MRI-documented contrast extravasation is associated with early neurological deterioration and in-hospital mortality in primary intracerebral hemorrhage

Poster No.: C-2550
Congress: ECR 2010
Type: Scientific Exhibit
Topic: Neuro
Authors: S. Remollo, Y. Silva, K. Mowatt, J. Puig, J. Serena, S. Pedraza; Girona/ES
Keywords: Cerebral Hemorrhage/diagnosis, Magnetic Resonance Imaging, Extravasation of Diagnostic and Therapeutic Materials
DOI: 10.1594/ecr2010/C-2550

Any information contained in this pdf file is automatically generated from digital material submitted to EPOS by third parties in the form of scientific presentations. References to any names, marks, products, or services of third parties or hypertext links to third-party sites or information are provided solely as a convenience to you and do not in any way constitute or imply ECR's endorsement, sponsorship or recommendation of the third party, information, product or service. ECR is not responsible for the content of these pages and does not make any representations regarding the content or accuracy of material in this file.

As per copyright regulations, any unauthorised use of the material or parts thereof as well as commercial reproduction or multiple distribution by any traditional or electronically based reproduction/publication method is strictly prohibited.

You agree to defend, indemnify, and hold ECR harmless from and against any and all claims, damages, costs, and expenses, including attorneys' fees, arising from or related to your use of these pages.

Please note: Links to movies, ppt slideshows and any other multimedia files are not available in the pdf version of presentations.

www.myESR.org
Purpose

We sought to find MRI predictors associated with poor outcome in patients with acute primary intracerebral hemorrhage (ICH).

Our concrete objectives were:

• To study the presence of contrast extravasation at MRI in patients with acute primary intracerebral hemorrhage.
• To study the relationship between contrast extravasation patterns and clinical outcome.

Methods and Materials

BACKGROUND

Spontaneous intracerebral hemorrhage (ICH) is one of the most devastating forms of stroke. It accounts for approximately 15% of all strokes and has a higher mortality rate (40%) than ischemic stroke. Although the treatment of ICH is a major area of research, there is currently no treatment that has been shown in a randomized controlled trial to improve outcome after ICH.

Recently some authors have pointed out that the presence of active contrast extravasation (also known as the spot sign) on computed tomography (CT) angiography is an indicator of active hemorrhage and is associated with an increased risk of significant hematoma expansion and mortality in patients with ICH.

Identifying a reliable predictor of poor outcome in patients with ICH is important, because it may serve to select patients for treatment, such as early hemostatic therapies, intensive blood pressure reduction, or surgical evacuation.

The aim of this study was to find MRI predictors associated with poor outcome in patients with acute primary ICH.

PATIENT SELECTION
Our study was approved by the hospital's Institutional Review Board.

Between January 2005 and June 2007 we studied 34 consecutive patients with primary ICH diagnosed by CT and MRI within the first 12 hours of stroke onset. Fig. 1 on page 4

**Inclusion criteria** were primary supratentorial ICH evaluated in the first 12 hours from symptom onset and informed consent. If the patient was incapacitated by the stroke and unable to give informed consent, the next of kin gave it.

**Exclusion criteria** were ICH due to tumors; anticoagulant therapy; vascular malformation; trauma; unstable vital signs; previous Rankin scale greater than 2, dementia, or terminal illness; and infratentorial ICH. Also patients with a pacemaker, implantable cardioverter defibrillator, or any other contraindication for MRI examination were excluded from the study.

**CLINICAL VARIABLES**

**Clinical variables**, including vascular risk factors (history of hypertension, diabetes, or smoking), blood sugar levels, and blood pressure, were recorded at admission.

Patients were assessed on the National Institute of Health Stroke Scale (NIHSS) at admission and at 72 hours.

**Early neurological deterioration** (END) was diagnosed when the NIHSS score decreased #4 points between admission and 72 hours.

**Mortality** during hospitalization was recorded.

**COMPUTED TOMOGRAPHY VARIABLES**

CT scans were acquired on a Philips MX8000 IDT (Philips Healthcare, Best, the Netherlands) with 16 detectors using a 512×512 matrix, a 250 mm field of view, and a slice thickness of 3 mm with no interslice gap. A total of 45 slices per patient were acquired parallel to the orbitomeatal line.
Volume of the ICH and volume of the perihematomal edema were measured at CT on admission and at follow-up CT 72 hours later. We used computer-assisted planimetric analysis for volume calculation.

The presence of Intraventricular Hemorrhage at CT on admission was also registered.

MAGNETIC RESONANCE VARIABLES

All patients underwent MR examination on a 1.5-Tesla scanner (Intera, Philips Healthcare, Best, the Netherlands) with a SENSE head coil. The protocol included axial gradient-echo (GE) T2*-weighted, trace diffusion-weighted imaging (DWI), fluid-attenuated inversion recovery (FLAIR), and pre- and post-contrast axial T1-weighted images. The T1-weighted imaging parameters were as follows: repetition time/echo time (TR/TE) 428/15 ms, field of view 23 cm x 23 cm, and matrix size 224 x 112. Forty-five contiguous 6 mm axial slices with an intersection gap of 0.6 mm and one excitation covering the entire brain and brainstem were acquired parallel to the anterior-posterior line. Contrast-enhanced T1-weighted images were acquired after administration of 0.1 mL per kilogram of gadobutrol with a bolus technique (3 mL/sec) followed by a 15-mL bolus of saline at the same injection rate. The total MR imaging time was less than 6 minutes. Fig. 2 on page 5

Contrast extravasation (CE) was defined as high-intensity signals in postcontrast T1-WI compared with precontrast T1-WI.

