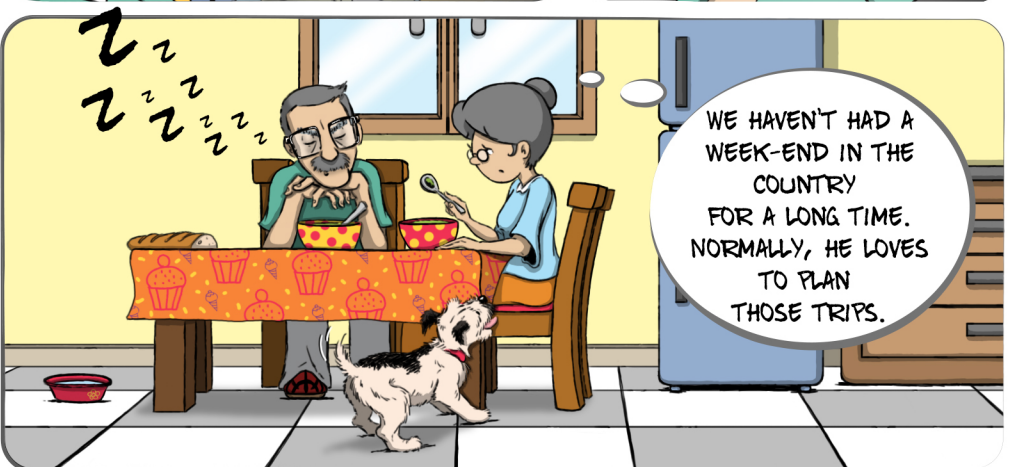


Dr. Timothée Jacquesson & Dr. Romain Manet, Neurochirurgiens

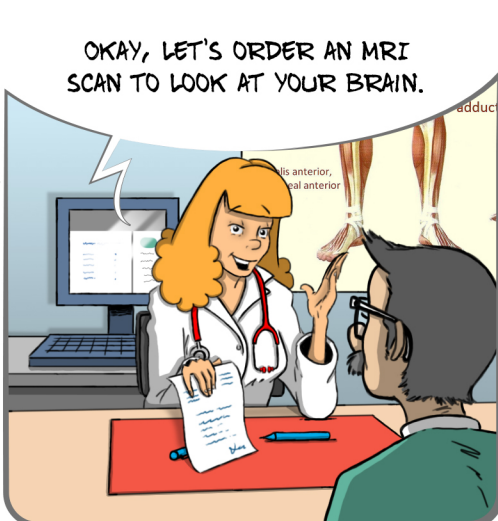
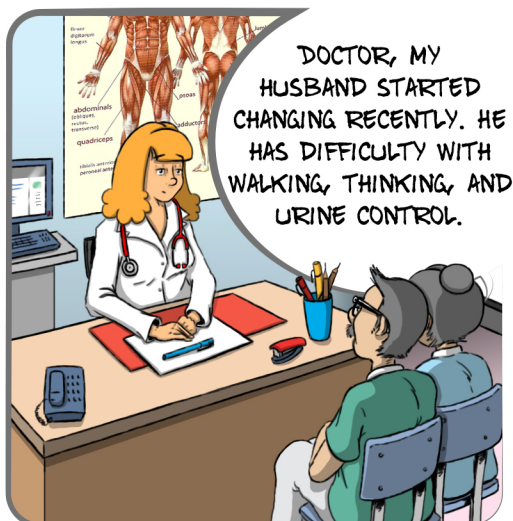


DARLING, YOU DON'T EXERCISE  
OR EVEN DO CROSSWORDS ANYMORE  
WHAT'S HAPPENING ?

