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Multiple neoplastic intracerebral aneurysms associated with renal cell carcinoma

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ABSTRACT

Intracranial neoplastic cerebral aneurysms (NCA) from metastasis are a is an extremely rare disease entities. NCA has been reported in a very small number of patients. Most cases of NCAs are usually complicated with cardiac myxomas and choriocarcinoma, other tumors are lymphoma, cardiac myxosarcoma, and rarely lung carcinoma. And these are much less common than myxomas and choriocarcinoma. Although lung cancer is very common neoplasm and have high metastatic potential to brain, there have only been 6 published reports of intracranial cerebral aneurysms secondary to metastatic lung cancer. But, we could not find any previous reports about NCA associated with renal cell carcinoma. We present multiple intracerebral aneurysms associated with renal cell carcinoma, causing subarachnoid hemorrhage (SAH) and intracerebral hemorrhage (ICH).

1. Introduction

Metastatic brain tumors are frequently cause of intracerebral hemorrhage. But Intracranial cerebral aneurysms associated with neoplasm are extremely rare disease. Stoane et al. [1] reported the first case of neoplastic cerebral aneurysm (NCA) from metastatic cardiac myxoma in 1966 and the most recently published review, NCA has been reported in a small number of patients. Only 97 cases have been reported in the literature [2]. Most cases are associated with cardiac myxomas (60.4%) and choriocarcinoma (26.1%), other types of metastatic tumors such as lymphoma, cardiac myxosarcoma, and lung carcinoma less commonly [1–5]. Even though lung cancer is very common neoplasm and have high metastatic potential to brain, there have only been 6 published reports of intracranial cerebral aneurysms secondary to metastatic lung cancer (Table 1) [6–10]. But, we could not find previous reports about NCA associated with renal cell carcinoma. We report multiple intracerebral aneurysms associated with renal cell carcinoma, causing subarachnoid hemorrhage (SAH) and intracerebral hemorrhage (ICH).

2. Case report

A 52-year-old woman with no past medical history was admitted to emergency room with a sudden, thunderclap headache and vomiting. Neurological examination showed decreased consciousness without motor impairment. Computerized tomography (CT) scan revealed large intracerebral hemorrhage involving left frontal, perifocal surrounding edema, mild midline shift to the right, edematous change [Fig. 1A]. In CT angiography, saccular aneurysmal pouch was suspicious in left frontal and occipital intraparenchymal area [Fig. 1B and C]. Conventional and 3D rotational angiogram defined a ruptured saccular aneurysm suspected as pseudoaneurysm in branch area of distal anterior cerebral artery (ACA) and another irregular aneurysm like dissection in occipital branch of distal posterior cerebral artery (PCA) [Fig. 2]. As treatment for aneurysms, endovascular coiling was determined. Our initial plan was to navigate microcatheter as close to the aneurysm as possible and embolize parent artery with coils or embolic material. During accessing to parent artery of aneurysm, the microcatheter slide into the aneurysmal sac gently when the microwires were removed from the microcatheter in parent artery near to aneurysm neck. Using the coil, the aneurysm was embolized very carefully and parent artery near the neck was also occluded [Fig. 3A, B and –C–]. During embolization, re-rupture was not occurred. In aneurysm of distal PCA branch, microcatheter could not be reached in aneurysm neck. The microcatheter was placed as far as possible, and then feeding artery was occlude using coils. After treatment, 2 aneurysms were not visible in final angiography [Fig. 3D and E]. Subsequent decompressive craniectomy was performed after embolization for aneurysms. On admission, the posteroanterior (PA) chest X-ray showed diffuse consolidation in right lung, suggesting of severe pulmonary edema with pneumonia [Fig. 4]. After surgical treatment, consolidation was more increased in both lungs. For evaluation of lung, chest CT was checked and showed multiple enhancing nodules in liver and spleen such as metastasis with severe pneumonia,

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Table 1
Reported cases of neoplastic cerebral aneurysms from metastatic lung cancer and current case.

