INTRODUCTION
The neurofibromatoses are genetic disorders of the nervous system that primarily affect the development and growth of neural cell tissues. The neurofibromatoses are classified as neurofibromatosis type-1 (NF-1) and neurofibromatosis type-2 (NF-2). NF-1 (von Recklinghausen’s disease) is the more common subtype and the gene responsible is located at the chromosome region 17q11.2.1 This hereditary systemic disease affects approximately one in 3500 individuals.2 Vascular abnormalities are well recognized in NF-1 and seen in the renal, gastrointestinal and coronary vessels. There have been case reports on cerebral vascular abnormalities in NF-1 which include stenosis or occlusion of major vessels, arteriovenous (AV) fistulae, arteriovenous malformations, and aneurysms.3 We report a young adult with intraventricular haemorrhage and was later found to have neurofibromatosis-1, AV malformation and pectus excavatum.

CASE REPORT
An 18 years old male presented with a one-day history of severe headache and altered consciousness. He also had few episodes of vomiting. On examination, he was drowsy but arousable and the GCS was 12/15. His blood pressure was 125/80 mmHg and he was afebrile with no skin rash. His neck was stiff. There was no focal neurological deficit with bilateral down going plantars and fundoscopy revealed no abnormality. He was found to have multiple lumps and brown patches on the skin. These lumps were identified as fibromas and the brown patches as café-au-lait spots. He also had axillary freckling (Crowe’s sign). He did not have optic glioma on MRI brain, any iris hamartomas (Lisch nodules), or long bone dysplasia and none of his first degree relative had NF-1. He met three out of the seven diagnostic criteria for NF-1. He had a very obvious pectus excavatum as well. An emergency plain CT scan of brain was done that showed blood in the ventricles as well as in the subarachnoid space (Fisher Kistler Grade 4, Figure 1). A CT angiogram was performed that showed an AV malformation (AVM) with the arterial feeding supply from right posterior cerebral artery and the venous component draining into right internal cerebral vein (Figure 2). The nidus was located in right occipital lobe and measured 18 mm, making it a small AV malformation (Spetzler-Martin grading system for AVMs). The patient was managed conservatively with nimodipine. He improved gradually with decrease in the intensity of headache. He was completely asymptomatic with a GCS of 15/15 after a period of one week. The patient refused any open surgery or stereotactic radiosurgery. He comes to the Neurology OPD for a regular checkup and is fine after a period of 3 months of that episode.

DISCUSSION
NF-1 vasculopathy is a potentially serious, but under-recognized component of this multisystemic, genetic disorder. Various vascular lesions have been noted in patients with NF-1, and are characterized by stenosis, rupture, aneurysm and fistula formation involving large and medium-sized arteries. Although the arterial system is more commonly affected, venous circulation may also be involved. Overall, the most common manifestation of NF-1 vasculopathy is renal artery dysplasia and hypertension is the usual manifestation. The most common form of cerebral vasculopathy in NF-1 patients is intracranial arterial occlusive disease, usually occurring in childhood or adolescence and often associated with a Moya-Moya pattern of collateral blood flow. The precise mechanism involved in cerebral vasculopathy in NF-1 is still not well understood but is likely...
related to the function of neurofibromin, the protein product of the NF-1 gene. Neurofibromin has been shown to control cell growth by positively regulating intracellular level of cAMP and negatively regulating RAS signaling pathway. Loss of neurofibromin expression seen in NF-1 increases the proliferation of vascular smooth muscle cells through the RAS signaling system with subsequent intimal proliferation and arterial stenosis. It has also been shown that there is a different distribution of neurofibromin within the endothelial and smooth muscle layers in different vessels, which is thought to explain why the renal and cerebral vessels are more commonly affected than the aorta by vascular dysplasia in NF-1. There are two possible mechanisms by which AV fistula may arise in a patient with neurofibromatosis. Dysplastic smooth muscle or neurofibromatous proliferation in the arterial wall could lead to aneurysm formation, leakage, and ultimately rupture into adjacent veins. Alternatively, an AV fistula could arise congenitally as a manifestation of mesodermal dysplasia.

Treatment options for AV malformations include surgical resection, radiosurgery, or embolization (or a combination of these, in some cases). Trials directly comparing these approaches with one another or with observation are lacking and information on outcomes derives largely from case series. Involvement of a multidisciplinary team with expertise in neurosurgery, endovascular intervention, and radiation therapy is recommended to provide all therapeutic options. Complete obliteration of the arteriovenous malformation is the goal of treatment, since partial obliteration appears to offer little or no protection from haemorrhage and may actually increase the risk.

In the reported case, the NF-1 patient had AV malformation as well as pectus excavatum. The authors could not find any case report in literature which showed the association of pectus excavatum and neurofibromatosis. Akasai et al. carried out a study on chest wall deformities and their sample included 43 patients out of which 24 had pectus excavatum and 2.7% of all the patients had neurofibromatosis. It meant that neurofibromatosis patients have a tendency for pectus excavatum.

This report shows that intracranial AV malformation is a rare but life-threatening complication of neurofibromatosis-1. Early screening and possible treatment of the lesion may be life saving.

REFERENCES

Figure 1: CT head of the patient showing high attenuation foci in the ventricles indicating intraventricular bleed.

Figure 2: Three-dimensional reconstruction image from CT angiography defines right posterior cerebral artery (large arrows) as arterial feeding supply. Venous component (small arrow) drains into right internal cerebral vein (large arrowhead), representing deep venous drainage pattern. Nidus (small arrowheads) measuring 18 mm, is localized adjacent to right occipital lobe.