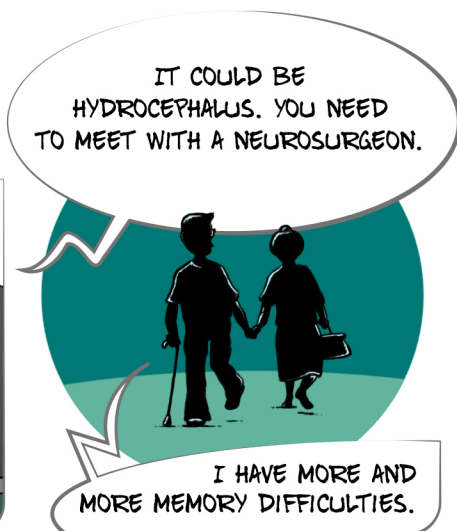
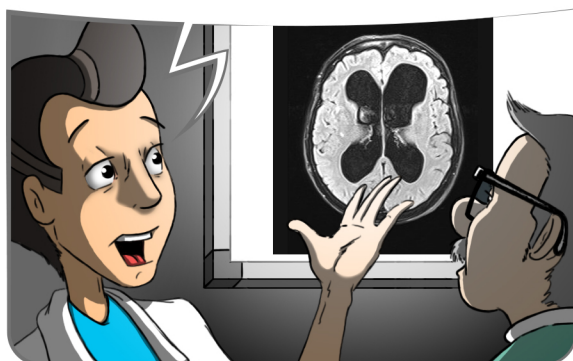
ACTUALLY, I HAVE  
BEEN FEELING WEAK LATELY,  
AND NOT VERY STEADY WALKING.



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.







WHEN CEREBROSPINAL FLUID (CSF) ACCUMULATES WITHIN THE BRAIN, THIS IS HYDROCEPHALUS.

I WILL EXPLAIN.

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

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

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

Lateral Ventricle

Choroid Plexus

Vein (Superior Longitudinal Sinus)

Arachnoid Granulations

Basal Cisterns

Foramen of Monro

Third Ventricle

Fourth Ventricle

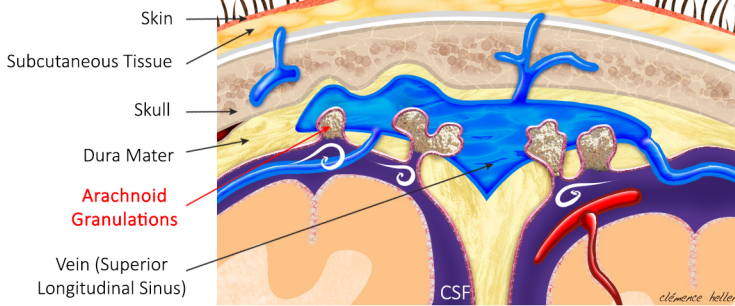
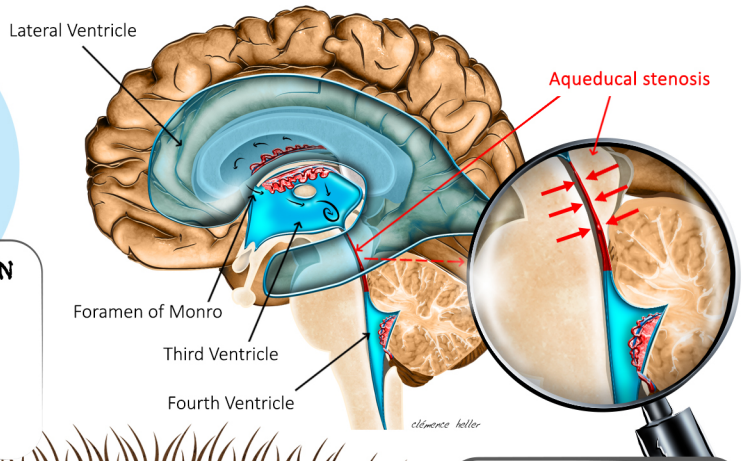
Ependymal Canal of the Spinal Cord

*clémentine heller*

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.



