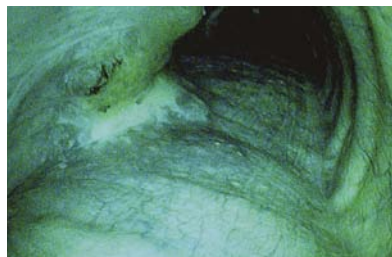
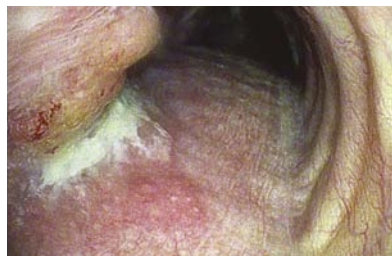
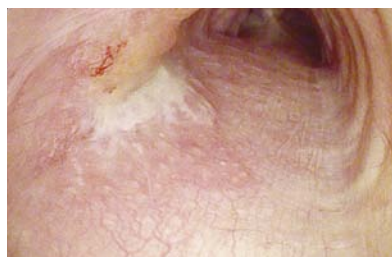


PENTAX Medical

i-scan Mini-Atlas for Pulmonology

Case studies from clinical practice with HD+ and i-scan.

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A picture tells a thousand words

Pulmonology with HD+ and i-scan technology

Dear readers,

Everyone appreciates a nice picture, be it from an artistic viewpoint, sentimental reasons, or in our case, as an interventional pulmonologist from a professional standpoint. Without going into the technical details of 'resolution' and 'definition', a sharper image that shows more detail will make it easier to detect abnormalities within the bronchial tree. Such excellent image quality, with a detailed visualisation is provided by High-Definition (HD+) endoscopy, combined with i-scan technology. In this i-scan Mini-Atlas, we present a number of relevant clinical cases showing you the possibilities of HD+ bronchoscopy with i-scan.

This combination supports the detection of epithelial changes. Enhancement of tumour margins and vessel architecture may lead to easier demarcation of suspicious areas and helps in characterisation of mucosal abnormalities. This will guide you to determine where to take biopsies, or which areas need to be treated. Endoscopic diagnosis can therefore be significantly improved.

Dedicated and well-known endoscopic centres have contributed to this unique selection of case studies. Each case follows the same format, which represents the recommended algorithm using i-scan.

A big thanks to all authors and people involved in the i-scan case studies. The following clinical cases show the added value and advantages of i-scan in day-to-day bronchoscopic examinations and will further support you in getting the best patient outcomes.

Dr. Erik van der Heijden
M.D., PhD, Chest Physician
Radboud University Medical Centre Nijmegen, The Netherlands

Faster detection. Easier demarcation. Support in characterisation.

i-scan technology: Your diagnostic support

The i-scan technology is an image enhancing technology based on real time post processing of reflected light. With the simple touch of a button on the endoscope or processor, i-scan can be switched on and off easily. The different i-scan modes, namely i-scan 1, i-scan 2 and i-scan 3 will be displayed on the monitor one after another.

i-scan 1 (Surface Enhancement, SE) highlights bronchial mucosal surface structures which can be used for the detection of epithelial changes. Abnormalities are easier to detect. i-scan 2 (SE and Tone Enhancement, TE) accentuates mucosal structures and vascular patterns, improving the determination of lesion margins. These details are helpful to demarcate and characterise bronchial lesions and cancer types. Neoplastic and inflammatory vessel and tissue patterns may be differentiated from non-neoplastic patterns. i-scan 3 (SE and TE) further enhances visibility of the vessel pattern and helps in the localisation of safe biopsy sites.

Detection, demarcation and characterisation are the most important first steps during routine endoscopy examinations. Once all suspicious areas have been identified and delineated, the endoscopist has to decide what endoscopic intervention (e.g. brush, biopsy or endoscopic resection) is needed. The i-scan technology supports those steps and adds great value to daily endoscopic procedures.

