

Grading Intracranial Hemorrhage After Ischemic Stroke and Reperfusion Therapy

(Radiological Subtypes using Heidelberg Classification)

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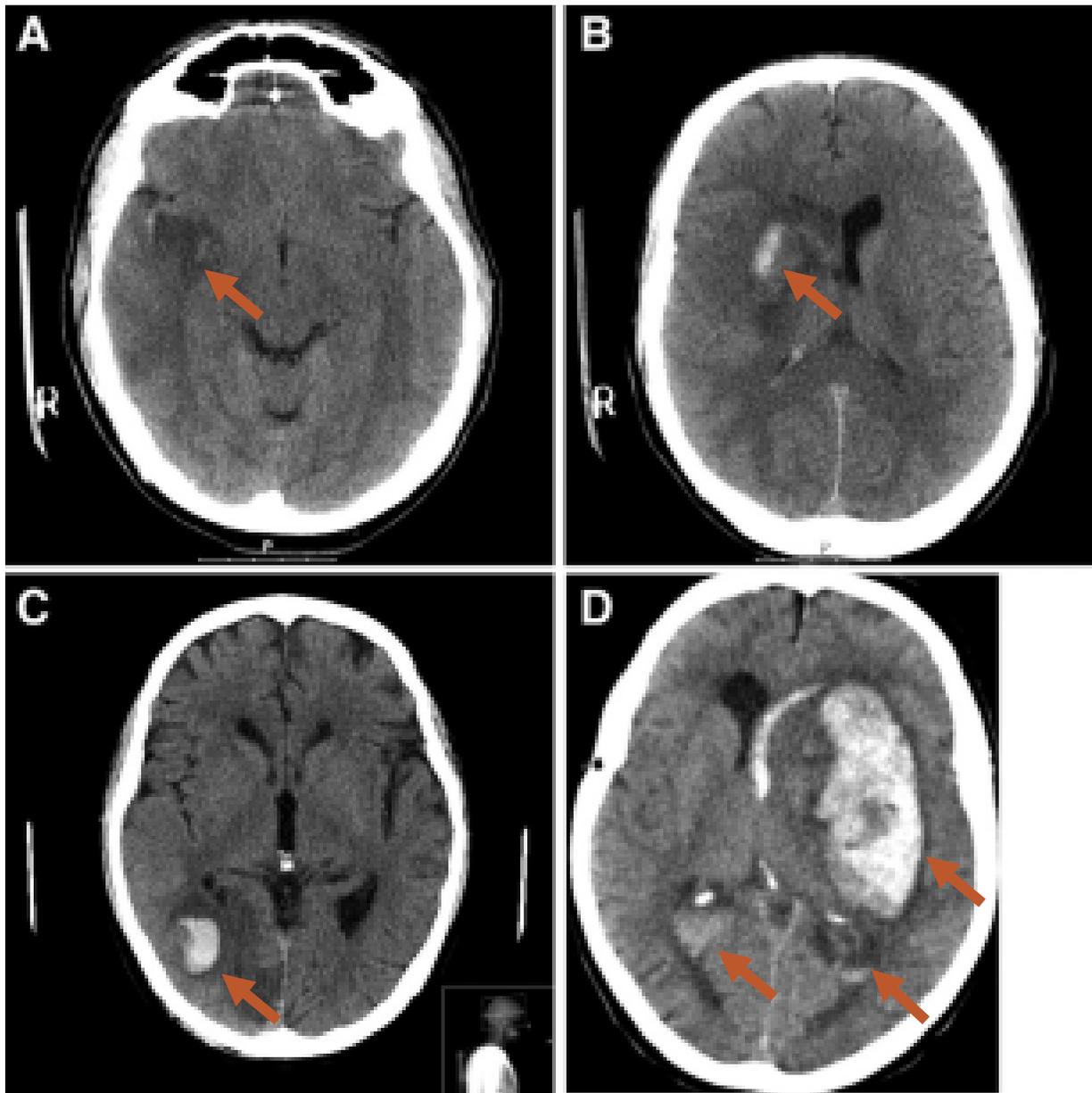
Learning Objectives

- To review the Heidelberg classification of intracranial hemorrhage after ischemic stroke and reperfusion therapy
- To discuss case examples from each category

Heidelberg Bleeding Classification

Class	Type	Description
1		Hemorrhagic transformation of infarcted brain tissue
1a	HI1	Scattered small petechiae, no mass effect
1b	HI2	Confluent petechiae, no mass effect
1c	PH1	Hematoma within infarcted tissue, occupying <30%, no substantive mass effect
2		Intracerebral hemorrhage within and beyond infarcted brain tissue
	PH2	Hematoma occupying 30% or more of the infarcted tissue, with obvious mass effect
3		Intracerebral hemorrhage outside the infarcted brain tissue or intracranial-extracerebral hemorrhage
3a		Parenchymal hematoma remote from infarcted brain tissue
3b		Intraventricular hemorrhage
3c		Subarachnoid hemorrhage
3d		Subdural hemorrhage