EXACTLY,

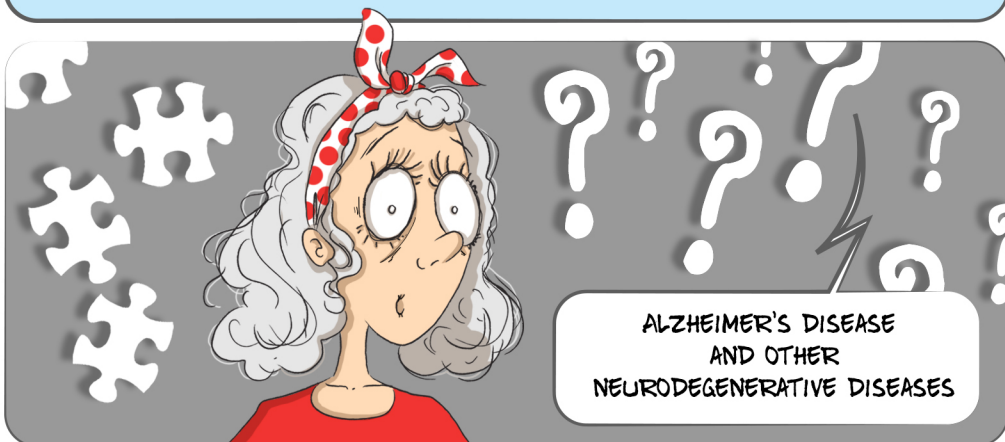
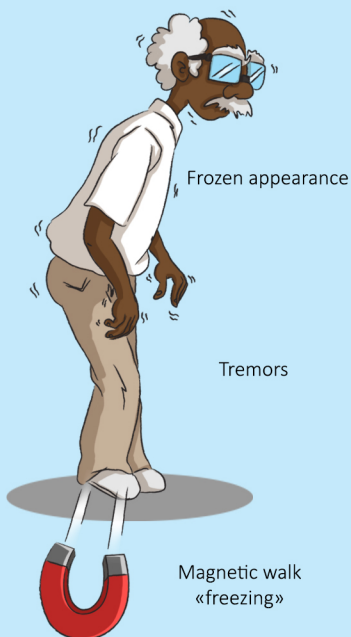
YOU SLEEP CONSTANTLY.  
AND, WE NEVER HIKE ANYMORE.



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



ALZHEIMER'S DISEASE  
AND OTHER  
NEURODEGENERATIVE DISEASES



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.

Endoscope

Third Ventricle

Basal Cisterns

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

Probe

Balloon

Basal Cisterns

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

...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.

Reestablished Circulation

Surgical Opening

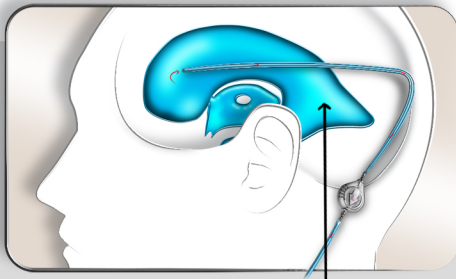
Basal Cisterns



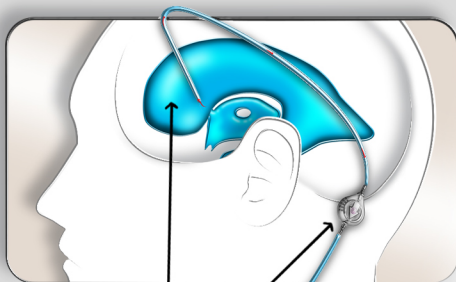
ON THE OTHER HAND, IF YOUR HYDROCEPHALUS IS DUE TO AN IMPAIRMENT OF CSF REABSORPTION, THEN WE PERFORM A VENTRICULOPERITONEAL SHUNT. A SMALL CATHETER IS INSERTED WITHIN ONE OF THE LATERAL VENTRICLES, AND IT IS CONNECTED TO A VALVE, THAT CONTROLS THE FLOW OF CSF.



Typical Ventricular Punctures:



Ventricular Atrium (Occipital Horn of Lateral Ventricle)

