LiquoGuard®

INTRODUCTION TO *LiquoGuard*® CSF MANAGEMENT

Since 2006, ***LiquoGuard***® (Liquor = German for CSF) is available on the European market as well as many countries outside Europe. In 2011, we are introducing the new and improved ***LiquoGuard*®*7*** which adds many features our customers have asked for. The principle, however, remains the same: simultaneous drainage and pressure measurement, maximized patient safety, reduced nursing workload/costs and enhanced mobility, a versatile medical tool.

SAFETY: Common problems of conventional external CSF drainage systems are incorrect level adjustment of the drip chamber (e.g. during patient movement, CT, angiography, OR) and unrecognized pressure sensor malfunction (sensor drift). ***LiquoGuard***®s dual pressure sensors, redundant microcontrollers, and sophisticated alarm concept reduce patient risks significantly. E.g., ***LiquoGuard***® constantly monitors the normal CSF pressure pulsation and thus helps detect catheter occlusions. ***LiquoGuard***®s closed system operates without airfilter, minimizing infection risks and eliminating another source for failure.

WORKLOAD REDUCTION: ***LiquoGuard***® by design does not need any height adjustments (unlike drip chambers), thus saves time and allows the nursing staff to focus on other essential tasks. The integrated documentation function reduces the nurse's workload even further.

MOBILITY: Thanks to powerful Li-ion rechargeable batteries, the system is independent of external power supply. ***LiquoGuard*®*7*** is portable, weighs about 3,600 g (8 lbs), and can be attached to poles and tracks by means of a bracket.

VERSATILITY: Besides CSF drainage on trauma patients, ***LiquoGuard***® is being successfully used in NPH diagnostics (lumbar drainage and infusion test) and thorako-abdominal aorta surgery (TAAA). The ***LiquoGuard*®*7*** system is a modular concept with basis version, expandable by six additional options: documentation/history, printing, presettings, infusion test, patient monitor connectivity and parenchymal sensor connectivity. ***LiquoGuard***® uses common lumbar and ventricular drainage catheters.

LUMBAR DRAINAGE AND INFUSION TEST

SAFETY: Conventional CSF drainage may lead to undetected catheter occlusions with consequential under drainage, leading to intracranial hypotension, collapsed ventricles or subdural haematoma. ***LiquoGuard***®, with its sophisticated alarm system, helps detect catheter leaks and occlusions, and helps avoid catheter occlusions by a continuous CSF flow.* ***LiquoGuard*®*7*** offers an additional "flow" alarm option to watch the drained volume.

WORKLOAD REDUCTION: No time consuming manual adjustment of exact CSF drainage flow.

MOBILITY: The ***LiquoGuard***® sensor unit is easily taped and adjusted to the lumbar catheter level using a specially designed fixation device for maximal patient comfort and mobility.*

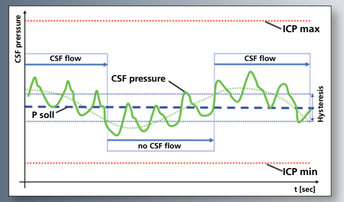
VERSATILITY: ***LiquoGuard***® is the worldwide first CSF management system permitting a safe drainage with preselected CSF flow. In NPH diagnostics, ***LiquoGuard***® supports the lumbar infusion test (Katzmann test), enabling the user to determine the ROF (resistance-to-outflow). In thorako-abdominal aorta surgery (TAAA), lumbar drainage with ***LiquoGuard***® helps control spinal perfusion and thus avoid ischaemic post-surgery neurological defects.

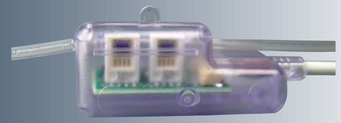
* The ***LiquoGuard***® alarm concept requires that alarms are always noticed by responsible staff.

REVOLUTIONARY APPROACH TO VENTRICULAR CSF MANAGEMENT

How *LiquoGuard*® works

LiquoGuard® is the first CSF management system that simultaneously measures pressure and drains CSF. The system determines CSF pressure (Pcsf) by two independent pressure sensors which are integrated in the tube set and fixed to the patient on the level of the Foramen Monro. Thus, the CSF pressure Pcsf is a good approximation to the intracranial pressure (ICP). For direct ICP measurement, ***LiquoGuard*®*7*** allows connection of an additional parenchymal or catheter tip sensor. This makes sense e.g. with frequent catheter occlusions or if collapsed ventricles may occur. After preselecting the desired target pressure (P_{set}, mmHg or cmH_2O), CSF flow is automatically controlled to keep the pressure within a corridor around P_{set}.

