CASE REPORT

Unexpected source of *Proteus mirabilis* bacteraemia

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SUMMARY

Mycotic (infected) aneurysm involving the thoracic aorta is an exceedingly rare and life-threatening condition that is associated with high morbidity and mortality. We report an unusual source of *Proteus mirabilis* bacteraemia thought to be due to an infected aneurysm in the thoracic aortic arch in an elderly woman. Source of gram-negative bacteraemia is usually isolated to an intra-abdominal or a pelvic source. *Proteus* bacteraemia from an intrathoracic pathology is very uncommon, and in this case led to a delay in diagnosis. Although an infected aneurysm is a rare source of gram-negative bacteraemia, it must always be considered when common causes of bacteraemia have been ruled out especially in patients with vascular risk factors.

BACKGROUND

Although only 1%–4% of all the arterial aneurysms are mycotic, they cause significant morbidity and mortality.\(^1\)\(^2\) We present a very rare case of *Proteus mirabilis* bacteraemia thought to have originated from an intrathoracic mycotic aneurysm. These infected aneurysms are more frequently seen in the femoral arteries and are commonly due to invasive procedures followed by mycotic aneurysms in the intra-abdominal region.\(^3\)\(^4\) Infected aneurysm involving the thoracic aorta is much less common and most published cases were due to non-typhoidal *Salmonella* species and *Staphylococcus aureus*.\(^5\)\(^-\)\(^7\) There was only one other case of thoracic-infected aneurysm due to *Proteus* bacteraemia reported in the literature.\(^8\)

There are no standardised guidelines to treat infected aneurysms. Surgical treatment with extensive local debridement and re-vascularisation is considered to be the preferred option; however, this is associated with high morbidity and mortality.\(^9\)\(^10\) Endovascular aneurysm repair (EVAR) is becoming popular, particularly in patients who have a high surgical risk with a reported 2-year survival rate of over 70% reported with this procedure.\(^9\)\(^10\) A disadvantage of EVAR is that the infected aneurysm is left behind which could lead to recurrent infections warranting lifelong antibiotics and follow-up, and therefore this is considered a palliative approach.\(^11\)

Our patient was treated with intravenous antibiotics together with thoracic endovascular aortic repair (TEVAR) with stenting, due to her age and other comorbidities.

CASE PRESENTATION

An 81-year-old woman was initially admitted to cardiology unit for treatment of angina that was secondary to anaemia requiring blood transfusion. The admission was complicated with new-onset atrial fibrillation, which necessitated the initiation of anticoagulation therapy, following which she was discharged. She represented after 1 week with a 2-day history of fever with chills and rigours. Her other significant medical history included coronary artery bypass graft, congestive cardiac failure, infra-renal fusiform abdominal aneurysm (3 cm), hypertension with stage 3 chronic kidney disease and a 40 pack/year history of smoking. On examination, her temperature was 39.5°C. She did not have any peripheral stigmata of infective endocarditis. There was no history of thoracic trauma or having had an interventional procedure in the recent past. Auscultation of the precordium and lungs identified no murmurs, but there was reduced air entry on the left lung base. Her systemic examination was otherwise unremarkable.

INVESTIGATIONS

Blood tests showed a haemoglobin of 113 g/L, a white cell count (WCC) of 12.7×10^9/L, a platelet count of 340×10^9/L and an elevated C reactive protein (CRP) of 280 mg/L. Her international normalised ratio (INR) was subtherapeutic at 1.3. Chest radiography showed a small left pleural effusion with overlying consolidation, and her urinalysis showed only 1×10^6/L polymorphs.

One blood culture grew *P. mirabilis*, and the patient was treated with tazobactam/piperacillin (Tazocin), to which the organism was sensitive. Further detailed history to elicit the primary source of *P. mirabilis* bacteraemia, focusing on the urinary tract, abdomen, skin and respiratory tract or any device-related infections, did not reveal a source of the infection. On review of past records, no urinalysis was done during her cardiology admission. Subsequent further investigations were undertaken to help identify the source of gram-negative bacteraemia. A CT scan of the abdomen and pelvis did not show any anatomical abnormalities of the urinary tract or an intra-abdominal pathology to explain the bacteraemia. Transthoracic echocardiography (TTE) did not show any obvious vegetations, but it showed mild overall systolic dysfunction with possible inferolateral hypokinesia. We attempted a pleural tap on the left small effusion, but were unsuccessful. As a urinary tract and intra-abdominal source of bacteraemia were ruled out, the source of bacteraemia was presumed to be secondary to hospital-acquired pneumonia, which was in view of her most recent admission and the findings on her chest radiography. The patient improved clinically...
Unusual presentation of more common disease/injury

Figure 1  An axial CT angiography of the thorax showing a saccular aneurysm measuring 56×55×57 mm (arrow) with mediastinal fat stranding.

after a 7-day course of intravenous tazobactam and piperacillin, her CRP trending down to 17 mg/L.