Author(year)	Aneurysm location	symptoms	neoplasm	Age/sex	Aneurysm shape
Ho (1982) [22]	Rt PCA	ICH	Bronchogenic carcinoma	68/M	Fusiform
Kochi et al (1984) [7]	Rt PTA	ICH	Squamous cell carcinoma	56/M	Fusiform
Murata et al (1993) [8]	Rt PCA	ICH	Small-cell carcinoma	63/M	Fusiform
Gliemroth et al (1999) [6]	Lt AICA	SAH	Adenocarcinoma	38/F	Fusiform
Nomura et al (2009) [9]	Lt MCA	ICH	Pleomorphic carcinoma	61/M	Fusiform
Oluwaseun A Omofoye (2017) [10]	Lt SCA	SAH	Nonsmall cell carcinoma	41/M	Fusiform
Current case	Lt ACA	ICH	Renal cell carcinoma	52/F	Saccular fusiform
	Lt PCA	(–)			

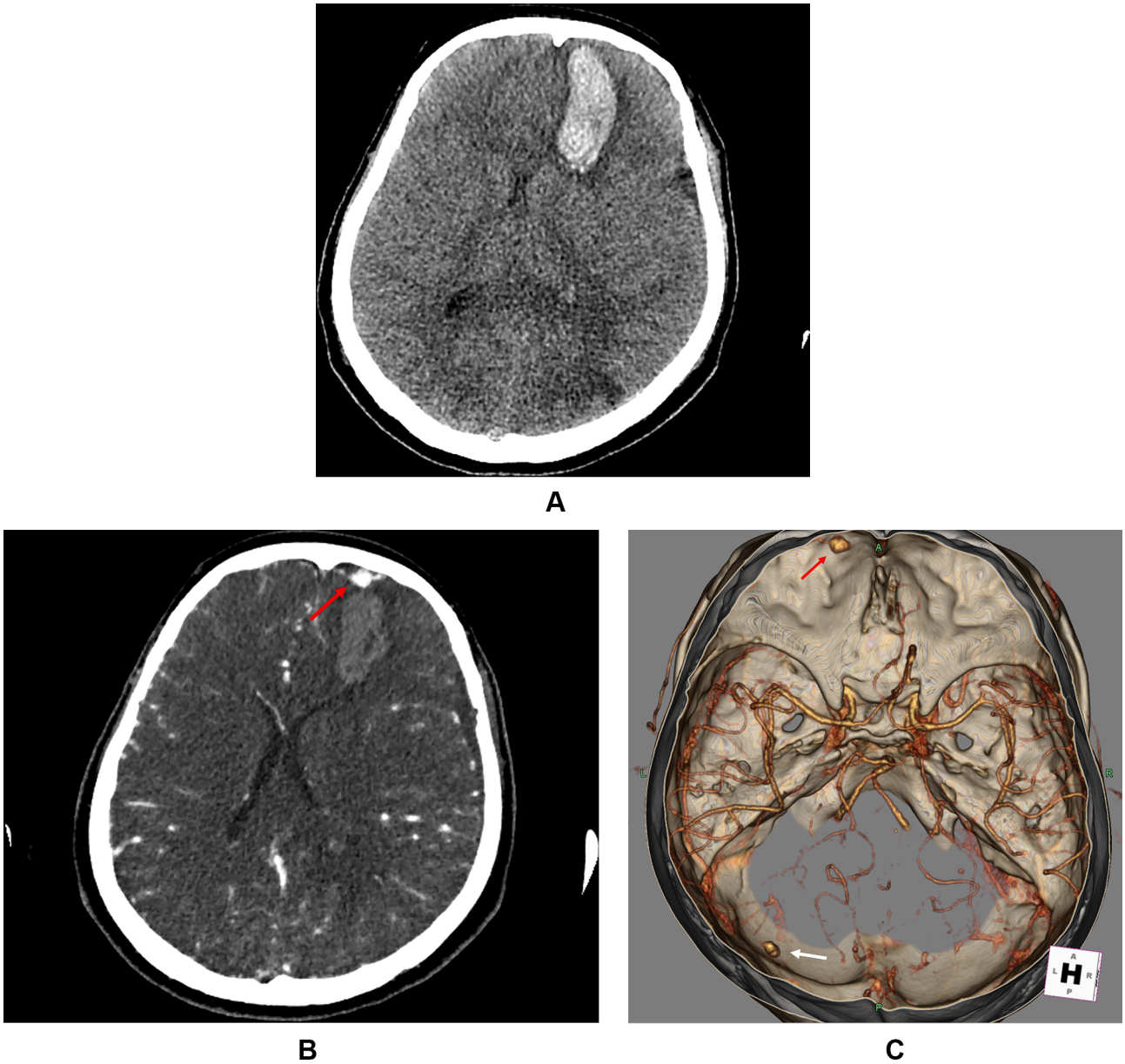


Fig. 1. (A) Computerized tomography (CT) scan showed large intracerebral hemorrhage involving left frontal, surrounding edema, midline shift to the right, severe edematous change. (B and C) In CT angiography, saccular aneurysmal pouch was suspicious in left frontal and occipital intraparenchymal area (red and white arrows). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