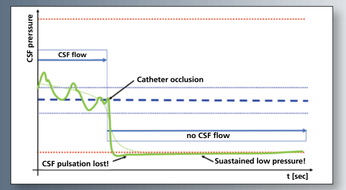




How *LiquoGuard*® enhances patient safety

In conventional ventricular CSF drainage, collapsed ventricles and catheter occlusions are most frequent issues. ***LiquoGuard***® supports early identification of both situations: When the drained ventricle is collapsed, pressure pulsation is usually lost and CSF flow periods are shortened. During catheter occlusion, the measured pressure drops below Pset, CSF flow stops and pulsation is also lost. ***LiquoGuard***® watches the CSF pressure pulsation and thus supports the user in detecting catheter occlusions and other pathological situations such as collapsed ventricles.* ***LiquoGuard*®*7*** features refined alarm criteria, further reducing unnecessary alarms.

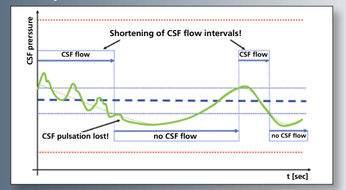
Catheter Occlusion



How *LiquoGuard*® checks itself

The throughout dual and redundant concept from sensors through processing of the CSF pressure information includes 2 pressure transducers, 2 analog-to-digital converters, 2 microcontrollers, separate loudspeakers and LEDs for alarms. The system does not only supervise the patient, it also supervises itself: any inconsistency in the measured values, sensor malfunctions and drifts lead to an alarm. If desired, ***LiquoGuard*®*7*** can be connected to an additional intracranial or catheter tip sensor to further increase redundancy.

Collapsed ventricles



THE 7 ADDITIONAL ADVANTAGES OF *LiquoGuard*®*7*

01 **Modular System** with affordable base price and strong options

02 **Reduced weight,** smaller size, Li-ion replacing lead battery, decreaded motor noise

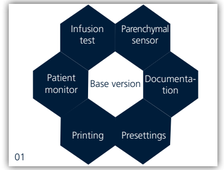
03 **Touchscreen** with intuitive user interface

04 **Improved alarm criteria,** new alarm "flow rate"

05 **Highly improved connectivity** including connections to USB-stick, parenchymal ICP or catheter tip sensor, printer, ethernet (for development and device diagnostics)

06 **Improved recording and documentation** and subsequent analysis possible

07 **Integrated bag holder, improved fixation bracket** for poles and tracks



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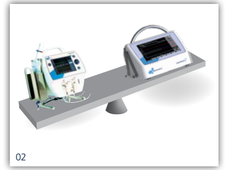
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VENTRICULAR DRAINAGE

SAFETY: CSF flow is controlled by the desired intracranial or in-tube pressure (ICP or Pcsf in mmHg or cmH_2O). Within pressure alarm limits, the CSF flow is limited to the pre-selected max. flow rate (ml/h). With standard settings, pressures below zero are never generated (no aspiration), but with advanced settings, a weak negative pressure can be tolerated without alarm; ***LiquoGuard®7*** even allows such a pressure as target.

WORKLOAD REDUCTION: There is no drip chamber and thus no need for time consuming manual height adjustments. Also, no calibration of the pressure sensor is needed, since it is already delivered pre-calibrated.

MOBILITY: CSF pressure measurement (ICP/Pcsf) and drainage is continued during transportation of the patient.*

VERSATILITY: Continuous documentation of pressure and CSF volume helps in decision making for permanent CSF shunting, analyzing effects of medications, and calculating CSF flow. The recorded data can be examined on-screen using the "history" tab, or they can be exported to a USB stick for further analysis on a PC, e.g. to judge the effect of medication or determine the optimal opening pressure of a shunt.

TECHNICAL INFORMATION

Size (W x H x D) 239 mm x 145 mm x 213 mm
Weight 3,620 g
Voltage 100-240 VAC
Pressure sensor Accuracy ± 0.375 mmHg (range of 0-75 mmHg)
Drift <1 mmHg in long-term tests
Display accuracy ± 2 mmHg
Interfaces USB (Memory stick, printer), parenchymal sensor, patient monitor, ethernet**

* The ***LiquoGuard®*** alarm concept requires that alarms are always noticed by responsible staff
** for device diagnostics and development

a new dimension of
CSF management

THE COMPANY MÖLLER MEDICAL

Möller Medical was founded in 1949 and is active mainly within the demanding OEM business; the company is developing components, systems and finished devices for human medicine, in vitro diagnostics (IVD) and precision engineering. Customers include many renowned medical devices/IVD companies. All products are manufactured in-house. The ***LiquoGuard®*** has been developed and is manufactured completely by Möller Medical.
LiquoGuard® has been approved for the European market since 2006, **in 2011 we were introducing *LiquoGuard®7***.

Möller Medical is certified according to EN ISO 13485 and EN ISO 9001 and manufactures the products shown here with CE mark according to EU-directive 93/42/EWG.

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LiquoGuard®7

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