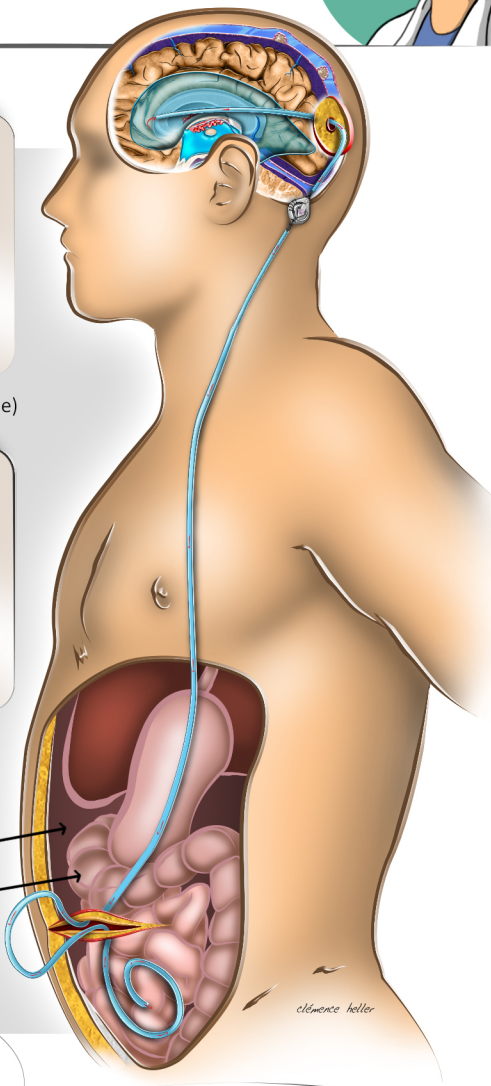


Valve

Frontal Horn of Lateral Ventricle

Abdominal Cavity

Digestive Tract



*clearence heller*

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.

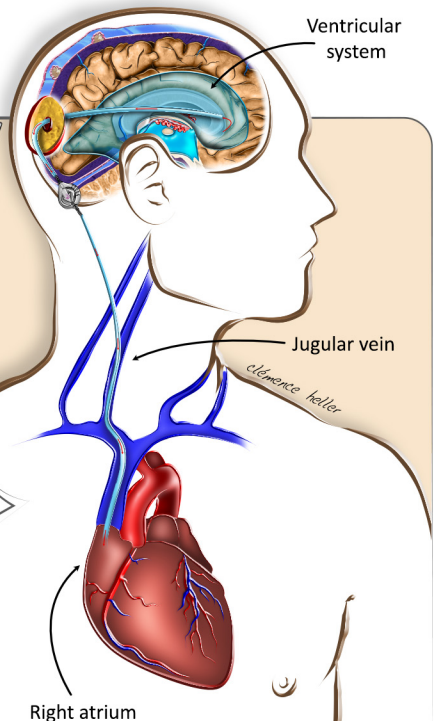
THE DIFFERENCE WITH THIS TYPE OF SHUNT:

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?

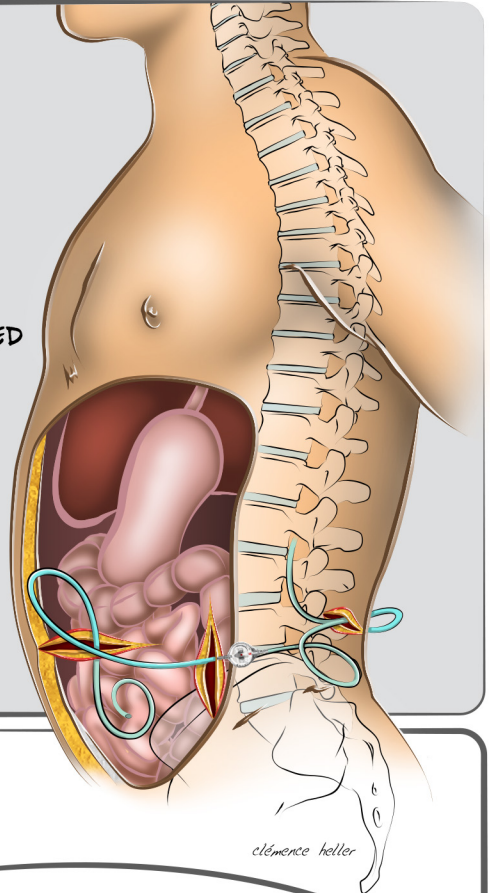


THERE IS A THIRD TECHNIQUE:  
THE LUMBO-PERITONEAL SHUNT.

THE CEREBROSPINAL FLUID IS COLLECTED  
FROM THE LOWER BACK,

THEN DIVERTED TO THE ABDOMEN.