Dr. Erik van der Heijden, M.D., PhD

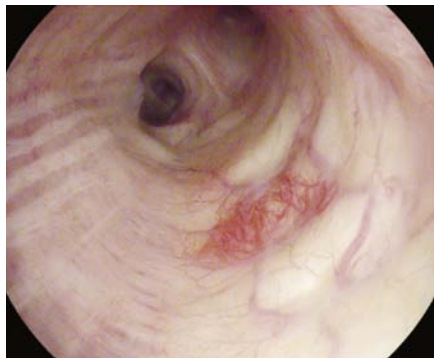
Equipment and approach for the i-scan case collection

In combination with the EPK-i series processors (EPK-i7000, EPK-i5000 and EPK-i) the HD+ images taken with the EB-1990i bronchoscope provide superior endoscopic image resolution. This equipment was used to capture the images shown in the following case studies. For further information on the products, please refer to the PENTAX Medical product overview or our website.

The i-scan case studies were collected in hospitals across Europe. All cases were documented in the same structure: patient history, endoscopic findings and patient outcome. All clinical images were acquired in an identical sequence: i-scan 1 (SE), i-scan 2 (SE and TE) and i-scan 3 (SE and TE). This makes the cases comparable and provides a good impression of the clinical value of i-scan.

Our special thanks goes to the editor of this i-scan Mini-Atlas, Dr. Erik van der Heijden of Radboud University Medical Centre Nijmegen.

Explore the advantages of HD+ and i-scan in everyday procedures



HD+: Hypervascular mucosa in the left main bronchus; indicative of vascular malformation

Unique High-Definition (HD+) images and excellent illumination

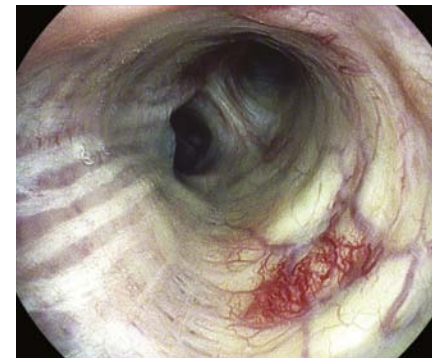
- Supports fast orientation and detection
- Significantly improves the visibility and evaluation of anatomical details of the bronchial mucosa, e.g. longitudinal elastic bands and mucosal glands
- Detailed inspection of irregular surface structures



i-scan 1: Hypervascular mucosa in the left main bronchus; indicative of vascular malformation

Detection and delineation support with i-scan 1 (SE):

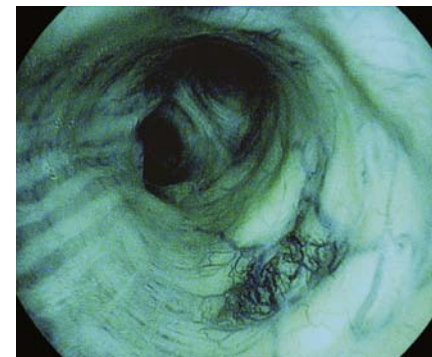
- i-scan 1 (SE) retains natural colour tones
- Accentuates epithelial structures in the central airways
- Enhancement of (lesion) margins and vessel patterns and support of the detection of epithelial changes



i-scan 2: Hypervascular mucosa in the left main bronchus; indicative of vascular malformation

Support in demarcation and characterisation with i-scan 2 (SE and TE):

- Specific imaging technology for further assistance in endoscopic procedures
- Enhances endoscopic outlines and margins of necrotic areas, non-neoplastic and neoplastic, or inflammatory bronchial lesions
- Allows better evaluation of the accentuated vascular pattern, which can support characterisation of visible abnormalities



i-scan 3: Hypervascular mucosa in the left main bronchus; indicative of vascular malformation

Characterisation and localisation support with i-scan 3 (SE and TE):

- Colour mode further highlights the vascular pattern
- Supports characterisation and localisation of safe biopsy sites
- Beneficial setting for physicians at the beginning of their learning curve or colour-blind doctors

Recurrent non-small cell squamous lung carcinoma with i-scan

Patient history

A 76 year old male with a history of a left upper lobe lobectomy for a pT1bN0M0 stage Ib squamous cell carcinoma, 4 years prior to referral. Twenty months prior to referral, a locoregional recurrence was found in the left main bronchus and lower trachea, with involvement of the mediastinal nodes for which chemotherapy and radiotherapy (67 Gy) were given. Now a new local recurrence was found and the patient was referred for endobronchial treatment.

