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# Role of Repeat Digital Subtraction Angiography in Acute Spontaneous Intracranial Haemorrhage of Unexplained Origin

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**Abstract** **Original Research Article**

***Objective:*** to evaluate the role of repeat digital subtraction angiography in acute spontaneous intracranial haemorrhage of unexplained origin. ***Methods:*** This was a cross-sectional observational study. A total of 70 patients were included in the study. CT scan examination was done in all the patients. All patients had DSA with diatrizoate meglumine and diatrizoate sodium via transfemoral route. ***Results:*** CT was positive among 97% (68/70) patients. Out of 70 patients, initial DSA was failed to demonstrate the cause of acute spontaneous intracranial haemrrhage among 75.7% (53/70) patients. 15.7% (11/70) were suggestive of aneurysm, 7.1% (5/70) were AVM and 1.4% (1/70) had tumorogenic. Among 53 patients with negative DSA, 62.3% (33/53) were hypertensive origin and 37.7% (20/53) were non-hypertensive. ***Conclusion:*** This study shows that the false negative rate is nil and DSA is the serious undertaking. With this fact that it is concluded that repeat pandigital subtraction angiography is not required unless further bleeding occur.

**Keywords:** Intracranial haemorrhage, Computed tomography, Angiography, Digital subtraction angiography.

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## INTRODUCTION

There are myriad causes of intracranial hemorrhage (ICH), which are broadly categorised into traumatic or spontaneous etiologies. The later has many causes which include vascular pathology (e.g. aneurysm, arteriovenous malformation; (AVM), arteriovenous fistula; (AVF), cavernous angiomas, amyloid angiopathy, vasculitis, moya moya disease), tumour and systemic disease (e.g. hypertension and bleeding diathesis). Some of the vascular pathologies are amenable to curative treatment; hence, it is crucial to achieve an accurate diagnosis early [1].

Acute spontaneous intracranial hemorrhage (ASICH) is well recognized complication in patients with hematological disease. Intracranial hemorrhage is the second leading cause of death in patients with acute myeloid leukemia. The reported mortality is over 50% for patients with hematological malignancy and spontaneous intracranial hemorrhage. The reported incidence of spontaneous intracranial hemorrhage appears to be slightly higher in acute myeloid leukemia (AML) and chronic myeloid leukemia in blast crisis than in other forms of hematological malignancy [2].

It is well established in the literature that computer tomography angiography (CTA) which has a high sensitivity and specificity of more than 90% (with the exception of small intracranial aneurysms measuring less than 3mm) is the preferred initial imaging tool for detecting vascular pathologies [3, 4]. On the contrary, digital subtraction angiography (DSA), being superior to CTA in terms of spatial and contrast resolution with no interference from surrounding bony structures, is often regarded as the gold standard diagnostic procedure, especially for equivocal findings. However, DSA is invasive, being associated with a small but significant risk of neurological complications, ranging from of 0.3 to 1.8% [5, 6]. It is also time consuming, operator dependent and the subtracted images obtained may not delineate the important morphological features such as the neck of the aneurysm, vessels arising from the sac, mural calcifications or luminal thrombus [7].

The present study was designed to evaluate the role of repeat digital subtraction angiography in acute spontaneous intracranial haemorrhage of unexplained origin.

# MATERIAL AND METHODS

This was a cross-sectional observational study conducted in a tertiary care hospital in north India. The study was approved by the Ethical Committee of the Institute and consent was taken from attendant/patients before including in the study.

A total of 70 patients were included in the study that was clinically suspected of ASICH. CT scan examination was done in all the patients. In CT negative patients, diagnostic lumbar puncture was done which showed the xanthochromic color and crenated RBCs in CS. All patients underwent 4 vessels digital subtraction angiography or a technically adequate 3 vessels cerebral DSA in which there was reflux of contrast medium from the dominant vertebral artery down to the contralateral posterior inferior cerebellar artery. Repeat DSA was done after 3 to 5 weeks of first examination in those patients only who were not belonging to hypertensive haemorrhage group.