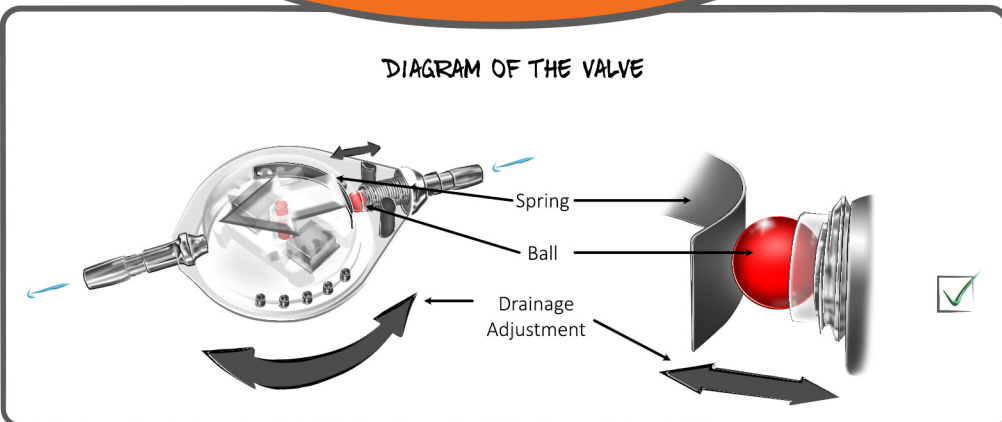
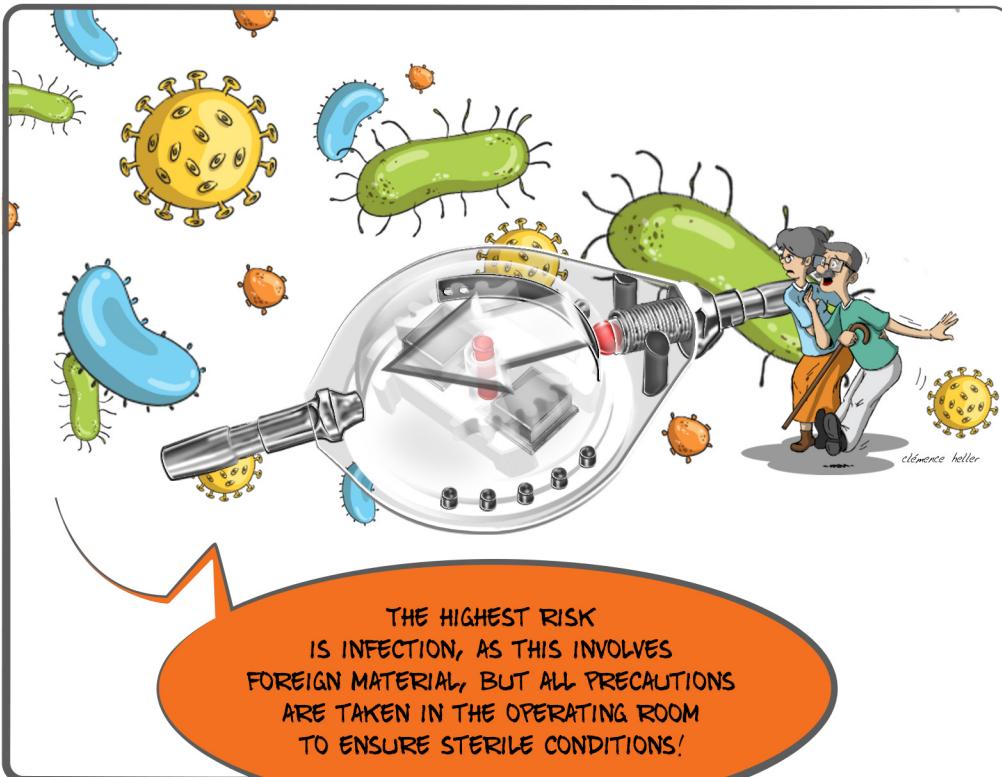
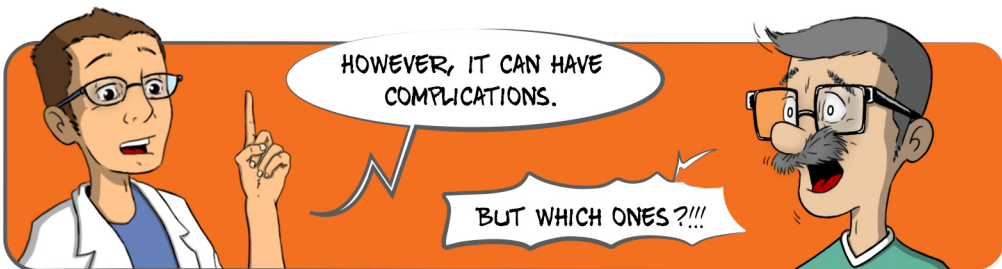
THE VALVE IS IMPLANTED ON  
THE ILIAC CREST OR ON A RIB,  
AND THE CATHETER THEN EXTENDS INTO  
THE PERITONEUM TO DRAIN THE EXCESS  
CEREBROSPINAL FLUID.



