Transarterial embolisation of spontaneous adrenal pheochromocytoma rupture using polyvinyl alcohol particles

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ABSTRACT

The spontaneous rupture of a phaeochromocytoma is a rare and potentially fatal complication. Prompt diagnosis, patient stabilisation and adrenectomy are crucial for survival. However, it is known that adrenectomy performed in the emergency setting is associated with a high mortality rate, in contrast to the negligible mortality rate with elective surgery. We describe transcatheter arterial embolisation (TAE) using polyvinyl alcohol particles (PVA) in restoring haemodynamic stability during an acute phaeochromocytoma rupture in a 67-year-old man to avoid the risks of performing an emergency adrenectomy. TAE improves the prognosis significantly by prolonging treatment time for patient optimisation and to enable the possibility of elective adrenectomy. To the best of our knowledge, TAE using PVA in an acute phaeochromocytoma rupture has not been previously reported in the English literature.

Keywords: adrenal haemorrhage, embolisation, phaeochromocytoma, polyvinyl alcohol particles, transcathetic arterial embolisation

Singapore Med J 2008;49(5):e126-e130

INTRODUCTION

Spontaneous rupture is a very rare complication of phaeochromocytoma. Massive release of catecholamines, as well as potential massive blood loss, makes it both an endocrinological and surgical emergency. Adrenectomy is the treatment mainstay. Acute tumour rupture poses not only a diagnostic problem but also a surgical challenge, as it has been shown that both delay in diagnosis as well as emergency surgery (non-elective) is associated with high mortality.[1] We present a case of acute rupture of phaeochromocytoma, illustrating the imaging appearance and potential role of transcatheter arterial embolisation (TAE) in this challenging entity.

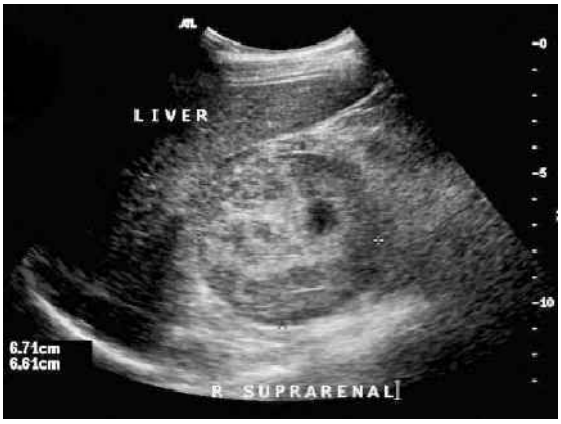

Fig. 1 Longitudinal US image shows a large round 6.7 cm × 6.6 cm right suprarenal mass with mixed echogenicity. Echogenic perinephric fluid is also present, suggestive of haemorrhage (not shown).

CASE REPORT

A 67-year-old man was admitted to the emergency department with a one-day history of severe right loin and back pain, associated with diaphoresis, nausea and vomiting. Clinical examination revealed positive right renal punch and right hypochondrium guarding. Except for a raised total white blood cell count of 17×10^9/L on the complete blood count, the rest of the laboratory tests, which included liver function, renal function, coagulation profile and cardiac panel, were normal. Bedside ultrasonography (US) of the abdomen showed a right suprarenal mass with echogenic perinephric fluid (Fig. 1)—findings that were indicative of suprarenal tumour with haemorrhage. The patient's condition gradually deteriorated over the next 12 hours, with increasing tachycardia and worsening of the right hypochondrial pain. This was associated with fluctuation of blood pressure between 127/97 to 234/100 and a decline in serum haemoglobin level from 13.6 g/dL (on admission) to 10.4 g/dL (12 hours after admission).

