DC Bead® Chemoembolisation for the Treatment of Primary [DEBDOX®] and Secondary [DEBIRI®] Liver Cancer
Review of Published Clinical Data

Professor Thomas J Vogl
Goethe University Hospital
Frankfurt-am-Main, Germany

DC Bead® has been shown to produce high response rates with a very favourable safety profile in HCC, cholangiocarcinoma, neuroendocrine metastases and colorectal metastases. Furthermore, data produced by the same authors in treatment of colorectal cancer provide further evidence that supports the use of DC Bead® in this indication.

Data also show that patient selection may be a key factor in ensuring optimal results. In the case of primary liver cancer, patients with advanced stages of cirrhotic and/or cancer disease were excluded from treatment. For metastatic disease, patients with a high degree of extrahepatic disease, a very high liver involvement and/or liver failure were also excluded from treatment.

The evidence from these data supports the use of DC Bead® for treatment of primary and secondary liver cancer. Owing to limited data and heterogeneity of studies for indications outside HCC, further trials are required in order to confirm these results. In the meantime, and given the poor prognosis and limited efficacy of existing therapies for these malignancies, DC Bead® should be considered as a treatment option, provided the patient is a good candidate for such therapy.

1. Drug-Eluting Bead Therapy in Primary and Metastatic Disease of the Liver.
   Carter S and Martin RCG
   © John Wiley & Sons Inc. Reproduced with permission.

2. Transarterial Chemoembolisation (TACE) Using Irinotecan-loaded Beads for the Treatment of Unresectable Metastases to the Liver in Patients with Colorectal Cancer: an Interim Report.
   Martin RCG, Robbins K, Tomalty D et al
   © Biomed Central Ltd. Reproduced with permission.

3. Surgical Downstaging and Neo-adjuvant Therapy in Metastatic Colorectal Carcinoma with Irinotecan Drug-Eluting Beads: a Multi-institutional Study.
   Bower M, Metzger T, Robbins K et al
   © John Wiley & Sons Inc. Reproduced with permission.

Biocompatibles
Excellence in Interventional Oncology

Biocompatibles UK Ltd is a BTG International Group company
Drug-eluting bead therapy in primary and metastatic disease of the liver


ABSTRACT

Background: Drug-eluting bead transarterial chemoembolization (DEB-TACE) [DEBDOX®] is a novel therapy for the treatment of hypervascularized tumours. Through the intra-arterial delivery of microspheres, DEB-TACE allows for embolization as well as local release of chemotherapy in the treatment of hepatic malignancy, providing an alternative therapeutic option in unresectable tumours. Its role as an adjunct to surgical resection or radiofrequency ablation (RFA) is less clear. The purpose of this review is to summarize recent studies investigating DEB-TACE in order to better define safety, efficacy and outcomes associated with its use.

Methods: A systematic review of all published articles and trials identified nine clinical trials and 23 abstracts. These were reviewed for tumour histology, stage of treatment, delivery technique, outcome at follow-up, complications and mortality rates.

Results: Publications involved treatment of hepatocellular carcinoma (HCC), metastatic colorectal carcinoma (MCRC), metastatic neuroendocrine (MNE) disease and cholangiocarcinoma (CCA). Using Response Evaluation Criteria in Solid Tumours (RECIST) or European Association for the Study of the Liver (EASL) criteria, studies treating HCC reported complete response (CR) rates of 5% (5/101) at 1 month, 9% (8/91) at 4 months, 14% (19/138) at 6 months and 25% (2/8) at 10 months. Partial response (PR) was reported as 58% (76/131) at 1 month, 50% (67/119) at 4 months, 57% (62/108) at 6–7 months and 63% (5/8) at 10 months. Studies involving MCRC, CCA and MNE disease were less valuable in terms of response rate because these are not a reliable surrogate for progression-free survival or overall survival. Ongoing clinical trials will further clarify the optimal timing and strategy of this technology.

Conclusions: Drug-eluting bead TACE is becoming more widely utilized in primary and liver-dominant metastatic disease of the liver. Outcomes of success must be expanded beyond response rates because these are not a reliable surrogate for progression-free survival or overall survival. Ongoing clinical trials will further clarify the optimal timing and strategy of this technology.