All patients had DSA with diatrizoate meglumine and diatrizoate sodium via transfemoral route. In femoral artery, 6 Fr./5 Fr catheter introducer sheath with haemostatic valve was placed by the Seldinger technique. $H_1$ and Simmon angiographic catheter were used. Atleast 3 projections were taken (AP, lateral and oblique) with automatic pressure injector (Angiomet 6000) & Technix TCA 4 computerized DSA machine. In all patients, major intracranial vessels were demonstrated in one session.

Descriptive statistics are presented.

# RESULTS

CT was positive among 97% (68/70) patients (Fig.1). Out of 70 patients, initial DSA was failed to demonstrate the cause of acute spontaneous intracranial haemrrhage among 75.7% (53/70) patients. 15.7% (11/70) were suggestive of aneurysm, 7.1% (5/70) were AVM and 1.4% (1/70) had tumorogenic (Table-1).

Among 53 patients with negative DSA, 62.3% (33/53) were hypertensive origin and 37.7% (20/53) were non-hypertensive (Table-2).

During the study, 17 patients with proven spontaneous intracranial haemorrhage but negative pandigital subtraction angiography were investigated by repeat pandigital subtraction angiography, because 33 out of 53 patients were having the hypertensive etiology (after exclusion by first DSA) and 3 patients did not turn up for re-examination. In none of these 17 patients, the repeat DSA could provide a positive result, thereby proving that there were no false negative in first DSA. There were only 2 patients in whom a spasm in first examination, in one patient, there was spasm of left M1 segment & in second spasm of basilar artery was present. In subsequent DSA examination, there was no spasm. Two patients had contrast reaction, 1 had minor allergic reaction in the form of rashes at the end of DSA and died due to the severe anaphylactic reaction (Table not shown).

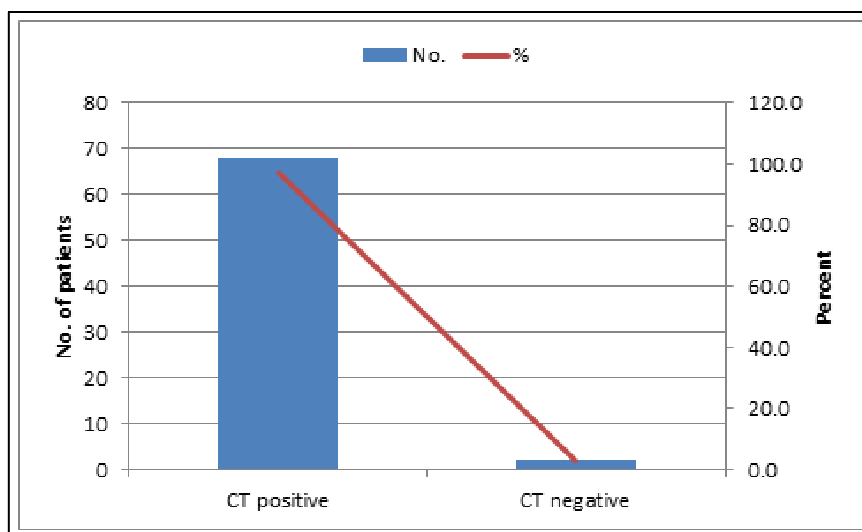


**Fig-1: Distribution of CT finding**

**Table-1: Distribution of DSA findings**

| DSA findings | No. (n=70) | % |
|---|---|---|
| Negative DSA | 53 | 75.7 |
| Aneurysm | 11 | 15.7 |
| AVM | 5 | 7.1 |
| Tumorogenic | 1 | 1.4 |

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**Table-2: Etiological Distribution of DSA negative patients**

| DSA findings | No. (n=53) | % |
|---|---|---|
| Hypertensive haemorrhage | 33 | 62.3 |
| Non-hypertensive haemorrhage | 20 | 37.7 |

## DISCUSSION

Previous publications have reported that the sensitivity for identifying aneurysms measuring 3mm or more on CTA (with DSA or surgical findings as the gold standard) is high, ranging from 93.3% to 100% [7, 8]. On the contrary, the sensitivity drops significantly for aneurysms measuring less than 3mm, ranging from 38% to 70.4% [4, 9].

