Case report

Palliative embolisation for intrapulmonary shunting in lepidic predominant adenocarcinoma of the lung

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1. Clinical record

A 64 year old man presented with haemoptysis and refractory hypoxia (pO2 41 mmHg on FiO2 0.8) following a short air flight. He was transferred for palliation closer to home. His history included 50 pack years smoking, asbestos exposure and weight loss. CT thorax (See Fig. 1) revealed extensive, dense consolidation of both lungs, bilateral hilar and subcarinal adenopathy, and centrilobular emphysema, but with no distant metastases evident. Sputum cytology reported atypical cells, favouring adenocarcinoma. He was polycythaemic with a haemoglobin of 203 g/L. He received antibiotics to treat any infective component, and glucocorticoids but without significant improvement. His oxygen saturations remained between 70 and 80% despite high flow oxygen. He was too unwell for further invasive investigations such as biopsy, or treatment such as chemotherapy (unknown ALK and EGFR status). He sought palliation and was discharged home with home oxygen approximately 10 L/min achieved via OxyMask with 2 connected oxygen concentrators.

8 months after initial diagnosis, he remained hypoxic, although his general condition remained stable (ECOG performance status 3) with no evidence of other end organ dysfunction. He was re-evaluated with CT scans, respiratory function tests, arterial blood gases, VQ scan, bubble contrast echocardiogram and a 100% oxygen shunt study. The calculated shunt fraction was 25% (pO2 54.1 on 100% O2, PCO2 38.9, SaO2 88%. Hb195) There was no evidence of extra-pulmonary shunting. The VQ scan revealed marked perfusion to the unventilated right lower lobe, consistent with significant intrapulmonary shunting. Distant metastases were not detected and there was only marginal progression of his extensive consolidation to both lungs. Given his poor pulmonary reserve, biopsy for EGFR and ALK status was not undertaken. However after multidisciplinary discussion, the feasibility of a palliative procedure to reduce the shunt and hopefully improve his oxygenation and quality of life was considered.

With informed consent, he underwent pulmonary angiography with intrapulmonary catheterisation and temporary occlusion of the right inferior pulmonary artery which improved oxygen...
saturations from 79% to 82%. Subsequent embolisation of his right lower lobe pulmonary artery with an 18 mm Amplatzer vascular plug II device was then performed. (See Fig. 2) He improved clinically although the dramatic improvement in oxygenation was not sustained with SaO₂ decreasing to 78–81% on 10 L O₂ within 1 day. Repeat VQ scanning 3 days later confirmed reduced perfusion of the non-ventilated posterobasal and lateral basal segments of the right lower lobe compared with the pre-procedural scan. However there was still flow to the superior and anterobasal segments of the right lower lobe. (See Fig. 3). He remained stable and was discharged home 5 days post procedure. He reported marked symptomatic improvement in his ability to carry out activities of daily living. His home monitored peripheral SaO₂ were between 71 and 96 % with a median of 86%. He subsequently died 3 months later from a complicated pneumothorax and pulmonary embolism.

Autopsy revealed extensive LPA involving all lobes of both lungs as well as hilar, mediastinal and retrosternal lymph nodes. There was a right upper lobe pulmonary embolus and a left upper lobe abscess colonised by aspergillus. The Amplatzer vascular plug was identified within a large vessel at the boundary of the right lower and middle lobes, with no evidence it contributed to his death.

2. Discussion

This is the first report we are aware of to use this minimally invasive, palliative procedure to improve shunting within a lung adenocarcinoma (lepidic predominant). There are few literature reports of LPA with refractory hypoxia from intrapulmonary shunting [1–7]. 5 reports have described 10 patients who underwent palliative surgery to correct the intrapulmonary shunt and hypoxia (see Table 1) [1–5]. Survival post resection ranged from 21 days to 24 months [1–5]. Some underwent chemotherapy and/or radiation therapy [1–5]. One patient even proceeded to
subsequent lung transplantation [3]. Intrapulmonary shunting has also been reported in squamous cell carcinoma and carcinoid of the lung [8–11].

It is uncertain why our patient’s initial dramatic oxygenation improvement was not sustained. Imaging did not reveal significant movement of the Amplatzer plug. Perhaps with his extensive bilateral lung disease, the moderate perfusion correction to unventilated lung was not enough to clearly demonstrate pO2 improvement. Despite no sustained improvement in oxygen saturation, he felt better and was more able to perform his activities of daily living. Unfortunately formal assessments of quality of life were not undertaken before and after the intervention.