The authors of this review conclude that TACE with DC Bead® produces beneficial tumour response with an exceptionally low complication rate.
### Inclusion Criteria
- HCC confirmed by EASL or biopsy
- Not suitable for resection, transplantation or PEI (except for 1 study)

### Exclusion Criteria
- BRB higher than 3mg/dl
- Advanced HCC
- Doxorubicin contraindication
- Contraindicated for embolisation
- Renal failure
- Severe atheromatosis

### Inclusion Criteria
- Histologically confirmed colorectal carcinoma, with metastatic disease confirmed by CT scan
- Karnofsky ≥60% or WHO PS 0-2
- Previous chemotherapy discontinued at least 4 weeks prior to beginning the study
- No signs of infection or ascites

### Exclusion Criteria
- Any history of inflammatory bowel disease or previous extensive bowel resection
- Signs of cardiac disease or renal, bone marrow, pulmonary or central nervous system metastases
- Uncontrollable infections
- Other types of cancer (except treated in situ cervical, basal cell carcinoma or squamous cell carcinoma)
- One study excluded patients with prior treatment with topoisomerase inhibitors

### Inclusion Criteria
- Histologically proven disease with 2 or fewer mitoses per high-powered field, and proven progressive disease on 2 subsequent imaging studies according to RECIST criteria
- BRB <2 x ULN
- Transaminases <3 x ULN
- Creatinine levels <120mol/l
- PT<1.5 IU
- Platelets >10 6/mm 3

### Exclusion Criteria
- Patients with any resectable disease
- Predominant extrahepatic disease
- Biliary tract dilation, biloenteric anastomosis or biliary stent
- Crossing the ampulla of Vater
- Previous treatment with TACE

### Treatment
- **HCC**: Doxorubicin used in all articles and most abstracts
  - Doxorubicin doses from 25mg/m 2 up to a maximum dose of 150mg/m 2 per treatment
- **Colorectal**: Irinotecan at doses of 100mg per TACE procedure
- **NET**: Doxorubicin
- **CholangioK**: Doxorubicin

### Response Rates
- **HCC**: EASL: Overall Response 75% at 6M and 88% at 10M
  - RECIST: Overall Response 42% at 6M
- **Colorectal**: RECIST: Overall Response 80% at 1M
- **NET**: RECIST: Overall Response 80% at 3M
- **CholangioK**: RECIST: Overall Response 100% at 3M

### Safety
- **Complications reported in ≥5%**
  - Fever (85% patients)
  - Nausea and vomiting (93% patients)
  - Abdominal Pain (80% patients)

### Length of Stay
- Average 2.3 days

### Mortality
- 11/233 (5%) patients - 5 of these 11 patients died from progressive disease

---

**Data for Published Studies Reviewed (n = 8)**

<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Date</th>
<th>Histology</th>
<th>Patients (n)</th>
<th>Chemotherapy Agent</th>
<th>Response Rate Reported</th>
<th>Complications Reported</th>
<th>Survival Reported</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malagari et al</td>
<td>Nov 2007</td>
<td>HCC</td>
<td>71</td>
<td>Doxorubicin</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Poon et al</td>
<td>Sep 2007</td>
<td>HCC</td>
<td>35</td>
<td>Doxorubicin</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Aliberti et al</td>
<td>Oct 2006</td>
<td>MCRC</td>
<td>10</td>
<td>Irinotecan</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Fiorentini et al</td>
<td>Nov 2007</td>
<td>MCRC</td>
<td>20</td>
<td>Irinotecan</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Aliberti et al</td>
<td>July 2008</td>
<td>CAC</td>
<td>20</td>
<td>Doxorubicin</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Varela et al</td>
<td>March 2007</td>
<td>HCC</td>
<td>27</td>
<td>Doxorubicin</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>de Baere et al</td>
<td>June 2008</td>
<td>NE</td>
<td>20</td>
<td>Doxorubicin</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Kettenbach et al</td>
<td>Jan 2007</td>
<td>HCC</td>
<td>30</td>
<td>Doxorubicin</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

HCC, hepatocellular carcinoma; MCRC, metastatic colorectal cancer; CAC, cholangiocarcinoma; NE, neuroendocrine disease

Table adapted from Carter S, and Martin RCG, HPB (Oxford) 11 (2009): 541-550
Transarterial chemoembolization (TACE) using irinotecan-loaded beads for the treatment of unresectable metastases to the liver in patients with colorectal cancer: an interim report.