Endoscopic findings

HD+ white light bronchoscopy revealed a superficial tumour at the left lateral wall of the trachea.

Further examinations using i-scan 1 (SE) revealed small tumour islets at the posterior wall. Using i-scan 2 (SE and TE) and i-scan 3 (SE and TE) the tumour could be characterised, showing necrotic parts and vessel patterns consistent with squamous cell carcinoma and improving tumour demarcation at the tumour margins, defining the area to treat.

Patient outcome and follow-up

Since no additional radiotherapy could be given for this in-field recurrence and no distal metastases were present, locoregional treatment was given using electrocautery on all visible tumour sites. Follow-up bronchoscopy after 3 months showed some small residual tumour, for which additional treatment was given. Follow-up CT scans and a bronchoscopy are scheduled.

Summary

In this case, HD+ bronchoscopy with the use of the i-scan technology improved tumour demarcation and characterisation, defining the area to treat.

Image 1:

Local recurrence of squamous cell non-small cell carcinoma in the trachea. i-scan 1 (SE) shows tumour islets on the posterior wall.

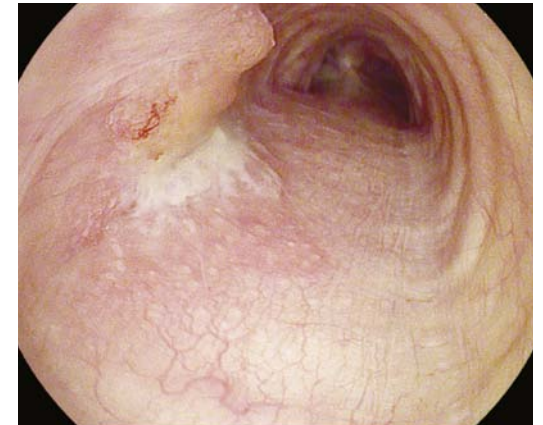


Image 2:

i-scan 2 (SE and TE) improves tumour demarcation and reveals necrotic parts of the tumour, consistent with squamous cell carcinoma.



Image 3:

i-scan 3 (SE and TE) accentuates vessel structures, indicating potential sites for bleeding upon treatment or biopsy.



Dr. Erik van der Heijden, M.D., PhD

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Bronchial carcinoid and i-scan

Patient history

A 61 year old male was admitted to our hospital for an aortic dissection and underwent emergency surgery. A week after surgery he developed ARDS and was transferred to the ICU where a routine bronchoscopy for microbiological examination was performed. A small pedunculated lesion was observed in the right main bronchus. Because of the critical clinical situation, no specimens were taken. After he recovered from the ARDS and underwent cardio-pulmonary rehabilitation, an endoscopic re-evaluation was performed in our centre.

Endoscopic findings

With the HD+ white light bronchoscopy, a small, wide-based polypoid lesion on the posterior wall of the right main bronchus was detected. The i-scan 1 (SE) showed a smooth surface with a florid vascularisation suggestive for carcinoid.

Further examination using i-scan 2 (SE and TE) gave greater visualisation of the vascularisation of this lesion. i-scan 3 (SE and TE) allowed a precise definition of the implant base and infiltration of the bronchus wall.

Patient outcome and follow-up

A laser assisted mechanical resection with rigid bronchoscopy was performed under general anaesthesia.

The histological examination confirmed the endoscopic suspicion of typical bronchial carcinoid.

Endoscopic follow up was scheduled at 3 months with biopsies on the implant base to confirm the endoscopic radicality and define the following therapeutic plan.