CE was classified in 4 patterns according to Murai et al. (J Neurosurg 1998;88:650-5):

- type A: CE within the hematoma. Fig. 3 on page 6
- type B: linear high-intensity signal surrounding the hematoma in the postcontrast T1-WI compared to the basal T1-WI. Fig. 4 on page 7
- type C: combination of A and B. Fig. 5 on page 8
- type D: no evidence of CE. Fig. 6 on page 9

Presence of Microbleeds (MB). The presence of MB was recorded. MB were defined as focal areas of signal loss on T2*-WI measuring <5 mm within the brain parenchyma remote from the ICH.

Images for this section:
Fig. 1: Study Inclusion-Exclusion Criteria.
Fig. 2: MR examination protocol included standard axial gradient-echo (GE) T2*-weighted, trace diffusion-weighted imaging (DWI), fluid-attenuated inversion recovery (FLAIR), and pre- and post-contrast axial T1-weighted images. The total MR imaging time was less than 6 minutes.
Fig. 3: Type A contrast extravasation. Contrast extravasation within the hematoma.
Contrast Extravasation Patterns

- CE Type B

**Fig. 4:** Type B contrast extravasation. Linear high-intensity signal surrounding the hematoma in the postcontrast T1-WI compared to the basal T1-WI.
Contrast Extravasation Patterns

- CE Type C

**Fig. 5:** Type C contrast extravasation. Combination of patterns A and B (CE within and surrounding the hematoma).
Fig. 6: Type D contrast extravasation. No evidence of contrast extravasation.
Results

The results of the univariate analysis for the association between all evaluated clinical and radiologic variables and the presence of CE on admission MR are summarized in Fig. 1 on page 11. There were no differences between patients with CE and those without CE in age, sex, vascular risk factors (smoking, hypertension, and diabetes), systolic blood pressure, or diastolic blood pressure at admission. There were no differences between the two groups in the time from the onset of symptoms to MRI examination or in the volume of the hematoma or perihematomal edema at admission.

The only variable that was significantly associated with CE on MRI was intraventricular hemorrhage on the initial CT ($p<0.05$). Intraventricular hemorrhage was found in 50% of the patients with CE and in only 7.1% of the patients without CE.

The results of the univariate analysis for the association between all evaluated radiologic variables and the clinical evolution of the patients (END and mortality) are summarized in Fig. 2 on page 12. The volume of the hemorrhage in the initial CT was significantly associated with END and mortality. Intraventricular hemorrhage at admission was associated with END but not with greater hospital mortality. Microbleeds on the initial MRI were not significantly associated with END or greater mortality.

Contrast extravasation was observed in 21 patients (61.8%); type A in 6 (17.6%), type B in 3 (8.8%), and type C in 12 (35.3%). Type A and C contrast extravasation had greater END (23.5% vs 0%, $p=0.002$) and hospital mortality (20.6% vs 2.9%, $p=0.025$) than type B and D contrast extravasation.

In the multivariate analysis, hematoma volume and CE type A and C were independent predictors of in-hospital death and END.

Images for this section:
Fig. 1: Association of clinical and radiologic variables with CE. For continuous variables, mean (± SD) is reported. The presence of intraventricular hemorrhage at admission CT was the only variable associated with CE.
**Fig. 2:** Association of radiological variables with early neurological deterioration (END) and in-hospital mortality. *P values were determined by the #2 test for categorical variables and by Student's t-test for continuous variables.
Conclusion

The postcontrast T1-weighted sequence is useful in the detection of contrast extravasation in the acute phase of ICH.

Contrast extravasation was detected in 61.8% of the patients in our series.

Type A and C contrast extravasation were associated with worse outcome of patients in the acute phase (72 h).

In addition to hematoma volume, contrast extravasation within the hematoma on MRI at admission is an independent predictor of poor functional outcome and greater mortality in the acute phase in patients with primary ICH.

References


**Personal Information**

**Sebastián Remollo** MD

Centre IDI, Radiology Department, Hospital Universitari de Girona Doctor Josep Trueta, Girona Biomedical Research Institute, Av. de França s/n, 17007 Girona, Spain. Tel.: +34 972486020; fax: +34 972483085.

*E-mail address:* sremollo@gmail.com

**Yolanda Silva** MD, PhD

Neurology Department, Hospital Universitari de Girona Doctor Josep Trueta, Girona Biomedical Research Institute, Av. de França s/n, 17007 Girona, Spain. Tel.: +34 972940262; fax: +34 972228296.

*E-mail address:* ysilva.girona.ics@gencat.cat

**Kirste Jane Mowatt** BASc

Centre IDI, Radiology Department, Hospital Universitari de Girona Doctor Josep Trueta, Girona Biomedical Research Institute, Av. de França s/n, 17007 Girona, Spain. Tel.: +34 972486020; fax: +34 972483085.

*E-mail address:* kjmowatt@yahoo.es

**Josep Puig** MD

Centre IDI, Radiology Department, Hospital Universitari de Girona Doctor Josep Trueta, Girona Biomedical Research Institute, Av. de França s/n, 17007 Girona, Spain. Tel.: +34 972486020; fax: +34 972483085.

*E-mail address:* jpuigalcantara@yahoo.es

**Joaquín Serena** MD, PhD
Neurology Department, Hospital Universitari de Girona Doctor Josep Trueta, Girona Biomedical Research Institute, Av. de França s/n, 17007 Girona, Spain. Tel.: +34 972940262; fax: +34 972228296.

E-mail address: jserena.girona.ics@gencat.cat

Salvador Pedraza MD

Centre IDI, Radiology Department, Hospital Universitari de Girona Doctor Josep Trueta, Girona Biomedical Research Institute, Av. de França s/n, 17007 Girona, Spain. Tel.: +34 972486020; fax: +34 972483085.

E-mail address: sapedraza@gmail.com