ABSTRACT

Background: Following failure of standard systemic chemotherapy, the role of hepatic transarterial therapy for colorectal hepatic metastasis continues to evolve as the experience with this technique matures. The aim of this study to gain a better understanding of the value of drug eluting bead therapy when administered to patients with unresectable colorectal hepatic metastasis.

Methods: This was an open-label, multi-center, single arm study, of unresectable colorectal hepatic metastasis patients who had failed standard therapy from 10/2006-10/2008. Patients received repeat embolizations with irinotecan loaded beads (max 100 mg per embolization) per treating physician’s discretion.

Results: Fifty-five patients underwent 99 treatments using Irinotecan drug eluting beads. The median number of total treatments per patient was 2 (range of 1-5). Median length of hospital stay was 23 hours (range 23 hours - 10 days). There were 30 (30%) sessions associated with adverse reactions during or after the treatment. The median disease free and overall survival from the time of first treatment was 247 days and 343 days. Six patients (10%) were downstaged from their original disease status. Of these, four were treated with surgery and two with RFA.

Neither number of liver lesions, size of liver lesions or extent of liver replacement (<= 25% vs >25%) were predictors of overall survival. Only the presence of extrahepatic disease ($p = 0.001$), extent of prior chemotherapy (failed 1st and 2nd line vs > 2 line failure) ($P = 0.007$) were predictors of overall survival in multivariate analysis.

Conclusions: Chemoembolization using Irinotecan loaded beads was safe and effective in the treatment of patients as demonstrated by a minimal complication rate and acceptable tumor response.

REVIEW

In 2009 Martin et al. published interim results from an open-label, multi-centre, single-arm study and evaluated the role of DC Bead® irinotecan (DEBIRI®) in the treatment of liver metastases from colorectal cancer. Fifty-five patients with confirmed diagnosis of liver-dominant metastatic colorectal cancer, liver involvement of less than 75%, preserved liver function and ECOG PS 0-2 or Karnofsky 60-100% were treated within the study.

DEBIRI® was administered in an outpatient setting, using a lobar approach with 100mg of irinotecan loaded into each DC Bead® vial (mainly 100-300µm).

Adverse events were seen in 29% of patients. Patients who received greater than 100mg irinotecan in the first treatment only, were more likely to suffer an adverse event ($p<0.0001$).

During a median follow-up of 18 months, 12 patients died, most of them due to disease progression. One patient died of liver failure. This patient had baseline BRB of 1.9mg/dl, a liver involvement of 26-50% with total target lesion size of 12.9cm.

Tumour response was seen in 80% patients at 6 months and 54% at 12 months according to EASL. According to RECIST, 56% responded at 6 months and 40% at 12 months.

The authors conclude that DEBIRI® is safe and effective in the treatment of patients with unresectable metastatic colorectal cancer.

...DEBIRI® is safe and effective in the treatment of patients with unresectable metastatic colorectal cancer.


ABSTRACT

Background: Neoadjuvant chemotherapy for potentially resectable metastatic colorectal cancer (MCC) is becoming a more common treatment algorithm. The aim of the present study was to evaluate the efficacy of precision hepatic arterial irinotecan therapy in unresectable MCC.

Methods: An open-label, multi-centre, multi-national single arm study of MCC patients, who received hepatic arterial irinotecan. Primary endpoints were safety, tolerance and metastatic tumour resection.

Results: Fifty-five patients with metastatic colorectal to the liver underwent a total of 90 hepatic arterial irinotecan treatments. The extent of liver involvement was <25% in 75% of the patients (n = 41), between 26 and 50% in 15% of the patients (n = 11) and >50% in 10% of the patients (n = 24). The median number of hepatic lesions was four (range 1–20), with a median total size of all target lesions of 9 cm (range 5.5–28 cm) with 50% of patients having bilobar tumour distribution. The median number of irinotecan treatments was two (range 1–5). The median treatment dose was 100 mg (range 100–200) with a median total hepatic treatment of 200 mg (range 200–650). The majority of treatments (86%) were performed as lobar infusion treatments, and 30% of patients were treated with concurrent simultaneous chemotherapy. Eleven (20%) patients demonstrated significant response and downstaging of their disease or demonstrated stable disease without extra-hepatic disease progression allowing resection, ablation or a combination of both.