heart failure and pulmonary hypertension. In Subsequent abdominal CT, heterogeneous enhancing masses were demonstrated in both kidneys (Rt. – 1.4 cm, 2.4 cm/Lt. – 3.3 cm, 1.6 cm) and multiple hypervascular masses at both lobe of liver and spleen [Fig. 4A,B and –C–]. Oncologist and radiologist strongly suspected renal cell carcinoma was primary cancer and metastasis was occurred to multiple organs. Patient and her family have not known anything about cancer and metastasis. In brain magnetic resonance imaging (MRI), multiple high signals left parieto-occipital lobe with irregular cortical enhancement suggesting brain metastasis were also shown [Fig. 5]. Many severe medical problems such as disseminated intravascular coagulation (DIC), thrombocytopenia, bone marrow suppression, severe pneumonia, and hematochezia were occurred in a few days and general conditions of patient was extremely poor. Further treatment and biopsy for cancer, medical problems and metastasis could not performed. Few weeks later after hemorrhage, patient was expired due to multiple organ failure.

3. Discussion

NCA is a rare, unrecognized disease entity. The pathogenesis of neoplastic cerebral aneurysm remains controversial. This is thought to occur when brittle tumor tissue is embolized into the distal cortical artery, similar to the formation of mycotic aneurysm. The possible mechanisms have been proposed about the development of NCA, but 2 main thought predominate: the vascular damage theory (VDT) and the neoplastic process theory (NPT). Zheng et al. [2], discussed multiple possible mechanisms that have been postulated, all of which can be classified under both VDT and NPT. The VDT assumes that after tumor particle embolization, blood vessel damage and subsequent endothelial scarring develop, which can cause flow dynamic changes that lead to aneurysm formation [11]. Additionally, there is a hypothesis that tumor cells penetrate the blood vessels through the vasavasorum, causing arterial wall destruction. However, it have been known vasavasorum are quite rare in cerebral arteries of experimental animals and humans [12]. In other theories, NPT postulates that tumor cells can remain viable after embolization and penetrate into intact or damaged endothelial cells at the lodgment site, causing subintimal growth, which can lead to destruction of the arterial wall. Currently, most authors favor the NPT. Because histopathological studies have demonstrated proliferation of tumor cells in the wall of aneurysms and active invasion of the internal elastic lamina by viable tumor cells [11,13].

It had not been well documented in regarding to diagnosis and treatment. There can be many reasons for this. NCA has very rare incidence. Despite the relatively large number of patients with metastatic cancer, the ratio of NCA development is very low. Oluwaseun et al. [10] postulate several reasons for this. First, the complex set of interactions described above by the NPT must occur in sequence to develop an NCA. Secondly, the endothelial damage sustained must be substantial enough to cause vessel rupture leading to an intraparenchymal or subarachnoid hemorrhage. Lastly, patients with metastatic cancer frequently carry a poor prognosis, and goals of care are often directed away from aggressive medical care. This may limit the time over which NCA might develop, and rupture, leading to diagnosis. In addition, they may not be diagnosed because fail of cerebrovascular evaluation after confirming ICH in CT or because of obliteration or destruction of the aneurysm following rupture or due to compression from a hematoma [14]. Like mycotic aneurysm, most NCA are small and located predominantly in the distal branches of the middle cerebral artery (MCA) and anterior cerebral artery (ACA), often buried in a cortical sulcus or parenchyme [8]. NCA appears small, irregular, or fusiform in the majority of cases. This is likely due to the infiltrative nature of tumor particles into the arterial walls causing a dissecting pattern of aneurysmal dilatation [15]. Some aneurysms are detectable on angiography only by delayed washout of contrast relative to the arterial phase. What is more, some distal aneurysms presented a very slow flow and were observed in the venous phase of the angiogram [12].

The natural history of NCA is not well established since the incidence of NCA is very rare and the nature of the each tumors may be very different in metastatic brain tumors [16,17]. The aneurysms may enlarge with possible hemorrhage, stabilize or resolve over years [16,18,19]. Suzuki et al. reported that the NCA showed rapid growth after the removal of the cardiac tumor [20]. Branch et al. reported a case of NCA due to cardiac myxoma, the aneurysm disappeared spontaneously within 18 months [21]. Hove et al. reported a case of NCA from metastatic choriocarcinoma, the aneurysms resolved completely after a serial treatment of methotrexate and actinomycin D [22,23]. Depending on the histological characteristics of metastatic brain neoplasms, clinical presentations may appear quite different. All the NCA from