Examples from original paper

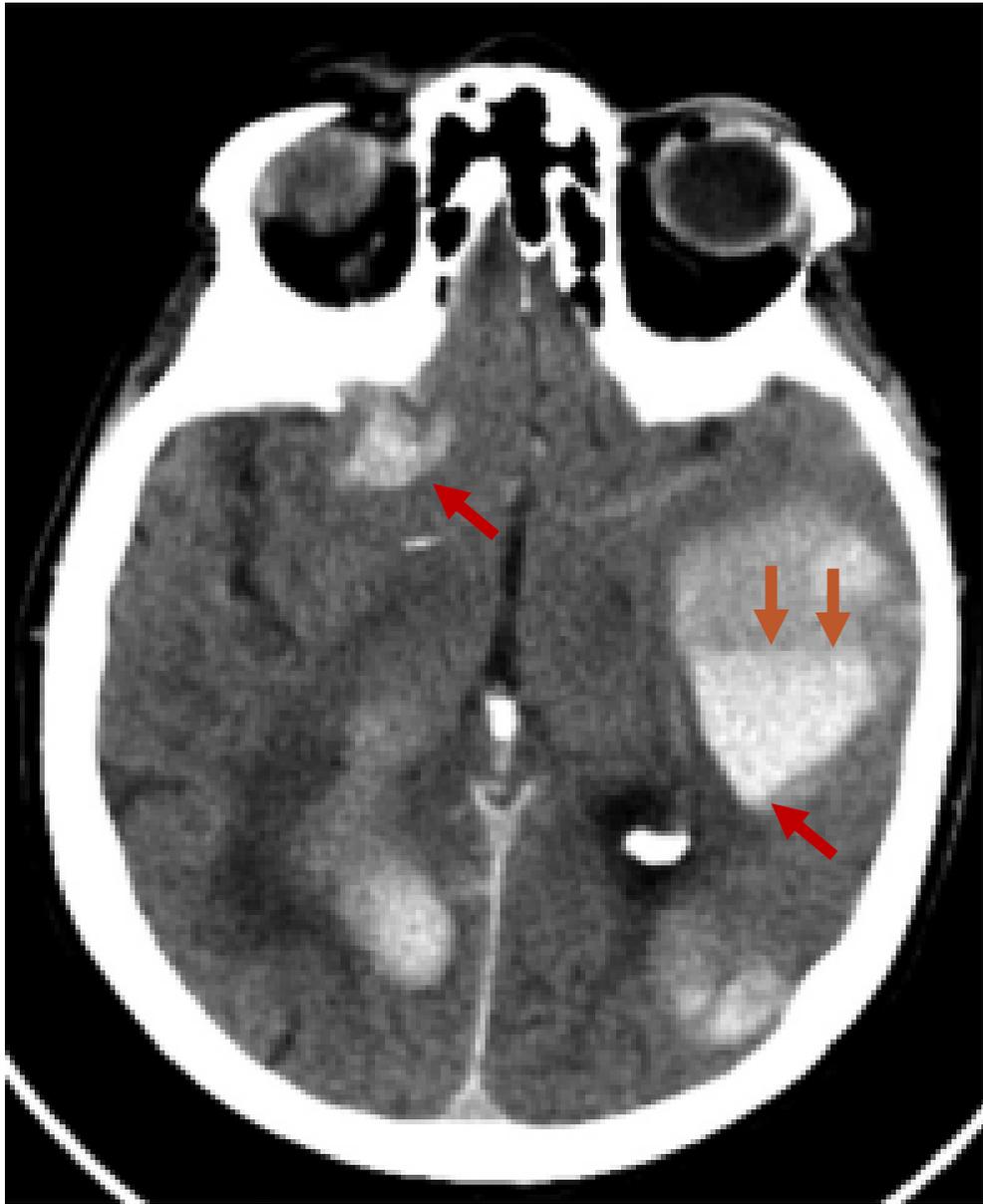


HI-1 in right temporal lobe (A)

HI-2 in right striatum (B)

PH-1 in right posterior cerebral artery territory (C)

PH-2 with mass effect and IVH in left basal ganglia and internal and external capsules (D)



Example from
original paper

Heidelberg class 3a

Bilateral parenchymal hematomas including remote parenchymal hematoma with **fluid level** in the left PH indicating coagulation disorder.

Key points

- The Heidelberg Bleeding Classification is based on CT scans.
- Hemorrhage is better seen on MRI; however, MR grading can be overestimated (particularly HI1 and HI2 categories).
- CT remains the workhorse (MR may or may not be available)
- Ideally, baseline and follow up modality should be same

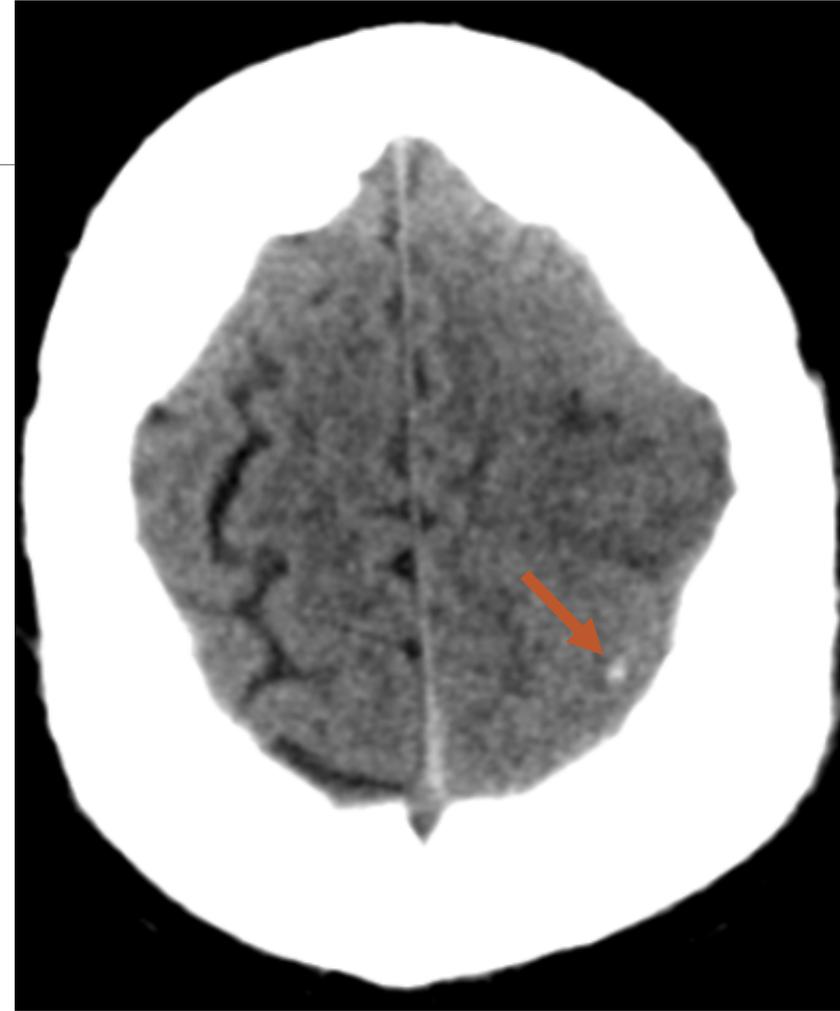
Case Examples



Heidelberg Class 1a (HI-1)