Urgent computed tomography (CT) of the abdomen showed a large heterogeneously enhancing right suprarenal mass with surrounding high density fluid and stranding extending along the retroperitonaeum,

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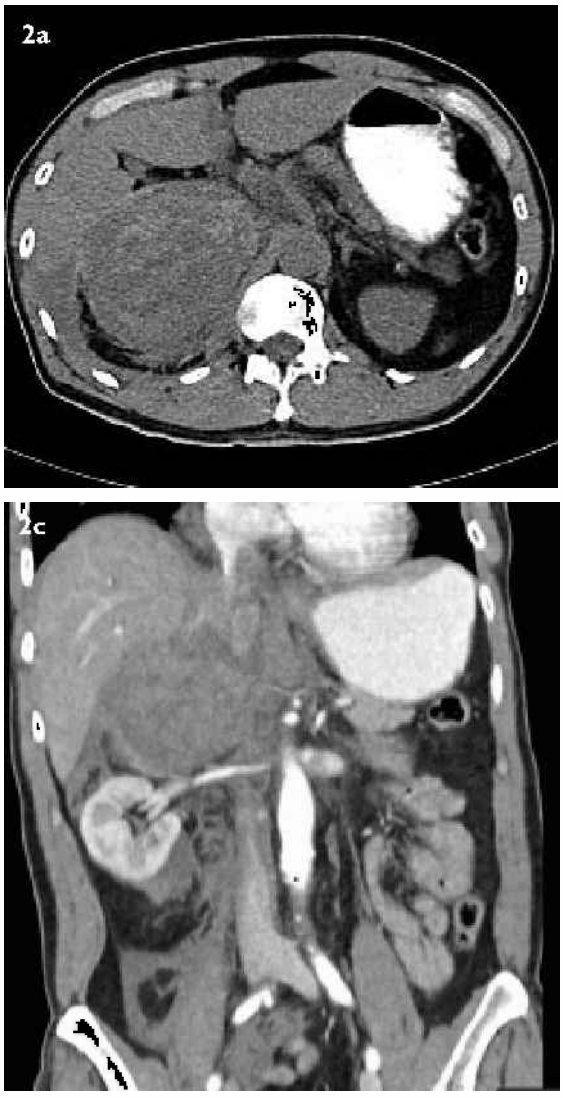

Fig. 2 (a) Unenhanced axial, (b) contrast-enhanced axial, and (c) coronal CT images show a heterogeneously-enhancing right suprarenal tumour with hyperdense intratumoral (Fig. 2a) and retroperitonaeal fluid. This is consistent with suprarenal tumour rupture with haemorrhage.

confirming the ultrasonographical diagnosis of suprarenal tumour haemorrhage (Fig. 2). Coupled with the clinical picture of fluctuating hypertension, it was deduced that an acute rupture of a phaeochromocytoma was likely to have occurred. Volume replacement and intravenous antihypertensives (labetalol hydrochloride) were instituted immediately. Transarterial catheter angiography was subsequently performed under judicious control of blood pressure with intravenous antihypertensives (magnesium sulphate and labetalol hydrochloride). Selective angiograms of the coeliac, superior mesenteric, right renal and right inferior phrenic arteries were obtained. Tumoral blood supply from the right inferior phrenic artery and two small branches of the right renal artery (Fig. 3) was demonstrated. Selective angiograms of the supplying vessels showed peripheral tumour blush with absent central tumour enhancement, a feature classically described for phaeochromocytoma. There was no tumoral pseudoaneurysm.

Successful selective polyvinyl alcohol (PVA) embolisation (355–500 microns) of all three supplying vessels was performed with vascular stasis documented post-TAE. The entire procedure was uneventful; haemodynamic stability was maintained throughout the operation. Post-TAE, there was no further decline in haemoglobin levels; the patient remained well and was discharged with oral antihypertensive (phenoxybenzamine) after six days. 24-hour urinary catecholamines obtained during this recovery period were markedly elevated (adrenaline 2,404 nmol/day, noradrenaline 2,460 nmol/day, metanephrine 33,376 nmol/day, normetanephrine 14,919 nmol/day and vanillylmandelic acid 04.6 umol/day). However, the results were thought to be inconclusive for phaeochromocytoma as severe physiological stress is also known to cause elevation in catecholamine levels.[2] The short synacthen test was normal.

A repeat CT, one month post-TAE, showed significant resolution of both intratumoral and retroperitonaeal haematomas (Fig. 4), and the tumour was also better delineated compared to the study performed. The patient underwent elective right adrenectomy two months after TAE and was successfully weaned off antihypertensive medications three days after adrenectomy. Histology confirmed the diagnosis of phaeochromocytoma (Fig. 5). The whole body meta-iodobenzylguanidine (MIBG) scintiscan performed one month post-adrenectomy (Fig. 6) showed no evidence of metastasis or tracer uptake in the right adrenal bed. The repeat 24-hour urine catecholamine levels were also normal.