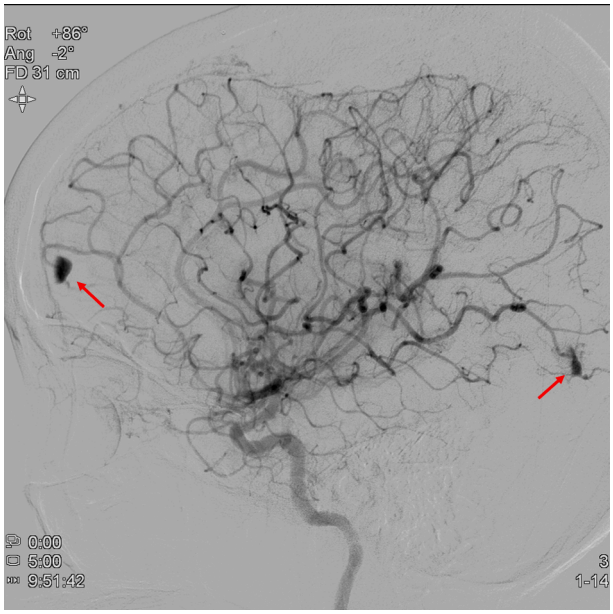


Fig. 2. Conventional and 3D rotational angiogram revealed a ruptured saccular aneurysm suspected as pseudoaneurysm in branch area of distal anterior cerebral artery and another irregular aneurysm like dissection in occipital branch of distal posterior cerebral artery.