DSA is widely accepted as the 'gold standard' for investigation of intracranial vascular lesions, offering better spatial and contrast resolution with no interference from bony structures. In addition, 3D rotational angiography (3DRA) is able to provide more exact and precise anatomical details [10, 11]. However, it is heavily operator-dependent and time consuming. Furthermore, DSA is not absolutely without errors. Pathirana *et al*. [12] reported initial negative IA-DSA results in 20.3% of patients with SAH; whereupon repeat angiography demonstrated aneurysms in 30% of these patients. Other authors have reported incidence of aneurysms in 11.7% and 21% on repeat angiograms [13, 14].

In this study, the incidence of negative angiogram was 75.7%. The incidence of angiogram negative SAH has been reported to be variable ranging from 2% to 24% in various studies. Vaitkevicius *et al*. [15] reported 15-20% cases, Fontanella *et al*. [16] reported 2-24% and Jung et *et al*. [17] reported 8-23% cases of total spontaneous SAH. Kumar *et al*. [18] reported 22% (39/178) of all SAH were angio-negative. Probably, it is due to the fact that in this series, all patients of ASICH are taken including the hypertensive haemorrhage though in other studies, only patients of SAH are studied.

The incidence of aneurism was 15.7% in this study. This incidence lower than the study by Bakar *et al*. [19] in which the incidence of aneurism was 38.8%. The incidence of aneurysm (15.7%) is also lower than that in other studies (16.8-25%)[20-22].

In the present study, in none of repeated DSA (17 patients), the repeat DSA could provide a positive result. This is in agreement with the study by Kumar *et al*. [18] in which repeat angiogram did not reveal any pathology in the PM-SAH group.

In this study, 2 patients who were in six decade of life, were having uncontrolled arterial blood pressure and CT scan was suggestive of anterior intraventricular haemorrhage, revealed pericallosal artery aneurysm & anterior communicating artery aneurysm respectively. CT scan was detectable ASICH was in 97% patients. Kelliny *et al*. [23] found the incidence of false negative being 2.5%.

The etiology of angiogram negative ASICH remains elusive which may be due to bleeding from a micro-aneurysm that undergoes thrombosis or is destroyed at the time of haemorrhage. But on the other hand, good prognosis reported, of negative angiogram ASICH patients in terms of re-bleeding and delayed cerebral ischemia.

## CONCLUSION

This study shows that the false negative rate is nil and DSA is the serious undertaking. With this fact that it is concluded that repeat pandigital subtraction angiography is not required unless further bleeding occur.

## REFERENCES

1. Qureshi AI, Tuhrim S, Broderick JP, Batjer HH, Hondo H, Hanley DF. Spontaneous intracerebral hemorrhage. New England Journal of Medicine. 2001 May 10;344(19):1450-60.
2. Batchelor JS. The pathogenesis of spontaneous intracranial hemorrhage in patients with hematological malignancy. Johns Stephen Batchelor, J Blood Disord Transfus. 2016; 7:5.
3. Yoon DY, Chang SK, Choi CS, Kim WK, Lee JH. Multidetector row CT angiography in spontaneous lobar intracerebral hemorrhage: a prospective comparison with conventional angiography. American Journal of Neuroradiology. 2009 May 1;30(5):962-7.
4. Romijn M, van Andel HG, Van Walderveen MA, Sprengers ME, Van Rijn JC, Van Rooij WJ, Venema HW, Grimbergen CA, Den Heeten GJ, Majoie CB. Diagnostic accuracy of CT angiography with matched mask bone elimination for detection of intracranial aneurysms: comparison with digital subtraction angiography and 3D rotational angiography. American Journal of Neuroradiology. 2008 Jan 1;29(1):134-9.
5. Willinsky RA, Taylor SM, terBrugge K, Farb RI, Tomlinson G, Montanera W. Neurologic complications of cerebral angiography: prospective analysis of 2,899 procedures and review of the literature. Radiology. 2003 May;227(2):522-8.
6. Cloft HJ, Joseph GJ, Dion JE. Risk of cerebral angiography in patients with subarachnoid hemorrhage, cerebral aneurysm, and arteriovenous

