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Spontaneous intracranial hematomas: role of dynamic CT and angiography

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Forty-five patients with spontaneous intracerebral hemorrhage (ICH) were studied prospectively by dynamic CT and cerebral angiography. The accuracy of dynamic CT in demonstrating the underlying vascular cause in ICH was evaluated. Dynamic CT correctly predicted 90% of aneurysms, 83% of AVMs and 100% of normal studies as compared to angiography. Cerebral angiography can be obviated in patients where dynamic CT does not show any obvious vascular anomaly.

N. Eshwar Chandra[1], N. Khandelwal[1], J. R. Bapuraj[1], S. N. Mathuriya[2], R. K. Vasista[3], V. K. Kak[2], S. Suri[1]

Departments of [1]Radiodiagnosis, [2]Neurosurgery and [3]Pathology, Postgraduate Institute of Medical Education and Research, Chandigarh 160012, India

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Dr J. R. Bapuraj, Department of Radiodiagnosis PGIMER, Sector 12, Chandigarh 160012, India

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The term spontaneous intracerebral hematoma (ICH) refers to all varieties of bleeding into the cerebral parenchyma in which "trauma or other exogenous" factors do not play an essential part (1).

It constitutes a major neurosurgical problem and its incidence varies from 10–32% of all cerebrovascular strokes (2). The various etiological factors include arterial hypertension, aneurysm, vascular malformation, neoplasm, coagulopathy, collagen vascular disease, cortical vein and/or dural sinus thrombosis (3). It has long been believed that the most common cause of ICH including subcortical hemorrhage is hypertension (4). However, recent publications have noted that an unknown etiology was more common than any single cause of subcortical hemorrhage and hypertension was the most common detected cause (3, 5, 6, 7).

Recently, small vascular malformations are being more frequently implicated as a cause of subcortical hemorrhage especially in those with negative angiograms. The exact incidence in patients with subcortical hemorrhage is still unclear (4, 7, 8). Amyloid angiopathy is reportedly the second most common cause of ICH however was not observed in a large necropsy series reported from this center (9, 10).

The indications of cerebral angiography in ICH are less clear as compared to subarachnoid hemorrhage (SAH) as the majority are caused by systemic diseases and managed conservatively (11). Cerebral angiography is helpful in defining or ruling out underlying vascular lesions in ICH and is mandatory prior to surgical intervention in specific setting. However, it is an invasive procedure and carries a complication rate of 1–1.5%, even in expert hands (10). While there are several publications describing the predictiveness of aneurysms based on the location of SAH with or without associated ICH by CT (5, 14–17), there are only scanty reports available predicting the underlying pathology in spontaneous ICH (5, 11).

Dynamic CT is a technique where, after bolus contrast infusion, very rapid slices of the area of interest are imaged to produce a near-angiographic mapping. Dynamic CT has been utilized in the detection of aneurysms and it has been found to be a safe and reliable method (18). The aim of this prospective study is to compare the value of dynamic CT and angiography in evaluating spontaneous ICH as regards to underlying etiology and to define specific indications of angiography in spontaneous ICH.

Material and methods

Forty-five patients (29 males and 16 females) of ages ranging from 3 years to 75 years, admitted with spontaneous ICH between 1990 and 1995 were studied prospectively. All hypertensive patients with hemorrhage in the thalamus, putamen, internal capsule and cerebellum were excluded from this study. A plain CT was done to confirm the diagnosis of ICH and its location, size and associated SAH/IVH were recorded. A dynamic contrast enhanced study was done covering the circle of

Table 1. Location of hematoma (n=45)

Location	No. of patients
Supratentorial	
Parietal	13
Temporal	10
Frontal	8
Frontoparietal	2
Temporoparietal	3
Occipital	2
Basal ganglia (including thalamus)	4
Infratentorial	
Cerebellar	3
Total	45

Willis and the region of hematoma followed by conventional CT of the brain. All scans were done using either Shimadzu SCT 2000T/Siemens Somatom HiQ S Scanner. Conventional cerebral angiography was done in all the patients except one and the findings were correlated with those of dynamic CT. Histopathological examination was performed in 11 surgically evacuated hematomas where no cause was demonstrated on angiography.