DISCUSSION

Phaeochromocytomas are rare chromaffin tissue tumours which produce catecholamines. Up to 90% are intraadrenal in location. Spontaneous rupture is a rare complication, with only about 50 cases reported in the literature,[1] and the mortality rate can be as high as 50%.[3-5] Risk factors for spontaneous rupture include: initiation of alpha-blockers,[6] trauma and use of anticoagulation agents (e.g. warfarin).[3] Adrenectomy is the conventional treatment

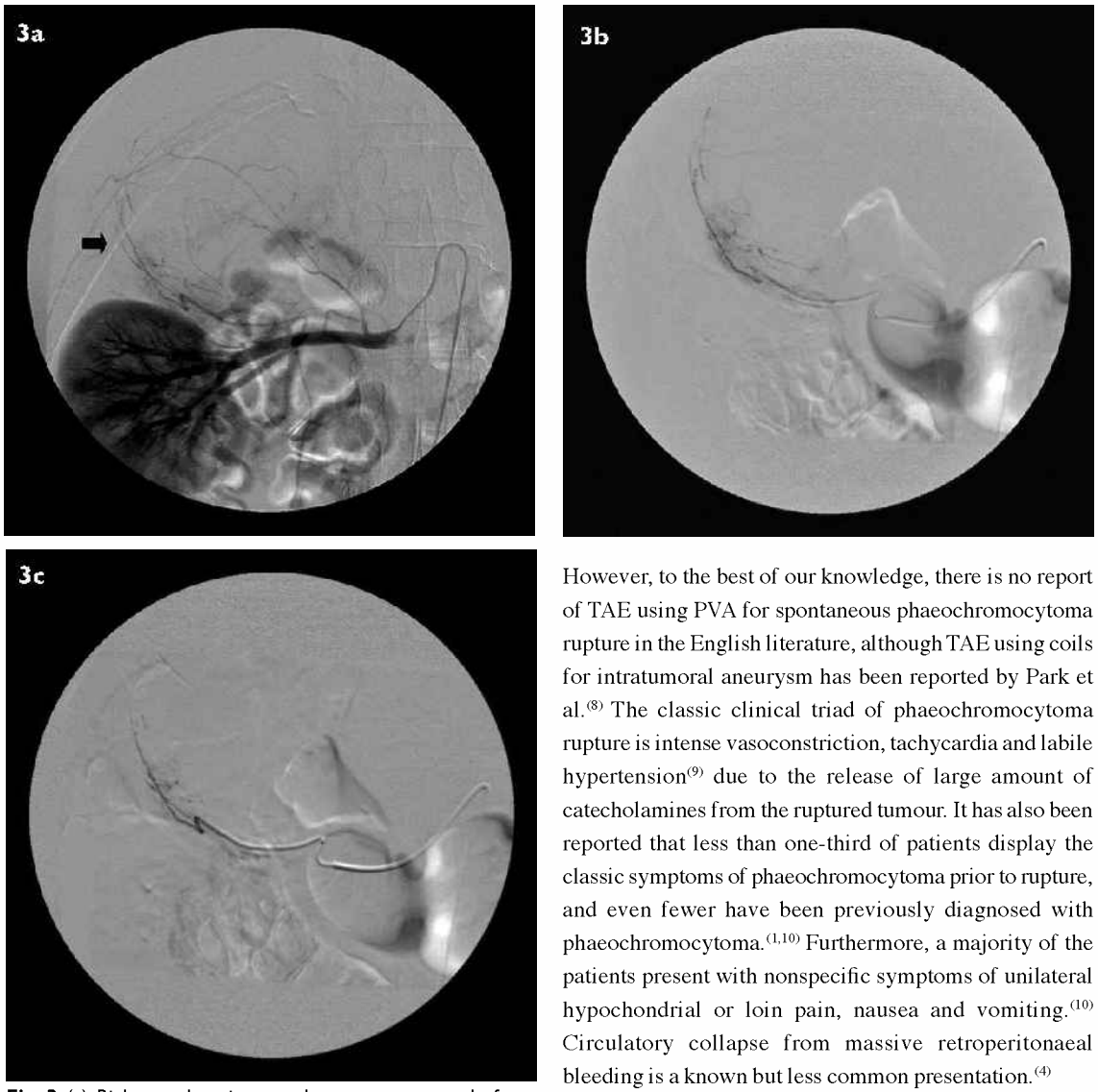

Fig. 3 (a) Right renal angiogram shows tumour supply from two branches of the right renal artery. Fine tumoral network of vessels with relative central hypovascularity is seen (arrow). Selective angiography of one of the supplying vessels (distal of the two branches arising from the right renal artery), taken (b) pre- and (c) post-TAE, with vascular stasis demonstrated post-TAE.

for phaeochromocytoma ruptures. However, emergency adrenectomy has a high reported mortality rate of 44%.[1] Conversely, up to 100% survival rate has been seen in elective adrenectomy with optimal patient preparation.[1] Accurate preoperative diagnosis is noted to significantly improve clinical outcome, while haemodynamic instability is associated with a poor prognosis. Therefore, prompt and accurate diagnosis, timely institution of supportive measures (e.g. correction of haemodynamic instability, alpha- and beta-blockade) and if possible, elective rather than emergency adrenectomy can improve the clinical outcome significantly.

TAE of phaeochromocytoma is not novel and has been used to manage malignant hypertensive crisis[7] and palliation of hyperfunctioning malignant tumours. However, to the best of our knowledge, there is no report of TAE using PVA for spontaneous phaeochromocytoma rupture in the English literature, although TAE using coils for intratumoral aneurysm has been reported by Park et al.