Conclusions: Hepatic arterial infusion irinotecan drug-eluting beads is safe and effective in pre-surgical therapy and helpful in evaluating the biology of metastatic colorectal cancer to the liver prior to planned hepatic resection.

REVIEW

A further paper by Martin et al. focuses on those patients from the original 55 who were either downstaged to resection or treated in the neo-adjuvant setting. Eleven (20%) patients demonstrated either significant response and downstaging of their disease or stable disease without extra-hepatic disease progression allowing for resection, ablation or a combination of both.

All of these 11 patients had multiple liver metastases, with nine patients having less than 25% liver involvement. They all had also received systemic chemotherapy, including either FOLFOX, FOLFIRI, bevacizumab or capecitabine. Three patients were treated with concurrent irinotecan and cetuximab while on hepatic arterial therapy.

After TACE, median length of hospital stay was 23 hours. One patient suffered an adverse event of post-embolic syndrome.

No peri-operative mortality was reported. One patient suffered a biloma which was resolved with percutaneous drainage and another patient experienced a minor wound infection.

Pathological evaluation showed no evidence of chemotherapy-associated steatohepatitis. Overall, pathological response in resected specimens was 90%.

Median disease-free interval was 9 months and median overall survival 12 months.

In the authors’ view, this initial evaluation confirms the activity of this therapy in the management of colorectal cancer liver metastasis. They also consider it to be an acceptable treatment option for evaluating the overall metastatic biology prior to planned hepatic resection.
**Patient Prior Liver Therapy**

<table>
<thead>
<tr>
<th>Patient</th>
<th>Prior Liver Therapy</th>
<th>Reason for Unresectability and Initial Bead Treatment</th>
<th>Number of Bead Treatments</th>
<th>Operation After Bead Therapy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Lobectomy</td>
<td>Insufficient remnant liver</td>
<td>2</td>
<td>Ablation</td>
</tr>
<tr>
<td>2</td>
<td>Lobectomy</td>
<td>Number and location</td>
<td>2</td>
<td>Ablation</td>
</tr>
<tr>
<td>3</td>
<td>Lobectomy</td>
<td>Location</td>
<td>1</td>
<td>Ablation</td>
</tr>
<tr>
<td>4</td>
<td>Ablation</td>
<td>Location</td>
<td>2</td>
<td>Ablation + Resection</td>
</tr>
<tr>
<td>5</td>
<td>Ablation</td>
<td>Number and location</td>
<td>2</td>
<td>Ablation + Resection</td>
</tr>
<tr>
<td>6</td>
<td>Ablation</td>
<td>Number and location</td>
<td>2</td>
<td>Atypical Resection</td>
</tr>
<tr>
<td>7</td>
<td>None</td>
<td>Lung metastases</td>
<td>3</td>
<td>Lobectomy</td>
</tr>
<tr>
<td>8</td>
<td>None</td>
<td>Lung metastases</td>
<td>3</td>
<td>Atypical Resection</td>
</tr>
<tr>
<td>9</td>
<td>None</td>
<td>Lung metastases</td>
<td>3</td>
<td>Atypical Resection</td>
</tr>
<tr>
<td>10</td>
<td>None</td>
<td>Portal lymph nodes</td>
<td>3</td>
<td>Lobectomy</td>
</tr>
<tr>
<td>11</td>
<td>None</td>
<td>Portal lymph nodes</td>
<td>3</td>
<td>Lobectomy</td>
</tr>
</tbody>
</table>

Table adapted from Bower M, Metzger T, Robbins K et al, HPB (Oxford) 12 (2010): 31-36

**Conclusion**

DC Bead® has been shown to produce high response rates with a very favourable safety profile in HCC, cholangiocarcinoma, neuroendocrine metastases and colorectal metastases. Furthermore, data produced by the same authors in the treatment of colorectal cancer provide further evidence that supports the use of DC Bead® in this indication.

