Clinical History:

A 53-year-old male patient presented sudden anisocoria. He was treated with endovascular thrombectomy after an acute ischaemic stroke (left posterior cerebral artery occlusion) some hours earlier.

Imaging Findings:

CT perfusion: Decrease of cerebral blood flow in left posterior cerebral artery territory.
CTA circle of Willis: Left posterior cerebral artery occlusion.
Basal CT: Intraparenchymal areas of hyperattenuation in cerebellar hemispheres, basal cisterns and brainstem. We cannot differentiate between haemorrhage vs iodinated contrast.
Dual-energy CT: Virtual unenhanced image clearly shows the foci of hyperattenuation, which are suggestive of an area of diffuse contrast material staining.

Discussion:

Haemorrhagic transformation (HT) is a major complication of reperfusion therapy for acute ischaemic stroke and contrast material extravasation (CE) is a very common finding after intraarterial therapy. Both of them appear identical on unenhanced CT scans so we cannot differentiate. Dual-energy CT has resolved this problem and the dilemma of how to treat these patients clinically. [3]

Dual-energy CT can differentiate some preselected materials because of fundamental physics of how attenuation is affected by the Compton and photoelectric effects.

The photoelectric effect is energy-dependent and increases as the energy of the incident photon approximates the K-shell binding energy of an electron. The K-shell binding energy varies for each element and it increases as the atomic number increases.

Hydrogen, carbon, nitrogen, and oxygen (human body components) have similar K edges, ranging from 0.01 to 0.53 keV. These values are far from the energies used in dual energy CT (80kVp and 140 kVp) so the attenuations of these elements are similar in 80 kVp and 140 kVp. [2]

However, the K edges of iodine (33.2 keV) are higher and closer to 80 kVp than to 140 kVp, so the attenuation of iodine-containing substances is substantially higher at 80 kVp than 140kVp. Thus we can differentiate iodine from soft tissues at dual-energy imaging. [2]

Postprocessing techniques may be used to create virtual unenhanced images on the basis of differences in
attenuation at the two energies (frequently 80 kVp and 140 kVp).
The discriminatory power of dual-energy CT comes at no extra cost in terms of radiation dose or image quality as compared with single-energy unenhanced CT. [1]
In conclusion, dual-energy CT has high sensitivity and specificity in the differentiation of intracranial haemorrhage from iodinated contrast material staining and may be particularly helpful in patients who have recently undergone intraarterial stroke therapy [4].

Differential Diagnosis List: Contrast material extravasation after an endovascular thrombectomy., Haemorrhagic transformation, Contrast material extravasation

Final Diagnosis: Contrast material extravasation after an endovascular thrombectomy.

References:
Description: CT perfusion: decreased of cerebral blood flow in left posterior cerebral artery territory.

Origin: Radiology department. Asturias Central Hospital.
Description: CTA circle of Willis: Left posterior cerebral artery occlusion. Origin: Radiology department. Asturias Central Hospital.
Description: Basal CT: Intraparenchymal areas of hyperattenuation in cerebellar hemispheres, basal cisterns and brainstem. Origin: Radiology department. Asturias Central Hospital.
Description: Dual-energy CT: Virtual unenhanced image clearly shows the foci of hyperattenuation, which are suggestive of an area of diffuse contrast material staining. Origin: Radiology department. Asturias Central Hospital.
Figure 3

Description: 80 kVp CT.
The attenuation of hydrogen, carbon, nitrogen, and oxygen (human body components) are similar in 80 kVp and 140 kVp. Origin: Radiology department. Asturias Central Hospital.
Description: 140 kVp CT.
The attenuation of hydrogen, carbon, nitrogen, and oxygen (human body components) are similar in 80 kVp and 140 kVp. Origin: Radiology department. Asturias Central Hospital.
**Description:** Virtual unenhanced image.
The attenuation of hydrogen, carbon, nitrogen, and oxygen (human body components) ... are similar in 80 kVp and 140 kVp. **Origin:** Radiology department. Asturias Central Hospital.
Description: 80 kVp CT.

K edges of iodine (33.2 keV) are closer to 80 kVp than to 140 kVp, so the attenuation of iodine-containing substances is substantially higher at 80 kVp than 140 kVp. Origin: Radiology department. Asturias Central Hospital.
**Description:** 140 kVp CT
K edges of iodine (33.2 keV) are closer to 80 kVp than to 140 kVp, so the attenuation of iodine-containing substances is substantially higher at 80 kVp than 140kVp. **Origin:** Radiology department. Asturias Central Hospital.
**Description:** Virtual unenhanced image.

K edges of iodine (33.2 keV) are closer to 80 kVp than to 140 kVp, so the attenuation of iodine-containing substances is substantially higher at 80 kVp than 140 kVp. **Origin:** Radiology department. Asturias Central Hospital.
Figure 5

Description: 80 kVp CT.
Contrast material extravasation and haemorrhagic transformation

Origin: Radiology department.
Asturias Central Hospital.
**Description:** 140 kVp CT.
Contrast material extravasation and haemorrhagic transformation

**Origin:** Radiology department.
Asturias Central Hospital.
Description: Virtual unenhanced image. Contrast material extravasation and haemorrhagic transformation. **Origin:** Radiology department. Asturias Central Hospital.