The total cost of the Amplatzer II vascular plug and associated procedural costs is estimated at $1500, and bed costs approximately $2000. His home oxygen usage was unchanged but the palliative benefits of improving quality of life must not be

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**Fig. 3.** VQ scan a) before and b) after procedure.
Cooperative Oncology Group Performance Status, RA associated with shorter hospital stays.

...resection, intravascular stenting is less invasive and should be...

Published cases of intrapulmonary shunting from lung cancer causing refractory hypoxia.

Table 1
Published cases of intrapulmonary shunting from lung cancer causing refractory hypoxia.

| Authors                  | Age (years) | Cancer          | ECOG | Initial PO2 (mmHg) | PO2 after surgery | Treatment                                      | Survival            |
|-------------------------|-------------|-----------------|------|-------------------|-------------------|-----------------------------------------------|---------------------|
| Barlesi et al. [1] 2001 | 53 M        | LPA             | 1    | 54 on 5LO2        | 133 on 5LO2       | Surgery + Chemo                               | 3 months            |
|                         | 54 F        | LPA             | 1    | 53 on 5LO2        | 125 on 5L02       | Surgery + Chemo                               | 12 months           |
|                         | 68 M        | LPA             | 2    | 46 on 5LO2        | 102 on 5L02       | Surgery                                       | 21 days MI complicating pneumonia |
|                         | 46 M        | LPA             | 2    | 49 on 5L02        | 240 on 5L02       | Surgery + chemo                               | 18 months           |
|                         | (7 other cases at institution) |                |      |                   |                   |                                               |                     |
| Chetty et al. [2] 1997  | 71 M        | LPA             |      | 46 on RA          | 63 on RA          | Surgery + XRT                                 | 6 months from stroke |
| Falcoz et al. [3] 2009  | 68 M        | LPA             |      | 45 on RA          | 72 on RA          | Surgery + Chemo                               | 24 months           |
|                         | 54 M        | LPA             |      | 57 on RA          | 75 on RA          | Surgery + subsequent                          | 16 months later, post op after lung |
|                         | 63 M        | LPA             |      | 55 on 15L02       | 109 on RA         | Lung transplant transplantation due to colon perforation | Alive 6 months after surgery |
| Fishman et al. [4] 1974 | 64 M        | LPA             |      | 21 on RA          | 55 to 68 on RA    | Surgery                                       | 8 months            |
| Sarlin et al. [5] 1980  | 68 M        | LPA             |      | 58 on RA          | 80 on RA          | Surgery                                       | Alive 7 months later |
| Vanoyan et al. [6] 1998 | 74 M        | LPA             |      | 49 on 2L02 and    | 52 on 100%O2      | Ventilator support withdrawn after            | 30 days             |
| Venkata et al. [7] 2009 | 68 M        | SCC             |      | 47 on RA          | 79.5 on RA        | XRT                                           | Alive 1 year later  |
| Wartski et al. [8] 1998 | 68 M        | SCC             |      |                   |                   |                                               |                     |
| Kikano et al. [9] 1994  | 36 M        | Carcinoid       |      | 6.14 kPa on RA    | 84.7 on 100%O2    | Surgery                                       |                     |
|                         |             |                 |      | (46 mmHg)         | 52               |                                               |                     |
| Hussain et al. [10] 1994| 37 F        | carcinoid       |      | 46 on RA          |                   | Chemo                                         | Alive 1 year later  |
| Lee et al. [11] 1999   | 37 F        | carcinoid       |      | 46 on RA          | 71 on 100%O2      |                                               |                     |

M – male, F – female, LPA – lepidic predominant adenocarcinoma (formerly known as bronchioalveolar adenocarcinoma), SCC – squamous cell carcinoma. ECOG – Eastern Cooperative Oncology Group Performance Status, RA – room air, O2 – oxygen, Chemo – chemotherapy, XRT – radiation therapy, MI – myocardial infarction.

discounted. Compared with major palliative thoracic surgical resection, intravascular stenting is less invasive and should be associated with shorter hospital stays.

Although life expectancy is unlikely to change, this procedure may also have a role as bridging therapy while awaiting more definitive treatment for selected cases with minimal disease.

3. Conclusion

This is a novel, minimally invasive approach to lung adenocarcinoma with lepidic pattern with refractory hypoxia from intrapulmonary shunting for symptom relief. Given the rarity of this condition, further studies with multi-centre collaboration are needed.

Conflicts of interest

Joanne Tan – none declared.
Darren Walters - none declared.
Karl Poon – none declared.
Paul Zimmerman – none declared.
Pat Aldons – none declared.

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