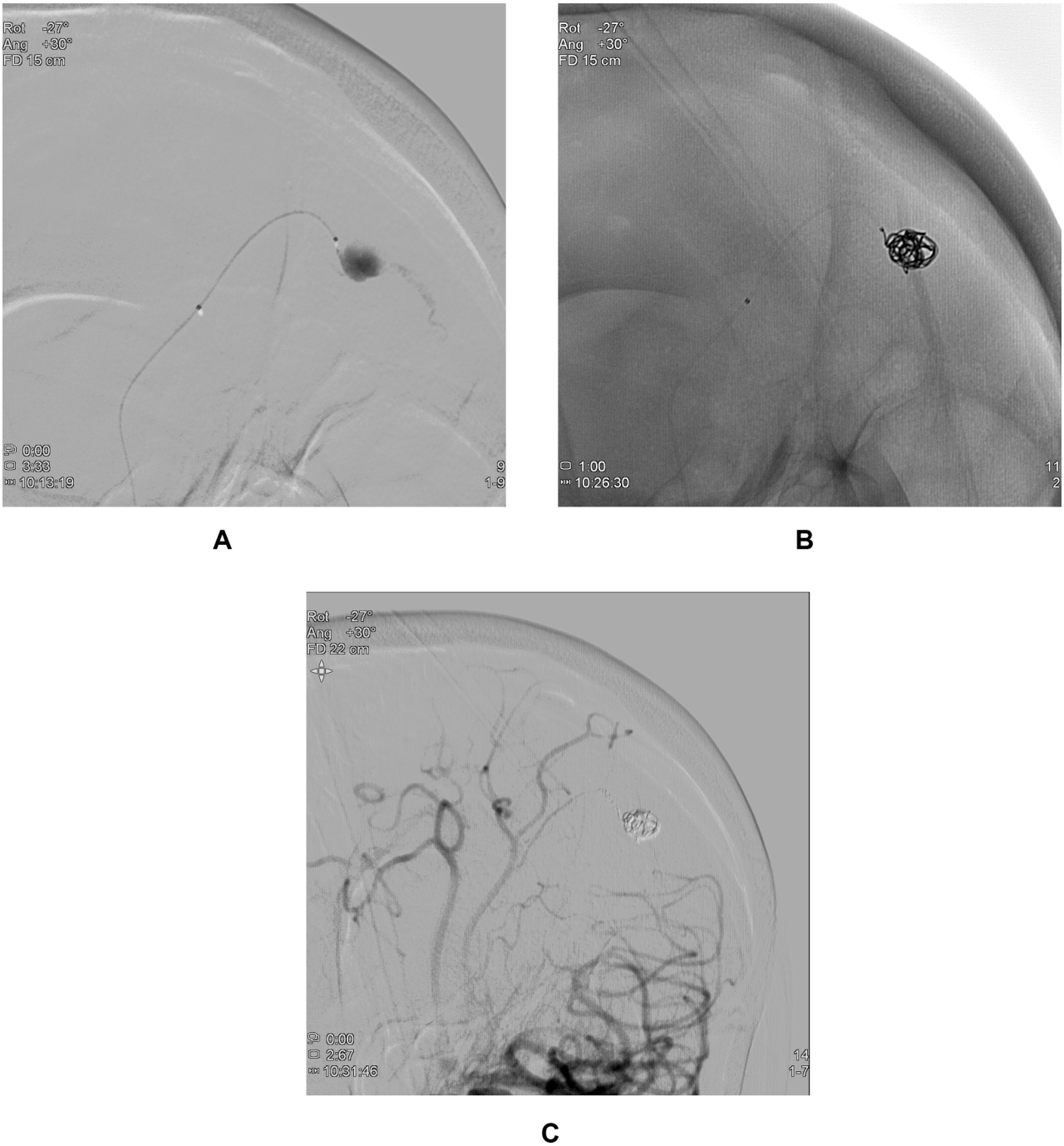


Fig. 3. (A–C) Using the coil, the aneurysm was embolized very carefully and parent artery near the neck was also occluded. (D and E) In aneurysm of distal PCA branch, microcatheter was not reached in aneurysm neck. The microcatheter was placed as far as possible, and then feeding artery was occlude using coils. After treatment, 2 aneurysms were not visible in final angiography.

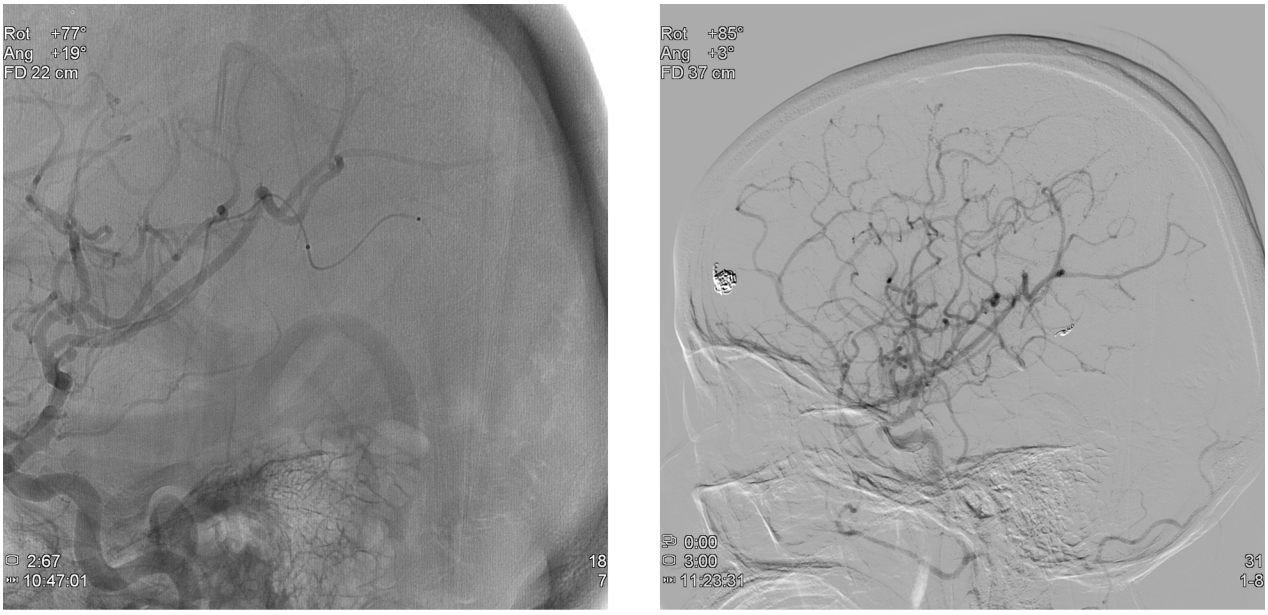


Fig. 3. (*continued*).

choriocarcinoma presented with intracranial hemorrhage, and 84.6% of the NCA from other metastatic neoplasms presented with intracranial hemorrhage. However, only 19.6% of the NCA from cardiac myxoma presented with hemorrhage. The enlargement and rupture of an aneurysm may depend upon the severity of vessel wall destruction, which is probably associated with the degree of malignancy of the neoplastic cells [7].

Due to rarity of the cases, there is still no definitive treatment for neoplastic cerebral aneurysm. Several modalities of treatment have been reported. Treatments usually are open surgery, endovascular occlusion, chemotherapy, radiotherapy or conservative management. In the subgroup of NCA from cardiac myxoma, 75.9% of the patients were managed conservatively. In the subgroup of NCA from choriocarcinoma, open surgery and/or chemotherapy were used in 92% of all the patients. All the patients in this subgroup presented with intracranial hemorrhage. Therefore, surgery was usually used to evacuate hematoma and excise or clip the aneurysm.