Ten days after discharge, she presented with left facial pain, hoarseness and high-grade fevers. A laryngoscopy confirmed left vocal cord palsy. An immediate cause of this vocal cord palsy was not apparent. A CT angiography (CT-A) of her thorax was then performed to determine the cause of her vocal cord palsy. This revealed a large saccular aneurysm (5.6×5.5×5.7 cm) with associated mediastinal fat stranding at the inferior aspect of the aortic arch (figure 1). The location of the aneurysm was just distal to the origin of the left subclavian artery extending out to the left side of the arch.

DIFFERENTIAL DIAGNOSIS
The CT findings were very suggestive of an infected aneurysm of the aortic arch. We reviewed our initial diagnosis of pneumonia being the source of her P. mirabilis bacteraemia, as it is unusual for this to be originating from the respiratory tract. An infected aneurysm was considered a more likely source and there had likely been an antecedent infection of unknown origin, with direct seeding to an atherosclerotic thoracic aorta.

TREATMENT
The patient underwent thoracic endovascular aortic repair with stenting (TEVAR) the following day. A culture was not obtained from the aneurysm wall as an open repair was not performed. She was treated with intravenous tazobactam and piperacillin for 2 weeks, and this was subsequently changed over to a prolonged course of ciprofloxacin. During this period, her inflammatory markers trended down and her blood cultures remained sterile. The aneurysm on presentation was considered the most likely explanation for the Proteus bacteraemia, rather than it being a simple association. Her clinical improvement after TEVAR together with antibiotic treatment, improvement in inflammatory markers, subsequent negative blood cultures and initial radiological appearance indicate that she had an infected aneurysm.

OUTCOME AND FOLLOW-UP
Postoperatively, she had a complicated and prolonged admission due to non-ST elevation myocardial infarction and renal failure, which was managed conservatively. She was eventually transferred to a rehabilitation service where she made a good recovery.

DISCUSSION
Mycotic (infected) aneurysms are focal and irreversible vascular dilatations that are caused by weakening and degeneration of the vessel wall, which is mostly due to invasive bacterial infection. They only cause 1%–4% of all arterial aneurysms but are associated with significant morbidity and mortality. They commonly affect any major arteries at bifurcations and tend to be more obvious if they involve the more superficial vessels (eg, femoral artery) and are harder to assess with deeper vessels. The femoral artery appears to be the most frequently involved artery and is associated with the use of more invasive intra-arterial monitoring and interventional procedures. The next most frequently involved arteries are those in the abdominal region.

Mycotic aneurysm of the thoracic aorta is even rarer, and a few reported cases were mostly due to Salmonella spp. The mortality associated with mycotic aneurysm was high, ranging from 30% to 50%. The clinical outcome is especially poor in patients with infection caused by non-typhoidal Salmonella. The word ‘mycotic’ comes from the fresh fungus vegetation appearance of the aneurysms, and this term was first mentioned...
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by Osler and was associated with bacterial endocarditis.16 17
Since the introduction of antibiotics, bacterial endocarditis as a
cause of mycotic aneurysms is now present in only a minority of
patients. The exception is intracranial mycotic aneurysms, which
are exclusively due to endocarditis.12 18
The most common risk factors for developing infected
aneurysms are atherosclerosis and old age, as seen in this case
report.18 19 20 The pathophysiology is thought to be due to a direct
intimal wall injury with susceptibility to bacterial seeding.12 18 20
Mycotic aneurysms could also arise due to septic emboli, direct
bacterial inoculations,21 22 a pre-existing aneurysm, contiguous
infection, antecedent infections or in an immunocompromised
host.12 21 The patient in this case likely had bacterial seeding to
an atherosclerotic thoracic aorta due to a previous transient
bacteraemia during her cardiology admission. It is unclear where
the initial cause of Proteus bacteraemia began, but it may have
been from the urinary tract or a vascular source.