Results

Forty-two patients had supratentorial hematomas ranging from 2 to 8 cms in diameter. Three patients had infratentorial hematomas. The location of hematomas is shown in Table 1. The dynamic CT, angiographic, surgical and histopathological findings are shown in Table 2.

Of the 12 aneurysms demonstrated on cerebral angiography, dynamic CT demonstrated all but one which was 4 mm in size. Ten of these aneurysms were clipped surgically (Fig. 1). One patient had a mycotic aneurysm and was treated conservatively. The other patient died of a re-bleed prior to surgery.

Of the 12 arteriovenous malformations (AVMs) detected on angiography, dynamic CT correctly demonstrated 10 of them (Fig. 2). A sylvian AVM was missed on dynamic CT in a patient who had a frontoparietal bleed and a lacunar infarct on the contralateral side. In the other patient who had a cerebellar bleed due to a torcular AVM, dynamic CT was interpreted as normal. In 1 patient a false positive diagnosis of AVM was made on dynamic CT, but angiography was normal. Surgical excision of the lesion proved it to be a glioma (Fig. 3).

Cerebral angiograms in 20 patients, where dynamic CT did not reveal any vascular abnormality, were normal. Angiography was not done in 1 patient and surgical evacuation of the ICH was performed on the basis of normal dynamic CT findings. Histopathological examination of the hematoma in 11 patients with normal dynamic CT and cerebral angiography did not reveal any abnormal findings.

Table 2. Dynamic CT, cerebral angiography, surgical and histopathological findings

Diagnosis	Dynamic CT	Angiogram*	Surgery	Histopathology
Aneurysm	11	12	10	0
AVM	11**	12	9	9
Normal	23***	20	11	11
Others	0	0	1	1

*Angiogram was not done in 1 patient with a normal dynamic CT study.

**Includes 1 false positive (normal angiogram), which proved to be glioma.

***Includes 3 false negatives which includes a 4 mm aneurysm, a missed forcular AVM and a sylvian fissure AVM.

Discussion

Spontaneous ICH accounts for about 10% of all strokes in the young, and is associated with major morbidity and mortality (2). Hypertension has been implicated as the major etiological factor especially in elderly patients (11). Angiomas and aneurysms account for the next usual causes responsible for spontaneous ICH. CT is the investigation of choice for diagnosing ICH but angiography is mandatory to diagnose/localize/specify/exclude a vascular lesion. Angiography, though, furnishes vascular details but is an invasive procedure with potential complications (12, 17, 19).

ICH was due to aneurysmal rupture in 12 patients in the present study. Dynamic CT demonstrated 11 aneurysms ranging in size from 3 mm to 12 mm with a sensitivity of 91%. In 1 patient cerebral angiography demonstrated a 4 mm A Com A aneurysm which was not demonstrated on dynamic CT. This is almost in conformity to Schmid's series (18) where angio CT (dynamic CT) demonstrated 74/76 aneurysms (97.4%)

Of the 12 AVMs demonstrated on angiography, 10 lesions were diagnosed on CT as serpiginous areas of enhancement with a sensitivity of 83%. A torcular and sylvian AVM were not diagnosed on dynamic CT and the scans were interpreted as normal. Four patients had associated flow related aneurysms (2 proximal, 1 intranidal and 1 distal), which were all demonstrated on dynamic CT.

Dynamic CT misinterpreted a case of glioma as an AVM.