IS IT JUST AS EFFECTIVE?

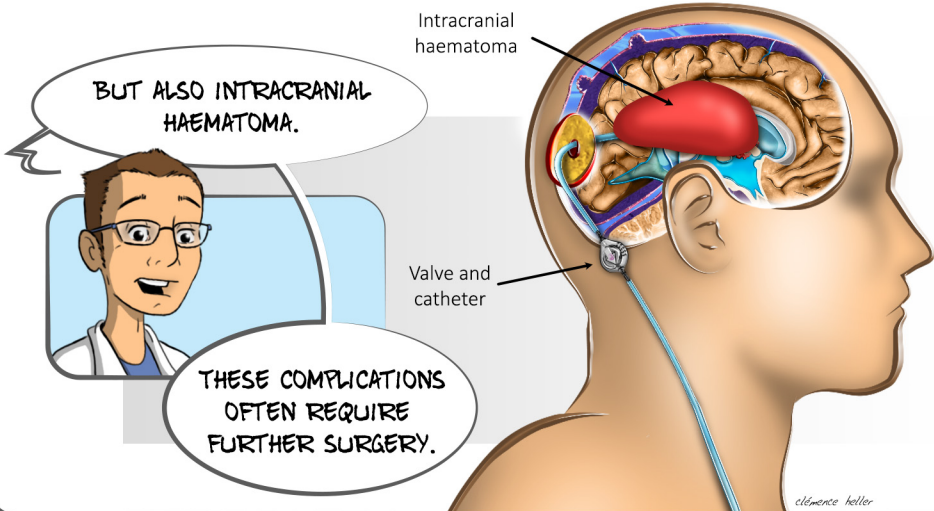
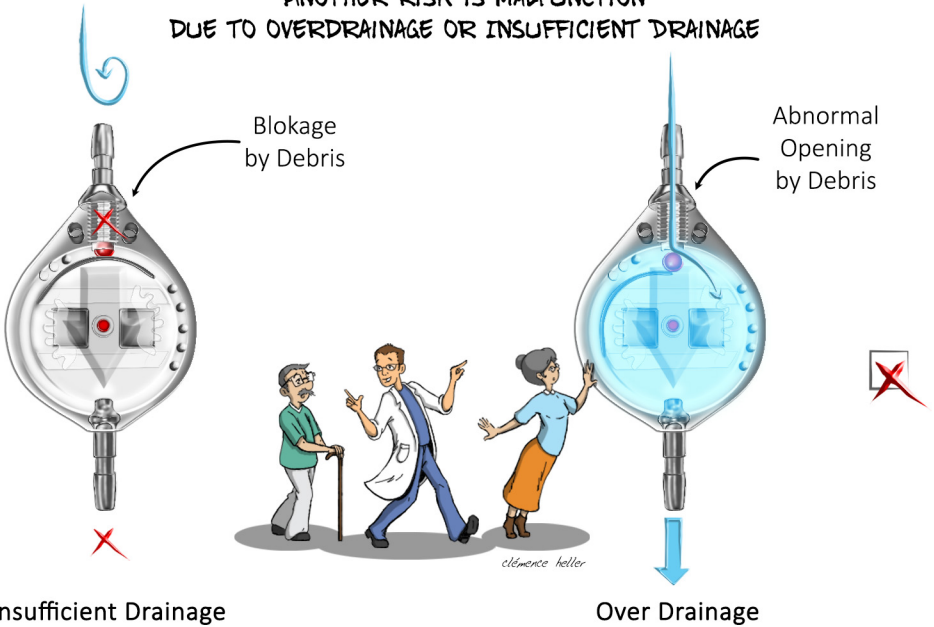


YES, THIS METHOD  
IS JUST AS EFFECTIVE AS THE OTHERS.  
LIKE ALL TECHNIQUES, IT HAS ITS  
ADVANTAGES AND DISADVANTAGES  
FOR PATIENTS.