Data also show that patient selection may be a key factor in ensuring optimal results. In the case of primary liver cancer, patients with advanced stages of cirrhotic and/or cancer disease were excluded from treatment. For metastatic disease, patients with high degree of extrahepatic disease, a very high liver involvement and/or liver failure were also excluded from treatment.

The evidence from these data supports the use of DC Bead® for treatment of primary and secondary liver cancer. Owing to limited data and heterogeneity of studies for indications outside HCC, further trials are required in order to confirm these results. In the meantime and given the poor prognosis and limited efficacy of existing therapies for these malignancies, DC Bead® should be considered as a treatment option provided the patient is a good candidate for such therapy.
The views and opinions expressed in this document are those of the author and may not reflect those of Biocompatibles. The author acted as a consultant for Biocompatibles, for which payment was made.

The products may not be available for sale, may not be registered, approved or cleared for use as claimed, in all countries where Biocompatibles is represented.

**Important Information**

**DC Bead® Indications:**
- DC Bead® is primarily intended as an embolic agent for the treatment of malignant hypervascularised tumours.
- DC Bead® is compatible with irinotecan, which can be loaded prior to embolisation and then, as a secondary action, elute a local, controlled and sustained dose to the hypervascularised tumour(s).

**DC Bead® Indications:**
- DC Bead® is primarily intended as an embolic agent for the treatment of malignant hypervascularised tumours.
- DC Bead® is compatible with irinotecan, which can be loaded prior to embolisation and then, as a secondary action, elute a local, controlled and sustained dose to the hypervascularised tumour(s).