The clinical features of an infected aneurysm depend on the
location. They commonly present with a painful, pulsatile and
enlarging mass or a febrile illness with insidious onset, anorexia
and lethargy.12 24 25 With disease progression, patients can
develop bacteraemia, rupture and haemorrhage of the aneu-
rysms.24 26

Deeper-infected aneurysms are harder to elicit, as a patient
could present with minimal signs. These should always be
suspected in elderly patients with vascular risk factors who
present with unexplained bacteraemia. The patient in this case
report presented with hoarseness, which is believed to be due to
thoracic aortic arch aneurysm causing impingement of the left
recurrent laryngeal nerve.26 27 Other clinical presentations of
deeper infected aneurysms include gastrointestinal bleeding (due
to an aorta-duodenal fistula),28 heart failure or massive haemop-
ysis.29 30

The most common microorganisms that caused infected
thoracic aortic aneurysms were non-typhoidal Salmonella (57%) and
Staphylococcus aureus (14%).7 13 Mycotic aneurysms from
gram-negative microorganisms present with a higher incidence
of aneurysm rupture and mortality compared with those from
gram-positive microorganisms.31 This is thought to be due to
bacterial seeding of a susceptible atherosclerotic aorta.17 20 21
A thoracic mycotic aneurysm is an extremely rare source of P.
mirabilis bacteraemia, with only one case report being found
in a literature review by Semba et al.8 Another case report of a
mycotic aneurysm involving the internal carotid artery was
also associated with P. mirabilis infection.33 Some case reports
of gram-negative organisms associated with infected aneurysms
include Pseudomonas,34 Escherichia coli,35 Haemophilus influ-
enzae36 and Campylobacter.37

After a detailed history and physical examination, a suspicion
of an infected aneurysm should be followed up by laboratory
and imaging studies. Laboratory examination typically reveals
an elevation of inflammatory markers that include a total WCC,
erythrocyte sedimentation rate and CRP. Blood cultures should
do not have any pathogen identified.39

Imaging studies should include a TTE followed by a transoesoph-
ageal echocardiogram, when clinically indicated, to exclude
bacterial endocarditis.12 CT-A is the test of choice. CT-A is more
useful for diagnosing infected aneurysm compared with digital
subtraction angiography and it has a sensitivity and specificity of
over 90%.12 41 42 CT-A findings that are suggestive of an infected
aneurysm include a multilobulated or a saccular aneurysm, soft
tissue stranding, intramural air around the blood vessel and peri-
vascular fluid collection.24 41–43 Magnetic resonance angiography
is indicated if there is a contraindication to intravenous contrast
and it is particularly useful for intracranial aneurysms.44 45

There are no standardised guidelines to help with the treat-
ment of infected aneurysms. Proposed management strate-
gies include a combination of antibiotic therapy with surgical
debridement.12 13 46 On suspicion of an infected aneurysm,
broad-spectrum antibiotic therapy should be used immediately
to cover both gram-positive and gram-negative species and later
tailored to culture and susceptibility results. Duration of treat-
ment is based on clinical circumstances and a prolonged course
of treatment (>6 weeks) may be warranted in the setting of an
immunocompromised state, antibiotic-resistant organisms,
persistently positive blood cultures and inflammatory markers
that are slow to improve.45 46

Antibiotic therapy alone may control the bacteraemia but
is associated with poor outcomes with reported in-hospital
mortality rate around 50%.46 47 The role of surgery for an aneu-
rysms which is infected follows the same principal as vascular
graft infections, for which the aim is to remove the infected
tissue to prevent further sepsis or complications that may arise
from the aneurysm rupture.33 Morbidity and 1-year mortality
rates in patients who underwent surgery were higher for patients
with infected arch aneurysms compared with others sites of
infected aneurysms.13 48

Endovascular aneurysm repair (EVAR) is emerging as a
treatment alternative for infected aneurysms, with a 2-year
survival rate of over 70% and EVAR has been successfully
done in patients who are deemed as being high risk for open
surgery.9 10 There is, however, concern of ongoing infection
and surgical treatment should be considered for patients with
aneurysm rupture or persistent fevers. Given the patient’s
age and comorbidities in our case, EVAR was the preferred
surgical option.

Pneumonia with an effusion is an unusual source for F. mira-
bilis bacteraemia and therefore we should have actively pursued
a vascular source of infection prior to her discharge.49 In
retro-
spect, we believe that Proteus bacteraemia, in this case originated
from either the urinary tract or less likely from an intravenous
cannula site during her cardiology admission, resulting in seeding
of the susceptible atherosclerotic thoracic aorta.

Learning points

► When the cause of the gram-negative bacteraemia remains
elusive after preliminary investigations, one should actively
look for vascular infections as a source especially in patients
with significant vascular risk factors.

► Pneumonia is an unusual source for P. mirabilis
bacteraemia, and therefore the clinicians should actively
pursue a vascular source of infection after excluding the
common causes.

► Mycotic aneurysms from gram-negative microorganisms
present with a higher incidence of aneurysm rupture
and mortality compared with those from gram-positive
microorganisms.

► The clinical outcome in patients with infected aneurysms is
good, especially in patients with infection caused by non-
typhoidal Salmonella species.

REFERENCES


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