ANOTHER RISK IS MALFUNCTION  
DUE TO OVERDRAINAGE OR INSUFFICIENT DRAINAGE



THERE MAY BE OTHER COMPLICATIONS SUCH AS:

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

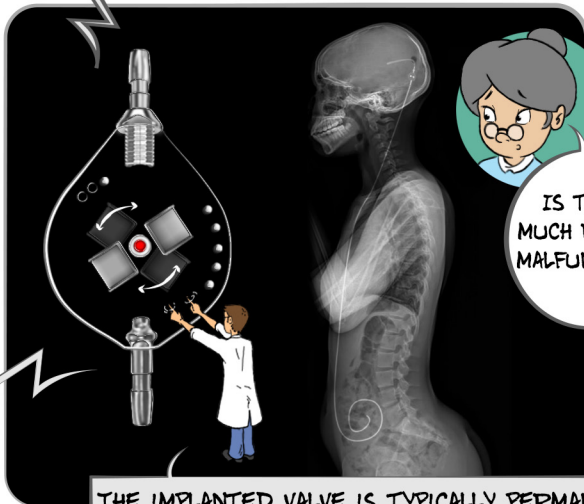


IS THERE ANY SPECIAL POST-OP FOLLOW-UP?



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 EXPOSED TO STRONG MAGNETS, LIKE AN MRI, OR WEAK MAGNETS, LIKE AIRPORT SECURITY GATES.



IS THERE MUCH RISK OF MALFUNCTION?

THE IMPLANTED VALVE IS TYPICALLY PERMANENT.

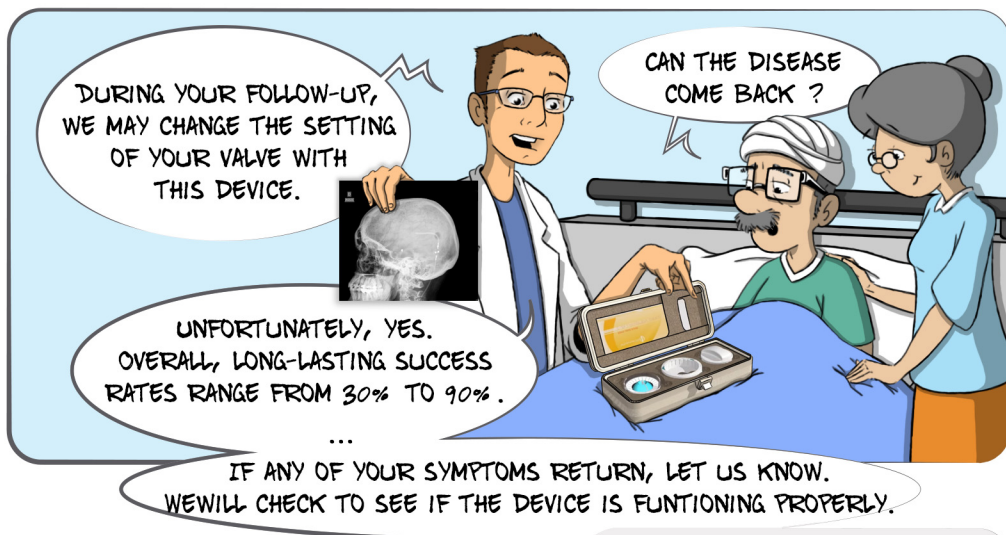
MR B JUST HAD SURGERY

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.





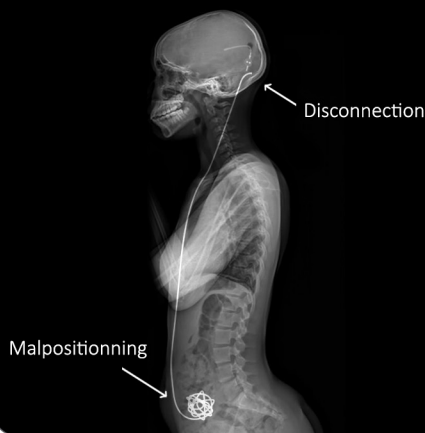
A compass is placed above the center of the valve



The valve is adjusted with a magnet

AND, IF WE EVER DECIDE TO ADJUST THE VALVE'S SETTING, IT IS VERY SIMPLE, AND TOTALLY 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, NORMAL POSITIONING OF THE CATHETERS



IN THE CASE OF THIRD VENTRICULOSTOMY, WE WILL CONFIRM THE PROPER FLOW OF CSF THROUGH THE VENTRICLE OPENING, USING SPECIFIC MRI SEQUENCES.





3 MONTHS LATER...

GREAT TO SEE YOU BACK HIKING !



clémence heller

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