malformation: a meta-analysis. Stroke. 1999; 30(2): 317-20

7. Karamessini MT, Kagadis GC, Petsas T, Karnabatidis D, Konstantinou D, Sakellaropoulos GC, Nikiforidis GC, Siablis D. CT angiography with three-dimensional techniques for the early diagnosis of intracranial aneurysms. Comparison with intra-arterial DSA and the surgical findings. European journal of radiology. 2004 Mar 1;49(3):212-23.
8. Van Gelder JM. Computed tomographic angiography for detecting cerebral aneurysms: implications of aneurysm size distribution for the sensitivity, specificity, and likelihood ratios. Neurosurgery. 2003 Sep 1;53(3):597-606.
9. Lubicz B, Levivier M, François O, Thoma P, Sadeghi N, Collignon L, Balériaux D. Sixty-four-row multisection CT angiography for detection and evaluation of ruptured intracranial aneurysms: interobserver and intertechnique reproducibility. American journal of neuroradiology. 2007 Nov 1;28(10):1949-55.
10. Hochmuth A, Spetzger U, Schumacher M. Comparison of three-dimensional rotational angiography with digital subtraction angiography in the assessment of ruptured cerebral aneurysms. American journal of neuroradiology. 2002 Aug 1;23(7):1199-205.
11. Anxionnat R, Bracard S, Ducrocq X, Trousset Y, Launay L, Kerrien E, Braun M, Vaillant R, Scomazzoni F, Lebedinsky A, Picard L. Intracranial aneurysms: clinical value of 3D digital subtraction angiography in the therapeutic decision and endovascular treatment. Radiology. 2001 Mar;218(3):799-808.
12. Pathirana N, Refsum SE, McKinstry CS, Bell KE. The value of repeat cerebral angiography in subarachnoid haemorrhage. British journal of neurosurgery. 1994 Jan 1;8(2):141-6.
13. Juul R, Fredriksen TA, Ringkjob R. Prognosis in subarachnoid hemorrhage of unknown etiology. J Neurosurg. 1986; 64(3): 359-62.
14. Iwanaga H, Wakai S, Ochiai C, Narita JI, Inoh S, Nagai M. Ruptured cerebral aneurysms missed by initial angiographic study. Neurosurgery. 1990 Jul 1;27(1):45-51.
15. Vaitkevicius G, Gvazdaitis AR, Lukosevicius S. Spontaneous subarachnoid hemorrhage: Patients' examination after aneurysm-negative initial angiograms. Medicina. 2002;38(10):976-81.
16. Fontanella M, Rainero I, Panciani PP, Schatlo B, Benevello C, Garbossa D, Carlino C, Valfrè W, Griva F, Bradac GB, Ducati A. Subarachnoid hemorrhage and negative angiography: clinical course and long-term follow-up. Neurosurgical review. 2011 Oct 1;34(4):477.
17. Jung JY, Kim YB, Lee JW, Huh SK, Lee KC. Spontaneous subarachnoid haemorrhage with negative initial angiography: a review of 143 cases. Journal of Clinical Neuroscience. 2006 Dec 1;13(10):1011-7.
18. Kumar R, Das KK, Sahu RK, Sharma P, Mehrotra A, Srivastava AK, Sahu RN, Jaiswal AK, Behari S. Angio negative spontaneous subarachnoid hemorrhage: Is repeat angiogram required in all cases?. Surgical neurology international. 2014;5.
19. Bakar IA, Shuaib IL, Ariff ARM, Naing NN and Abdullah JM. Diagnostic Cerebral Angiography in Spontaneous Intracranial Haemorrhage: A Guide for Developing Countries. Asian J Surg. 2005;28(1):1–6
20. Zhu XL, Chan MS, Poon WS. Spontaneous intracranial hemorrhage: which patients need diagnostic cerebral angiography? A prospective study of 206 cases and review of the literature. Stroke. 1997 Jul;28(7):1406-9.
21. Griffiths PD, Beveridge CJ, Gholkar A. Angiography in non-traumatic brain haematoma: an analysis of 100 cases. Acta Radiologica. 1997 Jan 1;38(5):797-802.
22. Halpin SF, Britton JA, Byrne JV, Clifton A, Hart G, Moore A. Prospective evaluation of cerebral angiography and computed tomography in cerebral haematoma. Journal of Neurology, Neurosurgery & Psychiatry. 1994 Oct 1;57(10):1180-6.
23. Kelliny M, Maeder P, Binaghi S, Levivier M, Regli L, Meuli R. Cerebral aneurysm exclusion by CT angiography based on subarachnoid hemorrhage pattern: a retrospective study. BMC neurology. 2011 Dec;11(1):8.