In 20 patients with normal angiography, dynamic CT was also normal. In the other patient with normal findings at dynamic CT, surgical evacuation of the hematoma also did not reveal any cause.Thus in patients with normal study dynamic CT has 100% sensitivity. In spontaneous ICH, the identification of the site and surgical cause of the

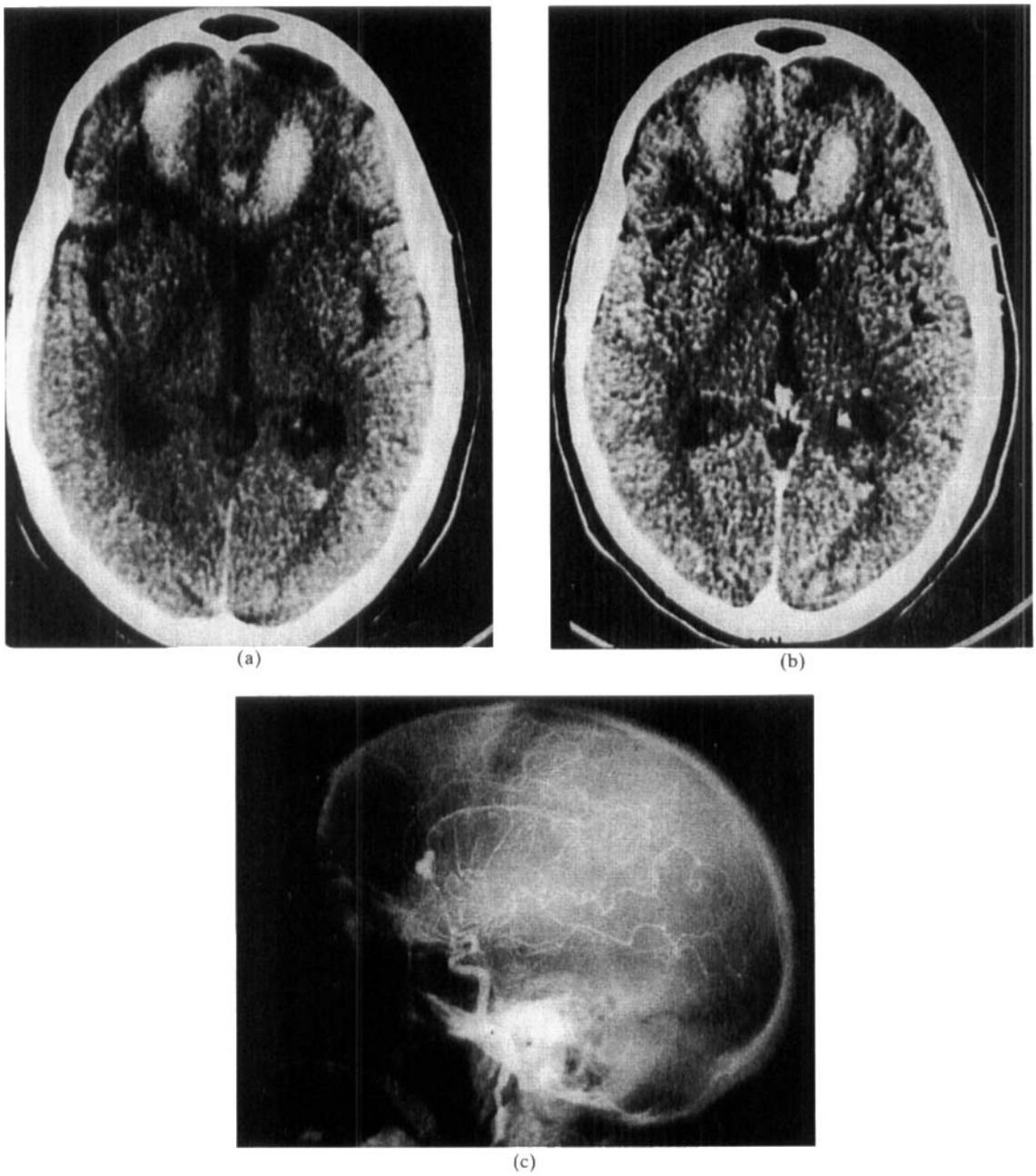


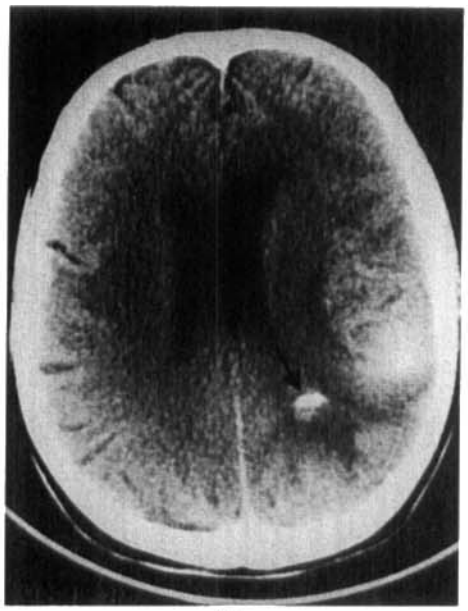
Fig. 1. (a) NCCT shows bifrontal ICH. (b) Dynamic CECT shows an oval area of enhancement in the interhemispheric fissure s/o aneurysm. (c) Left carotid angiogram lateral projection shows a lobulated DACA (pericallosal) aneurysm.

hematoma is important for correct diagnosis and proper management.

The present study tried to predict the underlying etiology utilizing dynamic CT which is an imaging modality with an acceptable sensitivity in addition to being noninvasive in nature. The overall sensitivity of dynamic CT in predicting the underlying etiology of intracranial hematoma is 93% in the present study.