Like clinical presentation, the prognosis of NCAs is associated with histological characteristics of metastatic brain neoplasms. The prognosis is quite good in the subgroup of NCA from cardiac myxoma. 77.3% of the patients were stable with or without aneurysm disappearance, and the mortality rate was 11.4%. While in the subgroups of NCA from choriocarcinoma or other carcinomas, the mortality rate was much higher (60.9% and 92.3%, respectively). Therefore, NCA from malignant tumors were associated with poor outcome [2]. Unfortunately, our patient's overall condition at the time of admission was not good, and additional several medical problems occurred and rapidly worsened within a few days after surgery and medical condition of patient was more worsened. Histopathological examination and invasive treatment due to severe thrombocytopenia, disseminated intravascular coagulation and pneumonia could not be performed. It would have been good if histological diagnosis was confirmed through autopsy. But generally, autopsies are often performed in the death from unnatural or external causes, but extremely rare in disease causes. Moreover, in most cases, family did not want post-mortem examination in death from disease causes. Further pathological confirmation could not be made due to these reasons.

4. Conclusion

NCA is an extremely rare event. In current reports, NCAs are usually complicated with cardiac myxoma, choriocarcinoma and lung carcinoma. However, we think that NCA can be induced in other cancers that have not been reported so far like our case. If cerebral hemorrhage occurs in patients with metastatic cancer, although rare, lesions such as NCA may be considered. Based on NPT theory, early control of primary cancer may help reduce the risk of tumor particle embolism. More research is needed to better understand this rare phenomenon.

5. Prior publication

Nil.

6. Support

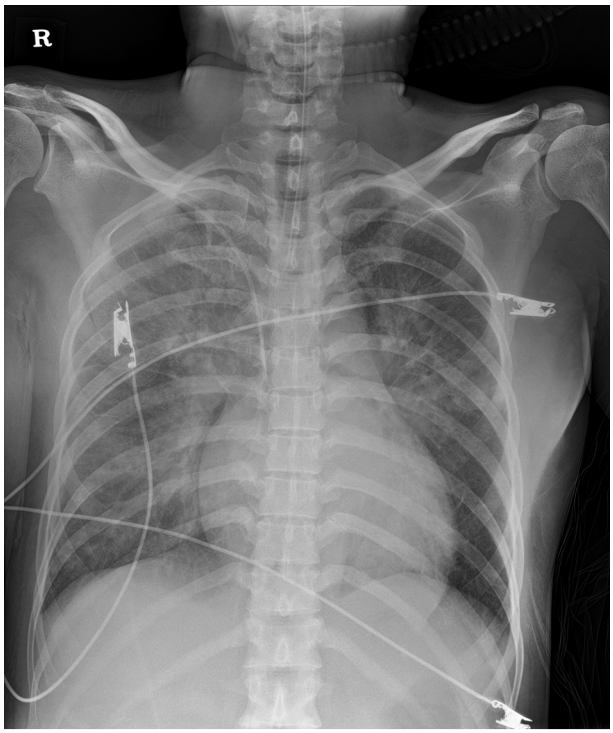
Nil.

7. Sources of funding

None.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.



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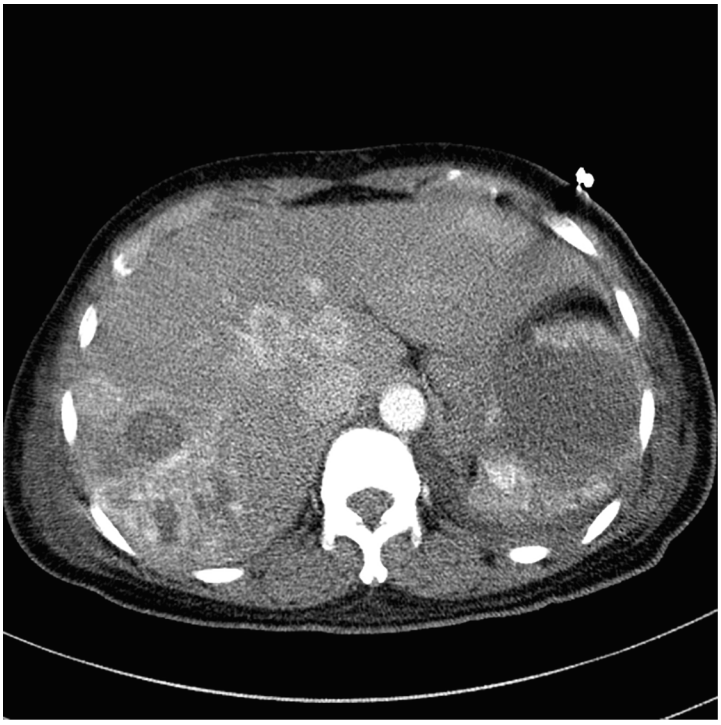