[8] The classic clinical triad of phaeochromocytoma rupture is intense vasoconstriction, tachycardia and labile hypertension[9] due to the release of large amount of catecholamines from the ruptured tumour. It has also been reported that less than one-third of patients display the classic symptoms of phaeochromocytoma prior to rupture, and even fewer have been previously diagnosed with phaeochromocytoma.[1,10] Furthermore, a majority of the patients present with nonspecific symptoms of unilateral hypochondrial or loin pain, nausea and vomiting.[10] Circulatory collapse from massive retroperitonaeal bleeding is a known but less common presentation.[4]

During initial resuscitation, two important pathophysiological processes have to be addressed simultaneously in order to attain haemodynamic stability. Firstly, the massive release of catecholamines during rupture of the phaeochromocytoma results in a "hypertensive crisis", and secondly, the ongoing blood loss causes hypovolaemic shock. Early adrenergic blockade using intravenous antihypertensives is crucial at this juncture. In our case, alpha-1 and beta-blockade was achieved using intravenous labetalol hydrochloride. With a rapid onset of action (5–10 minutes) and moderate duration of efficacy (3–6 hours), labetalol is ideal in the emergency setting. In addition, sustained blockade can be achieved using continuous labetalol infusion (0.5–2 mg/min). The exact choice of antihypertensive usually depends on the attending physicians, with several alternatives (e.g. phenolamine mesylate) available. Fluid resuscitation must be also instituted simultaneously to combat hypovolaemic shock. However, fluid resuscitation alone (without antihypertensives) is unlikely to achieve haemodynamic stability, and the fluctuation in blood