MRI was highly sensitive in diagnosing angiographically occult vascular malformations (20). In the present study, though MRI scanning was not performed, histopathological evaluation in 11 patients who had normal dynamic CT findings did not reveal any underlying etiology.

Fig. 2. (a) NCCT section at the level of body of lateral ventricles shows a left parietal ICH and an area of calcification (arrow). (b) Dynamic CECT section at the level of hematoma shows linear areas of enhancement s/o AVM. (c) Dynamic CECT at the circle of Willis shows an oval area of enhancement in the left sylvian fissure s/o MCA bifurcation aneurysm. (d) Lateral view of the left carotid angiogram shows a MCA bifurcation aneurysm: a prominent angular artery leads to an AVM. (e) Detail from study of "d" (above), shows the AVM in the right parietal lobe.

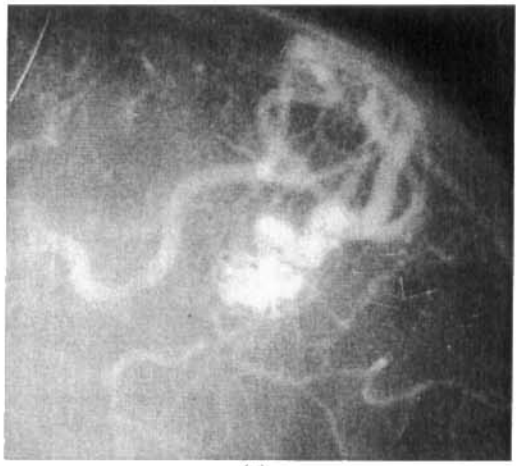


(a)

(b)

(c)

(d)



(e)