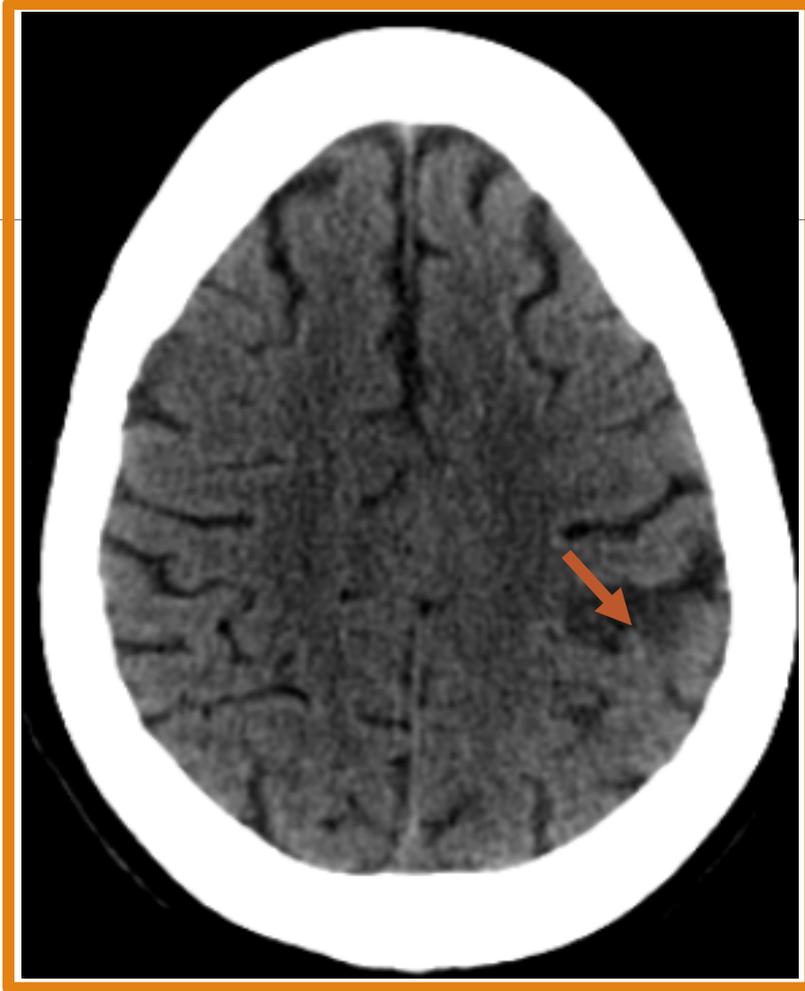
Scattered small petechiae, no mass effect

HI-1: Scattered small petechiae, no mass effect



CT shows **acute infarct** left MCA territory with **small petechial focus - Heidelberg Class 1a (HI-1)**

HI-1: Scattered small petechiae, no mass effect



Acute infarct left MCA territory on CT with **small petechial focus suggestive of HI-1** seen along the posterior margin of the infarct.



Acute infarct left anterior MCA territory on CT with **small petechial focus suggestive of HI-1**

HI-1: Scattered small petechiae, no mass effect



Acute infarct right MCA territory on CT with **small petechial focus suggestive of HI-1** seen along the posterior margin of the infarct,

Heidelberg Class 1b (HI-2)

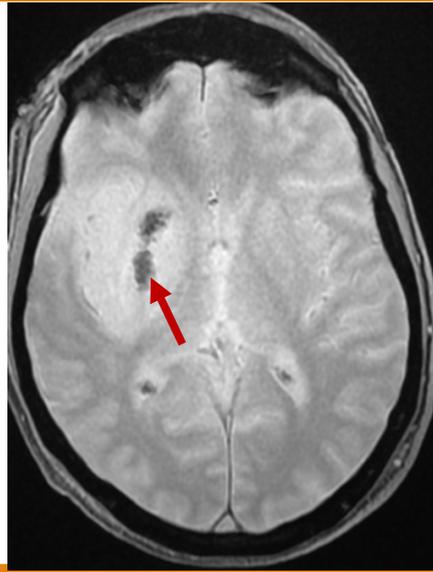
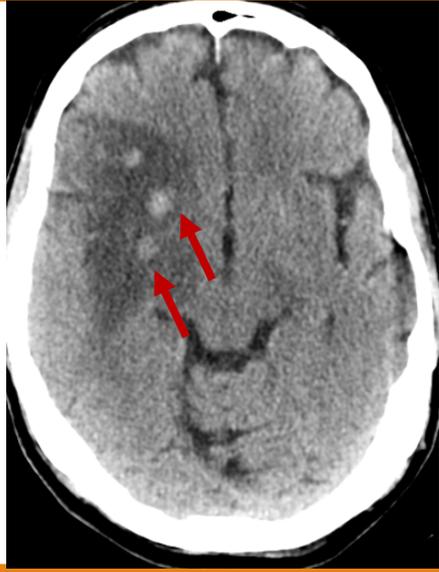
Confluent petechiae, no mass effect

