

# SCREENING OF CHRONIC CEREBROSPINAL VENOUS INSUFFICIENCY BY CERVICAL STRAIN-GAUGE PLETHYSMOGRAPHY.

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**Background:** Chronic cerebrospinal venous insufficiency (CCSVI) is a syndrome characterized by venous flow blockages at the level of the jugular and/or azygous veins, compensated by activation of collateral circulation. Blocked outflow is due to truncular stenosing malformation, mainly intraluminal defect like malformed valve, septum, web, etc, or more rarely, vein hypoplasia and agenesis. It has been described a strong association between CCSVI and multiple sclerosis (MS). The CCSVI condition can be diagnosed by vascular Doppler sonography and/or catheter venography. The former is operator dependent and the latter is of course invasive. MR venography does not represent a valid alternative, since diagnostic accuracy is still low. We experimented strain-gauge plethysmography as a screening device for CCSVI. Aim of the test is to assess the gravitational mechanism of venous outflow from the brain.

**Methods:** 40 healthy controls (HC) matched for age and gender with 29 CCSVI-MS patients were screened for CCSVI by means of vascular Doppler sonography by an expert operator. The entire cohort blindly underwent a protocol using an original strain-gauge collar connected with a volume transducer and dedicated software. After calibration, the subject is tilted from the upright to the supine posture (Fig.1). The redistribution of blood volume permits to obtain a volume-time curve from which extrapolates the venous volume (VV%), corresponding to the highest point of the filling plateau, the 90% VV and the venous filling index (VFI). The subject is tilted to up again, obtaining a reduction in venous volume defined as tilt ejection fraction (TEF and TEF 90%), with a slope curve proportional to the time of emptying. Finally, the residual

volume fraction (RVF) corresponds to the cervical volume after tilting up (Fig.1).

**Results:** VV% measured respectively in HC  $5.3\pm 2.5$  and in CCSVI-MS  $6.7\pm 2.5$  ( $p<0.0002$ ); VFI  $0.9\pm 0.5$  and  $1.3\pm 0.8$  ( $p<0.0001$ ); TEF 90%  $1.8\pm 0.7$  and  $2.8\pm 1.1$  ( $p<0.0001$ ); TEF slope  $2.6\pm 1.7$  and  $1.8\pm 1.1$  ( $p<0.0001$ ); RVF  $0.6\pm 1.5$  and  $1.7\pm 1.7$  ( $p<0.0001$ ). No significant variations were found for VV 90% and TEF between the two populations.

**Conclusions:** Cervical strain-gauge plethysmography showed several parameters significantly different in CCSVI respect to HC. It is a novel tool for non-invasive, non-operator dependent screening of CCSVI. Imaging techniques remains indispensable for defining location and morphology of venous outflow obstructions.