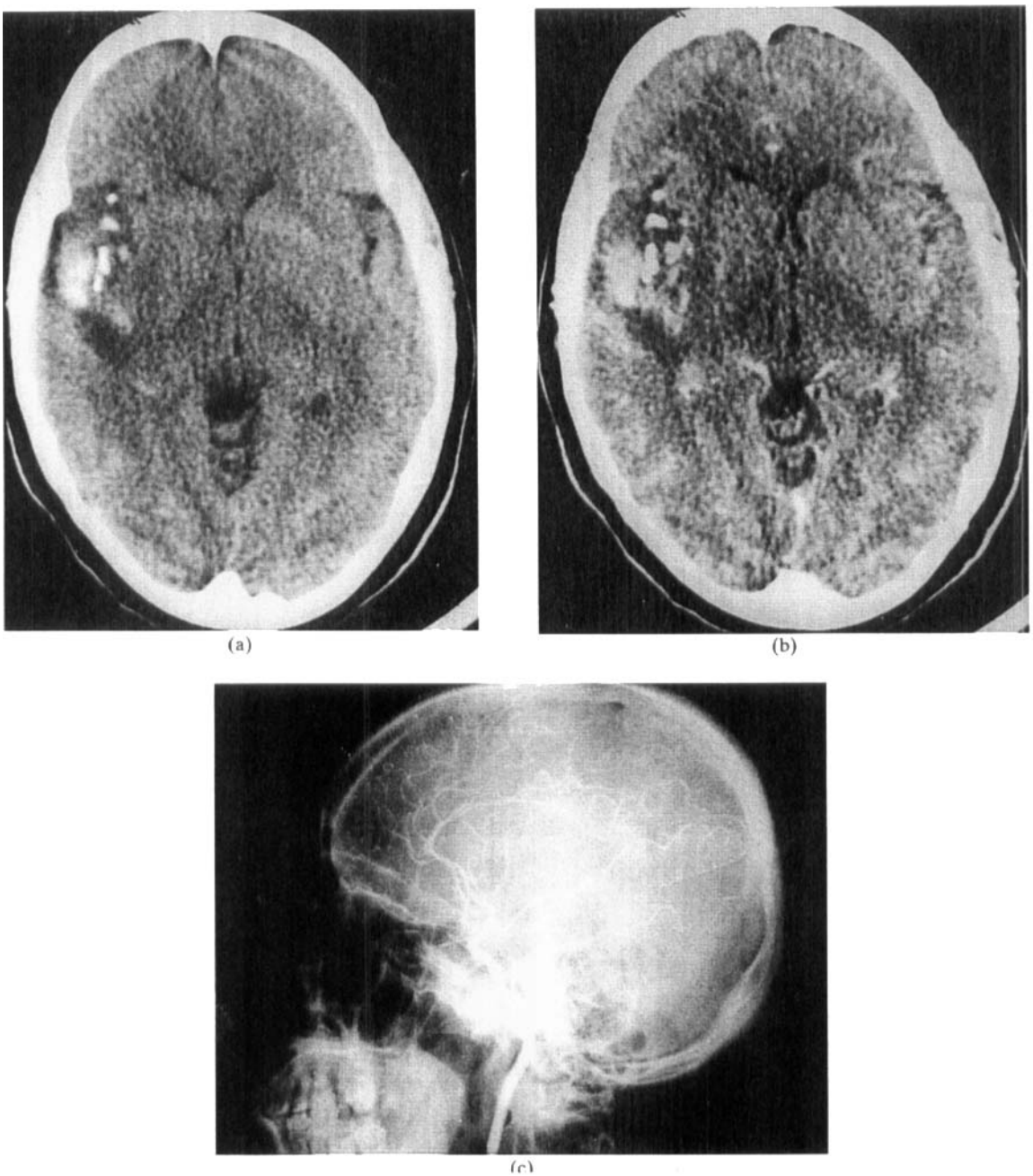


Fig. 3. (a) NCCT shows a mixed attenuation right temporal mass with few calcific specks. (b) Few enhancing linear areas noted on dynamic CECT which was interpreted as an AVM. (c) Right carotid angiogram lateral projection does not show AVM.

In conclusion, dynamic CT is a sensitive and inexpensive modality to predict the underlying etiology in cases of spontaneous intracranial hematomas. Cerebral angiography may be obviated in patients with negative findings on dynamic CT.

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