HI-2 : Confluent petechiae, no mass effect

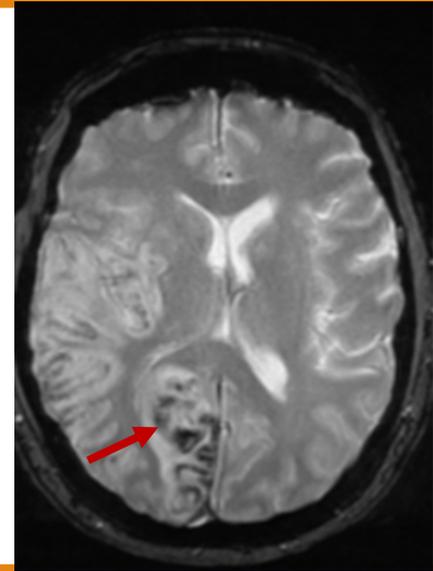


Acute infarct left anterior circulation on follow up CT with **confluent petechial foci** suggestive of **HI-2**

HI-2 : Confluent petechiae

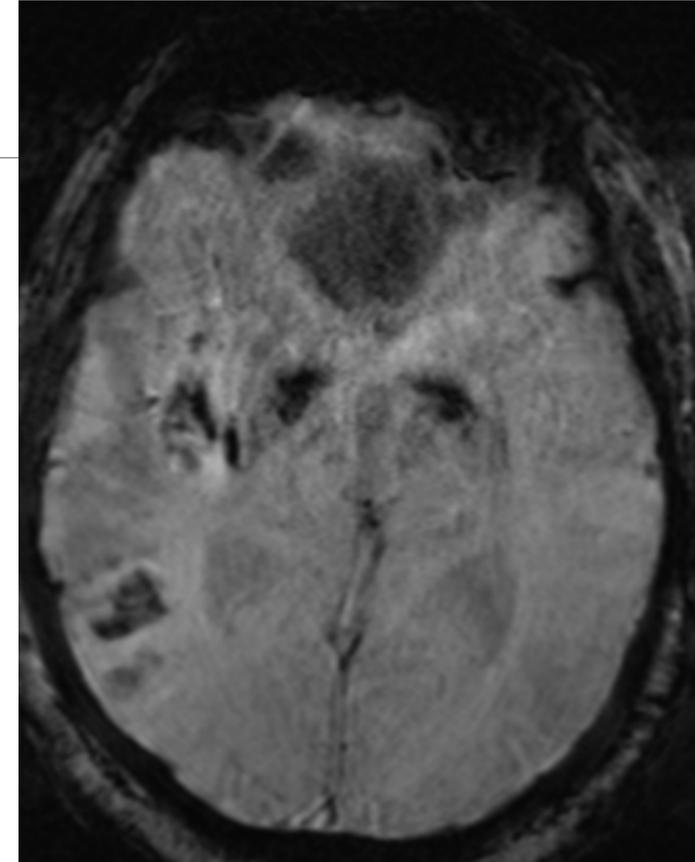
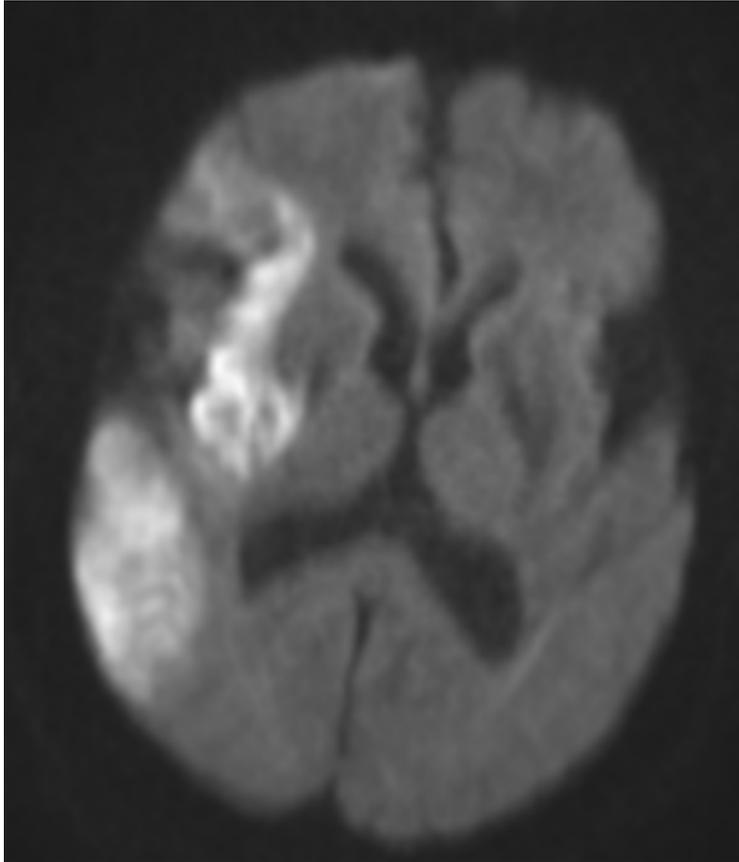


Acute infarct right MCA territory with **confluent hemorrhagic petechiae** suggestive of **HI-2 (Heidelberg class 1b)**