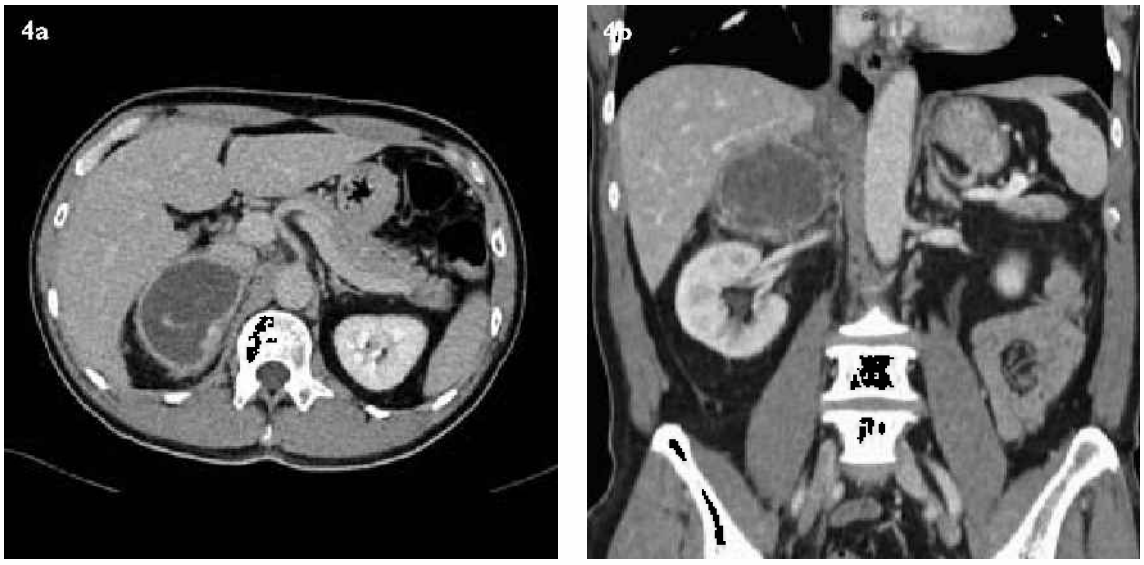

Fig. 4 Contrast-enhanced (a) axial and (b) coronal CT images of the abdomen post-TAE. A heterogeneously-enhancing suprarenal tumour with a large hypodense centre is seen. The tumour is better delineated due to resolution of the intratumoral and retroperitonaeal haemorrhage.

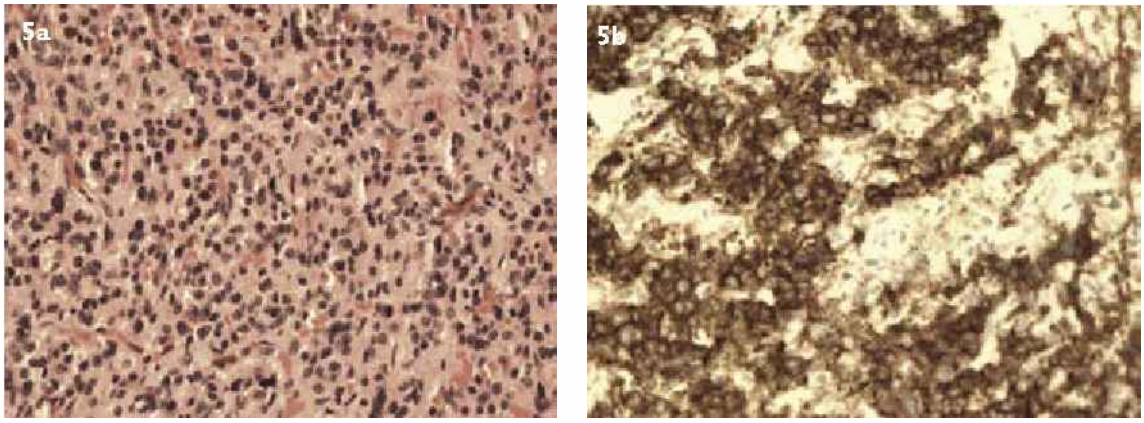

Fig. 5 (a) Photomicrograph of the resected suprarenal tumour shows proliferation of polygonal cells with generally eosinophilic cytoplasm and indistinct cytoplasmic borders. There is a nested pattern with zellballen appearance and accompanying vascular network (Haematoxylin & eosin, x 40). (b) Immunohistochemical slide shows that the tumour stains for synaptophysin (x 40) and chromogranin (not shown). Findings confirm the diagnosis of phaeochromocytoma.

pressure is likely to aggravate ongoing haemorrhage. Once initial haemodynamic stability is obtained, it should be sustained by careful titration of the antihypertensive infusions and fluid replacement should be conducted under close patient monitoring. Notably, attaining a sustainable haemodynamic state can be more difficult and time consuming than the initial resuscitation (as in our case). However, successful patient stabilisation is important in optimising the patient for TAE; TAE will in turn sustain long-term haemodynamic stability by securing haemostasis.