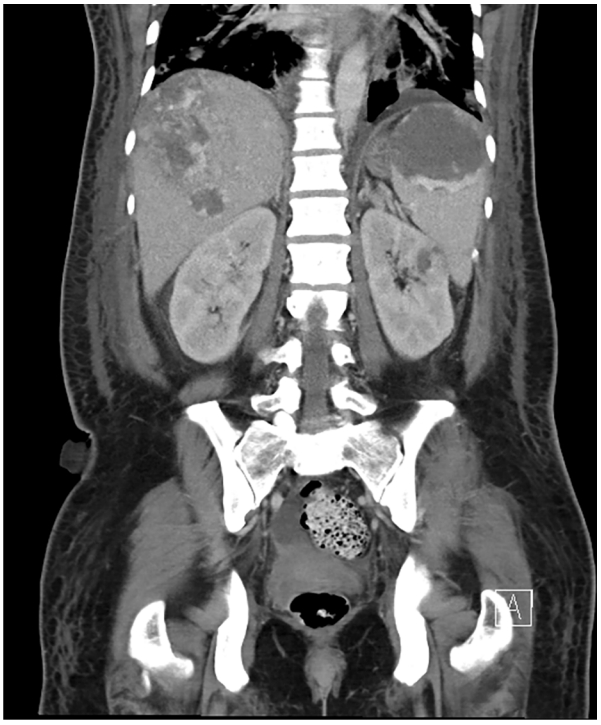

B C

Fig. 4. (A) On admission, simple chest PA showed diffuse consolidation in right lung, suggesting of severe pulmonary edema with pneumonia. (B and C) Abdominal CT, heterogenous enhancing masses was demonstrated in both kidneys (Rt. – 1.4 cm, 2.4 cm/Lt. – 3.3 cm, 1.6 cm) and multiple hypervascular masses at both lobe of liver and spleen.

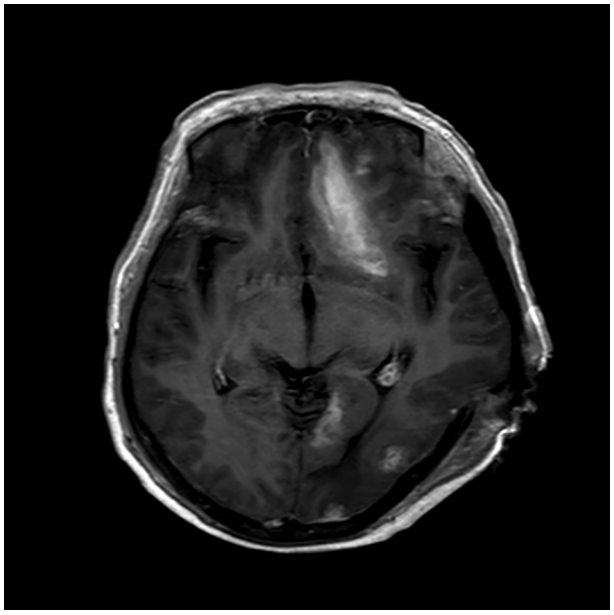

Fig. 5. In brain MR, high signal left parieto-occipital lobe with irregular cortical enhancement suggesting metastasis was also shown.

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None.