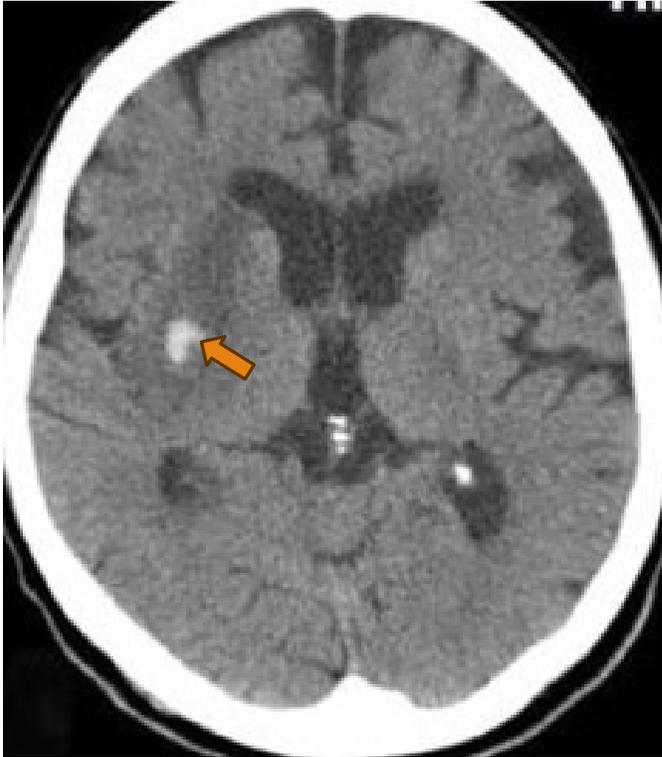
Acute infarct right MCA and PCA territories with **HI-2 (Heidelberg class 1b)** in occipital lobe

HI-2 with subarachnoid hemorrhage (SAH)



DWI showing acute right MCA territory infarct. CT and SWI demonstrate **confluent petechiae, compatible with HI-2** along with trace **SAH in right parieto-temporal sulci**.

HI-2 : Confluent petechiae



Courtesy: Hemorrhagic complications in ischemic stroke, Stroke Manual Treatment and Prevention

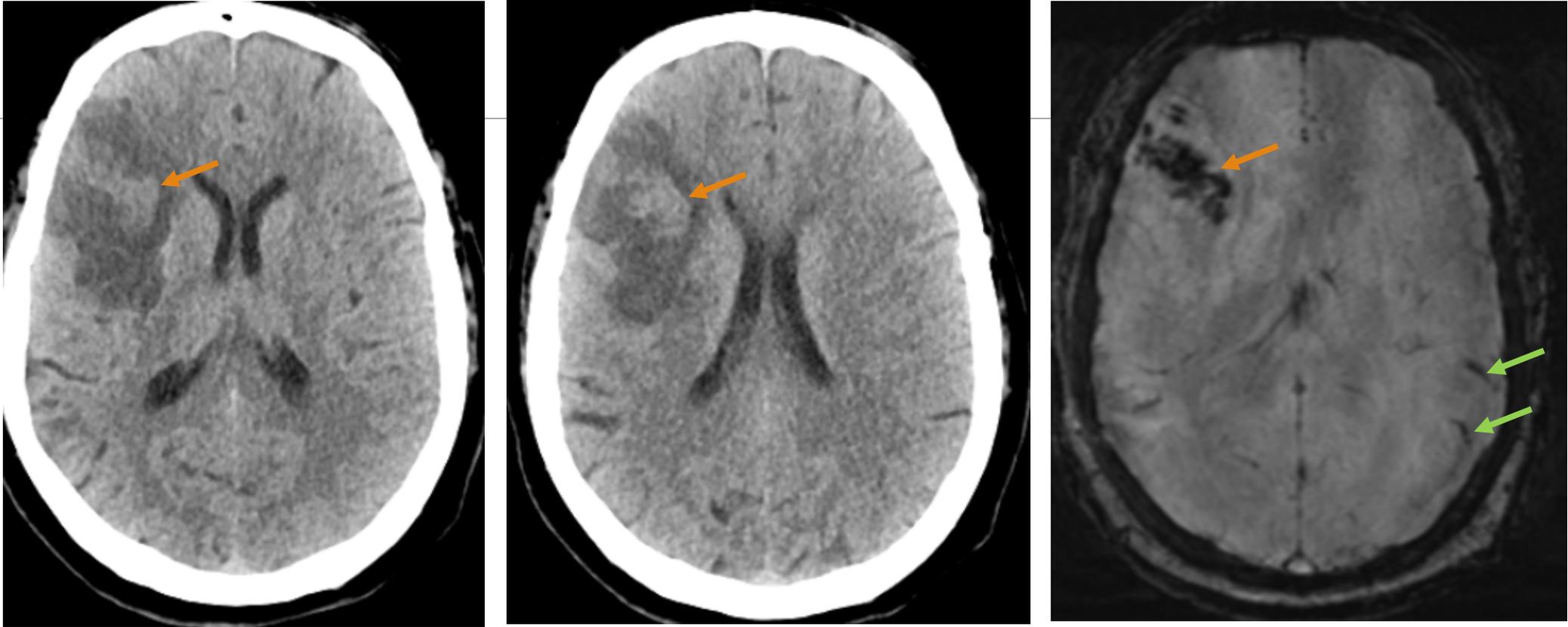


Courtesy: Hemorrhagic transformation of MCA infarct, Radiopedia.org

Heidelberg Class 1c (PH 1)

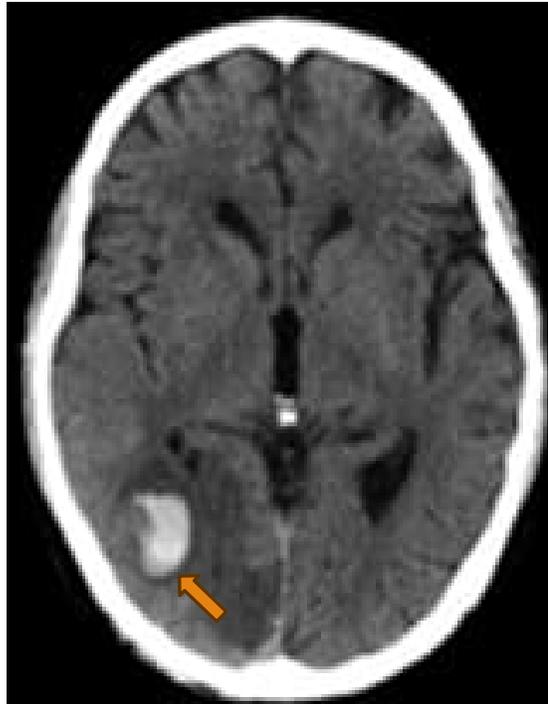
- Hematoma within infarcted tissue
- Involving <30% of infarction
- No substantiative mass effect