US, CT and magnetic resonance (MR) imaging can be used to image suprarenal tumour ruptures. Suprarenal tumour and the associated retroperitonaeum haemorrhage (echogenic fluid on ultrasound, hyperdense fluid [CT number > 30 HU] and blood products signal intensities on MR imaging) can be easily detected with any of these modalities. Furthermore, contrast-enhanced studies can potentially identify intratumoral pseudoaneurysm or bleeders and guide further intervention. However, diagnostic challenges do exist. Spontaneous intratumoral haemorrhage has been reported in other types of suprarenal tumour, including adrenal myelolipoma,[11] adrenal cortical neoplasm[12] and adrenal metastasis.[13] Besides the demonstration of intratumoral fat in the case of adrenal myelolipoma (fat attenuation values on CT or fat suppressed sequences on MR imaging),[11] differentiating the various tumours by imaging alone can be difficult. It is, however, important to note that phaeochromocytoma is the commonest primary adrenal tumour to undergo spontaneous rupture, and the presence of any of the clinical triad, in particular, labile hypertension, should be viewed with a high index of suspicion.

Angiography can be performed safely on patients with phaeochromocytoma and the mortality rate is low. However, there is a risk of precipitating a hypertensive

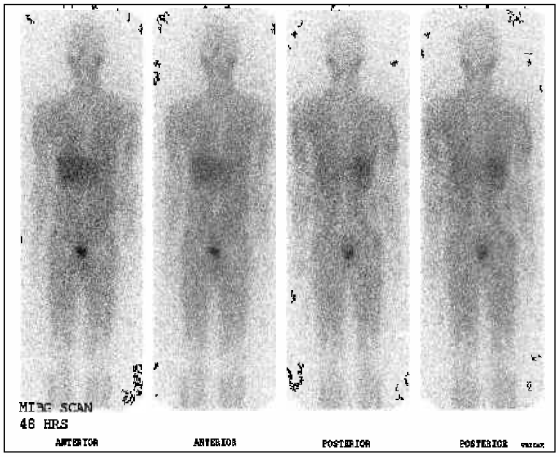

Fig. 6 MIBG whole body scintiscan images obtained one month postadrenectomy show no metastases or residual tumour in the surgical bed.

crisis. Hence, premedication with alpha-blockers, as well as the presence of a physician, capable of managing hypertensive reactions throughout the procedure, is strongly recommended. It is important to note that angiographical tumour staining can be faint and easily missed on aortography. Therefore, selective renal and adrenal arteriography with digital subtraction is advocated for demonstration of tumour vascularity and blood supply. Although selective renal artery catheterisation is usually straightforward, selective adrenal artery catheterisation in contrast, can be difficult due to the small size of the adrenal arteries. Even in the hands of experienced operators, the use of microcatheters is often required for selective adrenal arteriography. As illustrated in our case, selective adrenal arteriography and embolisation was successfully performed using a 3-F microcatheter (Renegade Hi-Flo, Boston Scientific, Natick, MA, USA), introduced coaxially through a 5-F Cobra catheter (Terumo, Tokyo, Japan)(Figs. 3b & c). The classic angiographical appearance of phaeochromocytoma is that of a moderately hypervascular tumour with a fine surrounding network of arteries and a centre of relative hypovascularity. The central hypovascularity is thought to represent an area of necrosis.

In our opinion, the network of fine tumoral arteries makes PVA the embolic agent of choice, provided selective catherisation of the supplying vessels is feasible. Angiographical evidence of vascular stasis, as well as improvement in clinical/laboratory (e.g. serum haemoglobin) markers, can attest to a successful TAE. Finally, by reducing tumour vascularity, intraoperative blood loss is also reduced. In summary, we describe a case of spontaneous rupture of a phaeochromocytoma which was successfully treated with TAE. This case illustrates the usefulness of TAE in securing haemostasis and restoring haemodynamic stability in the acute phase, thereby averting the need for high-risk emergency adrenectomy. By affording time for patient optimisation and securing the option for elective adrenectomy, the prognosis is significantly improved.

ACKNOWLEDGEMENTS

The authors thank the NUH-NUS Medical Publications Support Unit, Singapore, for assistance in the preparation of this manuscript. The authors also thank Dr BCS Ho of the Department of Pathology, Singapore General Hospital, for his histopathology input.

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