**DC Bead® and DC Bead® Important Information:**
- Embolisation with DC Bead®/DC Bead® should only be performed by a physician with appropriate interventional occlusion training in the region intended to be embolised.
- Consideration should be given to Tc99m-MAA scanning if there is suspicion of AV shunting.
- Do not use irinotecan-loaded beads with contrast agents containing salts (e.g. Calcium chloride).
- Infection necessitating medical intervention.
- Clot formation at the tip of the catheter and subsequent dislodgement.
- Vessel or lesion rupture and haemorrhage.
- Neurological deficits including cranial nerve palsies.
- Vasospasm.
- Death.
- Recanalisation.
- Foreign body reactions necessitating medical intervention.
- Other arteries or arterial beds.
- Pulmonary embolisation.
- Other arteries or arterial beds.
- Infection necessitating medical intervention.
- Clot formation at the tip of the catheter and subsequent dislodgement.
- Neurological deficits including cranial nerve palsies.
- Vasospasm.
- Death.
- Recanalisation.
- Foreign body reactions necessitating medical intervention.
- Other arteries or arterial beds.
- Pulmonary embolisation.
- Other arteries or arterial beds.
- Infection necessitating medical intervention.
- Clot formation at the tip of the catheter and subsequent dislodgement.
- Neurological deficits including cranial nerve palsies.
- Vasospasm.
- Death.
- Recanalisation.
- Foreign body reactions necessitating medical intervention.
- Other arteries or arterial beds.
- Pulmonary embolisation.
- Other arteries or arterial beds.
- Infection necessitating medical intervention.
- Clot formation at the tip of the catheter and subsequent dislodgement.
- Neurological deficits including cranial nerve palsies.
- Vasospasm.
- Death.
- Recanalisation.
- Foreign body reactions necessitating medical intervention.
- Other arteries or arterial beds.
- Pulmonary embolisation.
- Other arteries or arterial beds.
- Infection necessitating medical intervention.
- Clot formation at the tip of the catheter and subsequent dislodgement.
- Neurological deficits including cranial nerve palsies.
- Vasospasm.
- Death.
- Recanalisation.
- Foreign body reactions necessitating medical intervention.
- Other arteries or arterial beds.
- Pulmonary embolisation.
- Other arteries or arterial beds.
- Infection necessitating medical intervention.
- Clot formation at the tip of the catheter and subsequent dislodgement.
- Neurological deficits including cranial nerve palsies.
- Vasospasm.
- Death.
- Recanalisation.
- Foreign body reactions necessitating medical intervention.
- Other arteries or arterial beds.
- Pulmonary embolisation.
- Other arteries or arterial beds.
- Infection necessitating medical intervention.
- Clot formation at the tip of the catheter and subsequent dislodgement.
- Neurological deficits including cranial nerve palsies.
- Vasospasm.
- Death.
- Recanalisation.
- Foreign body reactions necessitating medical intervention.
- Other arteries or arterial beds.
- Pulmonary embolisation.
- Other arteries or arterial beds.
- Infection necessitating medical intervention.
- Clot formation at the tip of the catheter and subsequent dislodgement.
- Neurological deficits including cranial nerve palsies.
- Vasospasm.
- Death.
- Recanalisation.
- Foreign body reactions necessitating medical intervention.
- Other arteries or arterial beds.
- Pulmonary embolisation.
- Other arteries or arterial beds.
- Infection necessitating medical intervention.
- Clot formation at the tip of the catheter and subsequent dislodgement.
- Neurological deficits including cranial nerve palsies.
- Vasospasm.
- Death.
- Recanalisation.
- Foreign body reactions necessitating medical intervention.
- Other arteries or arterial beds.
- Pulmonary embolisation.
- Other arteries or arterial beds.
- Infection necessitating medical intervention.
- Clot formation at the tip of the catheter and subsequent dislodgement.
- Neurological deficits including cranial nerve palsies.
- Vasospasm.
- Death.
- Recanalisation.
- Foreign body reactions necessitating medical intervention.
- Other arteries or arterial beds.
- Pulmonary embolisation.
- Other arteries or arterial beds.
- Infection necessitating medical intervention.
- Clot formation at the tip of the catheter and subsequent dislodgement.
- Neurological deficits including cranial nerve palsies.
- Vasospasm.
- Death.
- Recanalisation.
- Foreign body reactions necessitating medical intervention.
- Other arteries or arterial beds.
- Pulmonary embolisation.
- Other arteries or arterial beds.
- Infection necessitating medical intervention.
- Clot formation at the tip of the catheter and subsequent dislodgement.
- Neurological deficits including cranial nerve palsies.
- Vasospasm.
- Death.
- Recanalisation.
- Foreign body reactions necessitating medical intervention.
- Other arteries or arterial beds.
- Pulmonary embolisation.
- Other arteries or arterial beds.
- Infection necessitating medical intervention.
- Clot formation at the tip of the catheter and subsequent dislodgement.
- Neurological deficits including cranial nerve palsies.
- Vasospasm.
- Death.
- Recanalisation.
- Foreign body reactions necessitating medical intervention.
- Other arteries or arterial beds.
- Pulmonary embolisation.
- Other arteries or arterial beds.
- Infection necessitating medical intervention.
- Clot formation at the tip of the catheter and subsequent dislodgement.
- Neurological deficits including cranial nerve palsies.
- Vasospasm.
- Death.
- Recanalisation.
- Foreign body reactions necessitating medical intervention.
- Other arteries or arterial beds.
- Pulmonary embolisation.
- Other arteries or arterial beds.
- Infection necessitating medical intervention.
- Clot formation at the tip of the catheter and subsequent dislodgement.
- Neurological deficits including cranial nerve palsies.
- Vasospasm.
- Death.
- Recanalisation.
- Foreign body reactions necessitating medical intervention.
- Other arteries or arterial beds.
- Pulmonary embolisation.
- Other arteries or arterial beds.
- Infection necessitating medical intervention.
- Clot formation at the tip of the catheter and subsequent dislodgement.
- Neurological deficits including cranial nerve palsies.
- Vasospasm.
- Death.
- Recanalisation.
- Foreign body reactions necessitating medical intervention.
- Other arteries or arterial beds.
- Pulmonary embolisation.
- Other arteries or arterial beds.
- Infection necessitating medical intervention.
- Clot formation at the tip of the catheter and subsequent dislodgement.
- Neurological deficits including cranial nerve palsies.
- Vasospasm.
- Death.
- Recanalisation.
- Foreign body reactions necessitating medical intervention.
- Other arteries or arterial beds.
- Pulmonary embolisation.