PH1: Hematoma within infarcted tissue, involving <30%, no substantiative mass effect

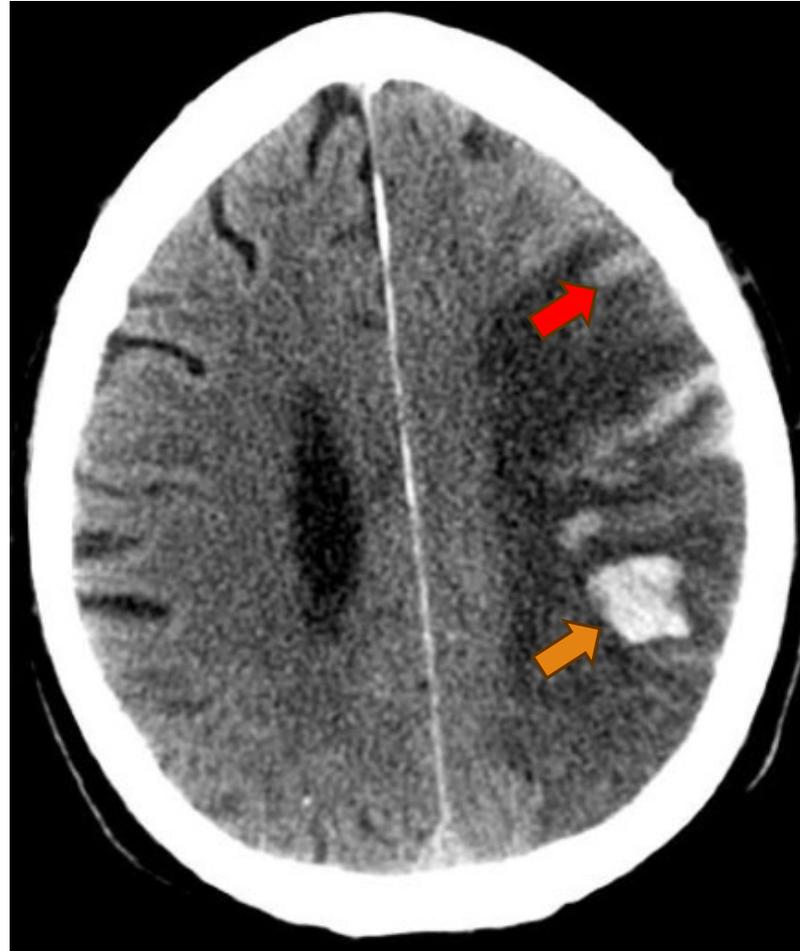


CT images show **hyperdense areas** in the infarct in right MCA territory suggestive of **PH-1**, confirmed on SWI.

PH1: Hematoma within infarcted tissue, involving <30%, no substantiative mass effect



PH1: Hematoma within infarcted tissue, involving <30%, no substantiative mass effect



CT image demonstrates **hematoma** in the left MCA territory infarct, involving less than 30% of infarcted brain, compatible with **PH1**.

No significant mass effect due to the hematoma.

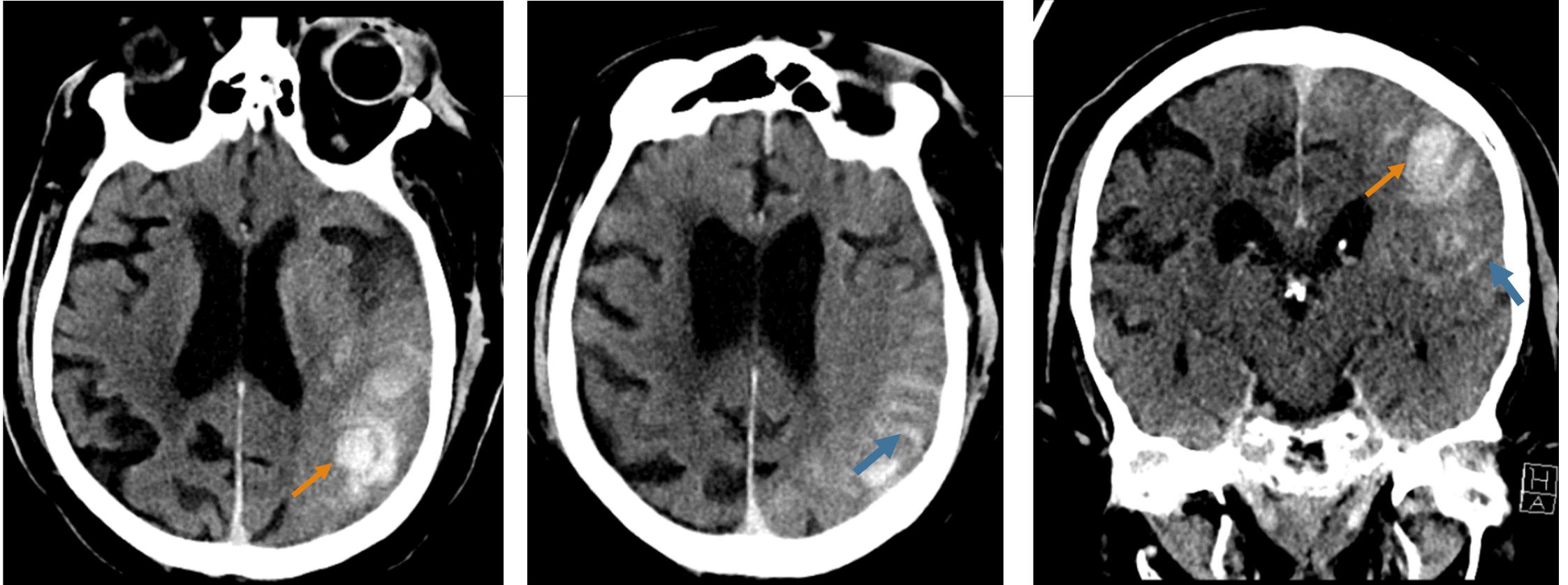
SAH in left frontoparietal sulci (**Heidelberg 3c**)