References

[1] L. Stoane, J.H. Allen, H.A. Collins, Radiologic observations in cerebral embolization from left heart myxomas, Radiology (1966), https://doi.org/10.1148/87.2.262.
[2] J. Zheng, J. Zhang, Neoplastic cerebral aneurysm from metastatic tumor: a systematic review of clinical and treatment characteristics, Clin. Neurol. Neurosurg. (2015), https://doi.org/10.1016/j.clineuro.2014.11.010.
[3] B.Z. Roitberg, E.J. Cochran, J. Thornton, F.T. Charbel, Giant anterior communicating aneurysm infiltrated with a primary cerebral lymphoma: case report, Neurosurgery (2000), https://doi.org/10.1097/00006123-200008000-00040.
[4] T. Anda, W. Haraguchi, H. Miyazato, S. Tanaka, T. Ishihara, K. Aozasa, I. Nakamichi, Ruptured distal middle cerebral artery aneurysm filled with tumor cells in a patient with intravascular large B-cell lymphoma: case report, J. Neurosurg. (2008), https://doi.org/10.3171/JNS/2008/109/9/0492.
[5] T.H. Lee, S.C. Huang, T.M. Su, K.Y. Yang, C.S. Rau, Multiple cerebral aneurysms and brain metastasis from primary cardiac myxosarcoma: a case report and literature review, Chang Gung, Med. J. (2011).
[6] J. Gliemroth, G. Nowak, U. Kehler, H. Arnold, C. Gaebel, Neoplastic cerebral aneurysm from metastatic lung adenocarcinoma associated with cerebral thrombosis and recurrent subarachnoid haemorrhage, J. Neurol. Neurosurg. Psychiatry (1999), https://doi.org/10.1136/jnnp.66.2.246.
[7] N. Kochi, E. Tani, M. Yokota, Y. Nakaya, Neoplastic cerebral aneurysm from lung cancer. Case report, J. Neurosurg. (1984), https://doi.org/10.3171/jns.1984.60.3.0640.
[8] J.I. Murata, Y. Sawamura, A. Takahashi, H. Abe, H. Saitoh, Intracerebral hemorrhage caused by a neoplastic aneurysm from small-cell lung carcinoma: case report, Neurosurgery (1993), https://doi.org/10.1227/00006123-199301000-00019.
[9] R. Nomura, D. Yoshida, K. Kim, S. Kobayashi, A. Teramoto, Intracerebral hemorrhage caused by a neoplastic aneurysm from pleomorphic lung carcinoma, Neurol. Med. Chir. (Tokyo) (2009), https://doi.org/10.2176/nmc.49.33.
[10] O.A. Omofoye, R. Barnett, W. Lau, D. Trembath, J.D. Jordan, D.M. Sasaki-Adams, Neoplastic cerebral aneurysm from metastatic nonsmall cell lung carcinoma: case report and literature review, Clin. Neurosurg. (2018), https://doi.org/10.1093/neuros/nyx588.
[11] R. Ashalatha, A. Moosa, A.K. Gupta, S.R. Krishna Manohar, S. Sandhyamani, Cerebral aneurysms in atrial myxoma: a delayed, rare manifestation, Neurol. India (2005), https://doi.org/10.4103/0028-3886.16416.
[12] J. Sedat, Y. Chau, A. Dunac, N. Gomez, L. Suissa, M.H. Mahagne, Multiple cerebral aneurysms caused by cardiac myxoma: a case report and present state of knowledge, Interv. Neuroradiol. (2007).
[13] M.P. Radoi, F. Stefanescu, D. Arsene, Brain metastases and multiple cerebral aneurysms from cardiac myxoma: case report and review of the literature, Br. J. Neurosurg. (2012), https://doi.org/10.3109/02688697.2012.692841.
[14] P. Gallo, O.M. Fabiao Neto, S.F. Raupp, C.A. Ordovas, P.P. Oppitz, Cerebral metastasis from choriocarcinoma and oncotic aneurysms. Case report, Arq. Neuropsiquiatr. (1993).
[15] P.F.J. New, D.L. Price, B. Carter, Cerebral angiography in cardiac myxoma. Correlation of angiographic and histopathological findings, Radiology (1970), https://doi.org/10.1148/96.2.335.
[16] D.P. Roeltgen, G.R. Weimer, L.F. Patterson, Delayed neurologic complications of left atrial myxoma, Neurology (1981).
[17] J.M. Seigle, A.J. Caputy, H.J. Manz, C. Wheeler, J.L. Fox, Multiple oncotic intracranial aneurysms and cardiac metastasis from choriocarcinoma: case report and review of the literature, Neurosurgery (1987), https://doi.org/10.1227/00006123-198701000-00011.
[18] O.M. Reed, J.R. Mellette, J.E. Fitzpatrick, Cutaneous lentiginosis with atrial myxomas, J. Am. Acad. Dermatol. (1986), https://doi.org/10.1016/S0190-9622(86)70188-6.
[19] M. Hisanaga, S. Kawai, M. Maekawa, Y. Hattori, K. Kotoh, Neoplastic aneurysms due to cerebral metastasis of choriocarcinoma: report of two cases, Neurol. Med. Chir. (Tokyo) (1988), https://doi.org/10.2176/nmc.28.398.
[20] T. Suzuki, R. Nagai, T. Yamazaki, I. Shiojima, K. Maemura, K. Yamaoki, N. Tanaka, T. Machida, Y. Kotsuka, A. Furuse, Y. Yazaki, Rapid growth of intracranial aneurysms secondary to cardiac myxoma, Neurology (1994).
[21] C.L. Branch, D.W. Laster, D.L. Kelly, Left atrial myxoma with cerebral emboli, Neurosurgery (1985), https://doi.org/10.1227/00006123-198505000-00018.
[22] B. Hove, B.B. Andersen, T.M. Christiansen, Intracranial oncotic aneurysms from choriocarcinoma, Neuroradiology (1990), https://doi.org/10.1007/BF02426472.
[23] K.-L. Ho, Neoplastic aneurysm and intracranial hemorrhage, Cancer 50 (12) (1982) 2935–2940.