Courtesy: Hemorrhagic transformation of MCA infarct, Radiopedia.org

Heidelberg Class 2 (PH 2)

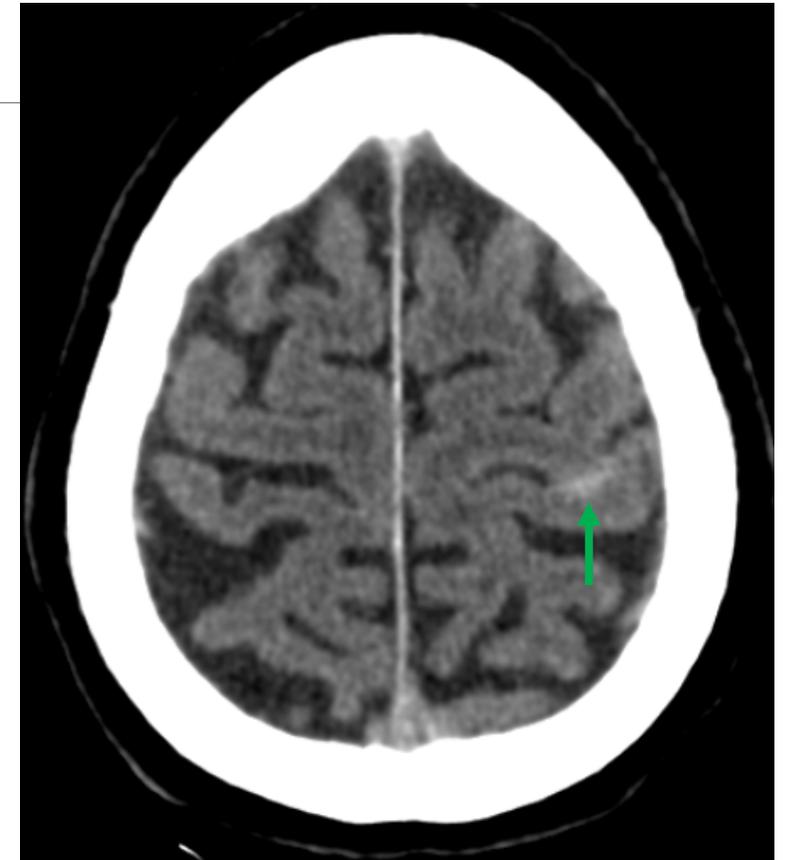
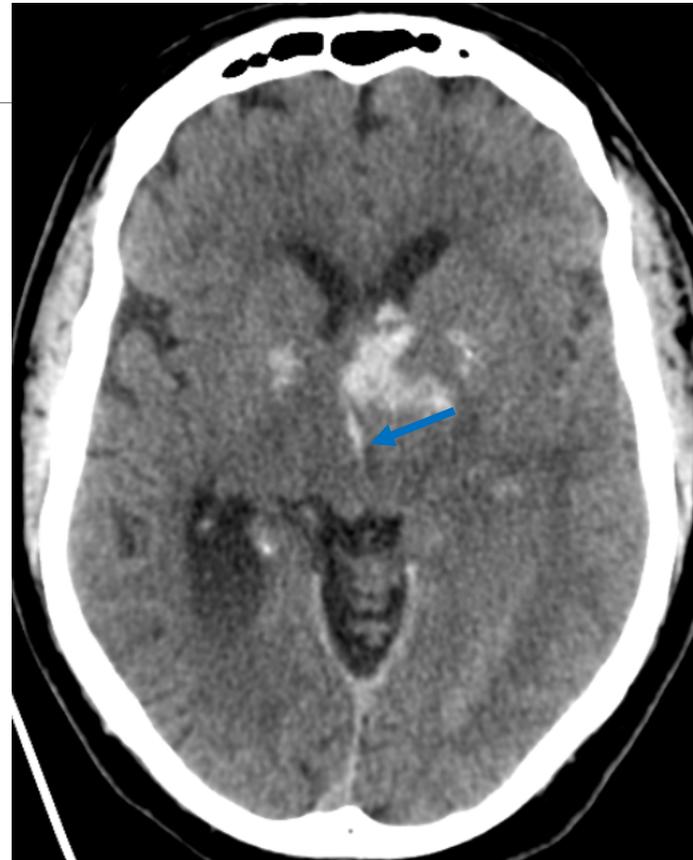
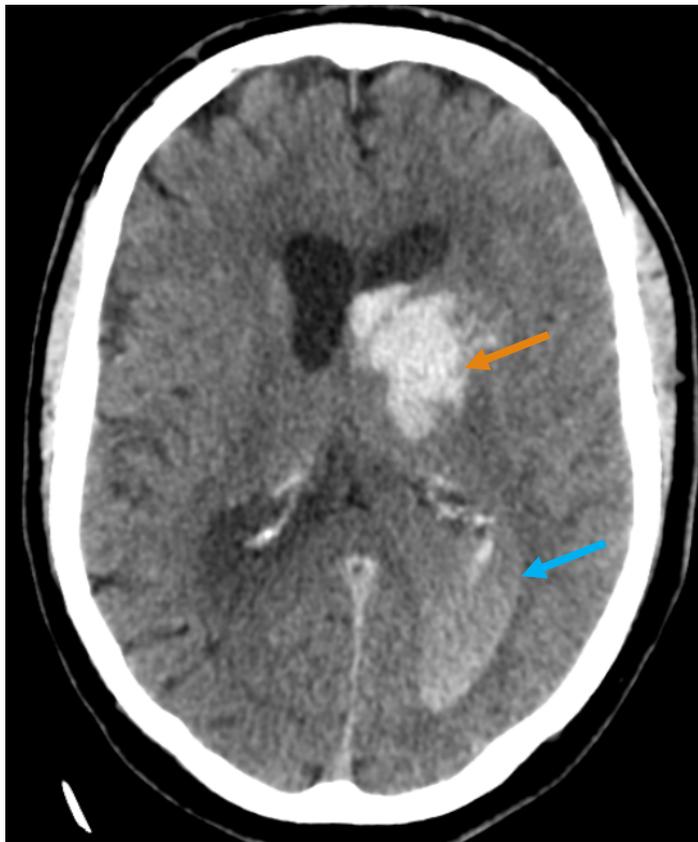
Hematoma involving ≥ 30 percent of infarcted brain tissue, with obvious mass effect

PH-2: Hematoma involving ≥ 30 percent of infarcted brain tissue, with obvious mass effect with Subarachnoid hemorrhage (SAH)



CT shows hyperdense **parenchymal hematoma suggestive of PH-2** in left parietal lobe causing mass effect, along with **acute SAH**.

PH-2 with intraventricular hemorrhage (IVH, 3B) with subarachnoid hemorrhage (SAH, 3C)

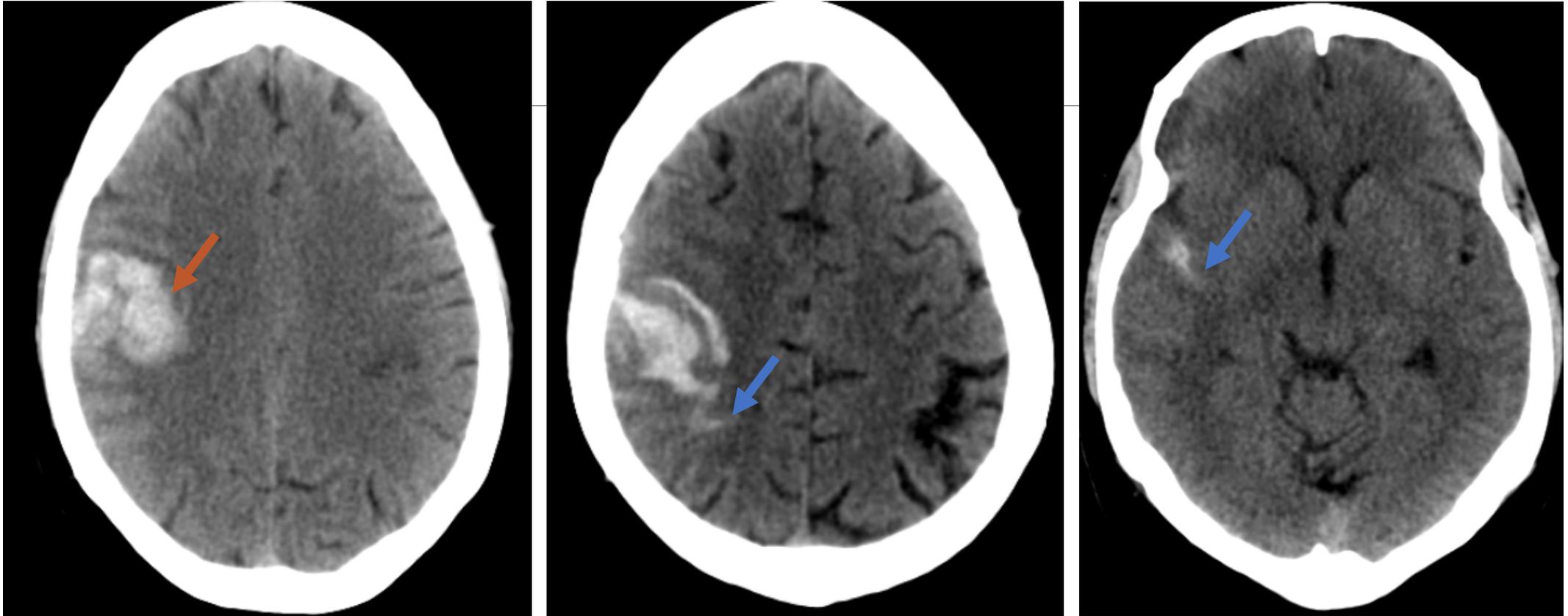


Left MCA territory infarct with **large parenchymal hematoma** left basal ganglia with **IVH (3B)** in bilateral lateral ventricles

IVH (3B) seen extending to third ventricle (**blue arrow**)

SAH in left frontal sulcal spaces (3C)

PH-2 (Class 2) with Subarachnoid Hemorrhage (3C)



Non-contrast CT images show **parenchymal hematoma** right frontal lobe (PH2) with accompanying **SAH (3C)** seen in right frontal sulci and right sylvian fissure.

Take Home Points:

- Be familiar with the Heidelberg classification.
- CT imaging was used for designing the Heidelberg classification.
- Hemorrhagic infarctions, especially HI-1, can be subtle on CT.
- MRI can detect even the subtlest of hemorrhages, may not be evident on CT
- While using SWI/GRE- important not to confuse old microbleeds/ remote hematoma with HI/PH.