Summary

Visualisation of the implant base of small lesion and its vascularisation as allowed by the HD+ and i-scan technology is helpful in the clinical management of small endobronchial lesion and in follow-up.

Image 1:

Polypoid lesion of the right main bronchus; image with i-scan 1 (SE).

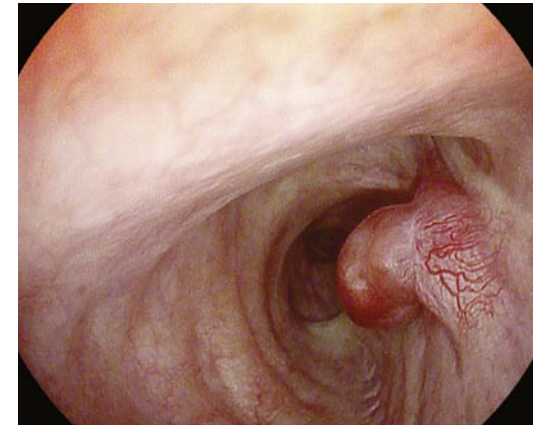


Image 2:

Enhancement of vascularisation with i-scan 2 (SE and TE).

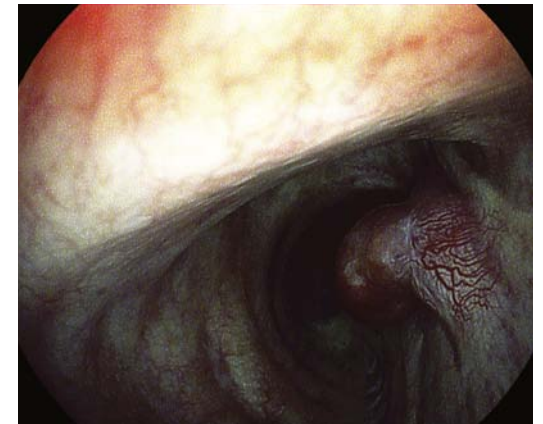


Image 3:

Better definition of the implant base due to i-scan 3 (SE and TE).



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NSCLC: Adenocarcinoma and i-scan

Patient history

A 56 year old male was referred with a persistent, irritative cough, which had been present for 3 months, accompanied with anorexia and weight loss. He was a current smoker. He reported no fever, chest pain or hemoptysis. Imaging revealed a lung mass in the posterior segment of the left upper lobe of 48 x 36 mm, with necrosis and cavitation.

Endoscopic findings

HD+ white light bronchoscopy revealed leukoplakia in the right vocal cord and in the left bronchial tree of the mediastinal wall of the middle third of the main bronchus hypervascular oval area, of less than 1 cm, with no sign of tumour infiltration, suggestive of a vascular malformation.

In the upper lobe bronchus, on the anterior wall, nodular mucosal thickening of a crescent shaped infiltration was suggestive of neoplastic mucosa, and submucosa was detected. Segmental stenosis caused complete posterior apical occlusion.

i-scan 1 (SE) delineates the alleged vascular malformation, as well as mucosal and irregular growing nodular tumour mucosa, defined and made more evident the neovascularisation and limits of the neoplasm.

i-scan 2 (SE and TE) and i-scan 3 (SE and TE) enhanced the choice of area to biopsy, allowing you to select areas of high infiltration and escape the most vascularisation.

Patient outcome and follow-up

Needle puncture cytology in nodular mucosal growth area in the left upper lobe was performed. Cytology showed malignancy of a possible adenocarcinoma. Biopsy of the posterior apical of the segmental bronchus (stenotic) left upper lobe showed adenocarcinoma. The patient had started chemotherapy.

Summary

HD+ and, above all, i-scan 2 (SE and TE) enhanced and defined mucosal irregularities, vascular development and neovascularisation. Other vascular abnormalities, in principle related to the tumour, are better defined.

Image 1:

Nodular mucosal thickening, crescent-shaped, in the left upper lobe bronchus. i-scan 1 (SE) delineates the malignant infiltration.

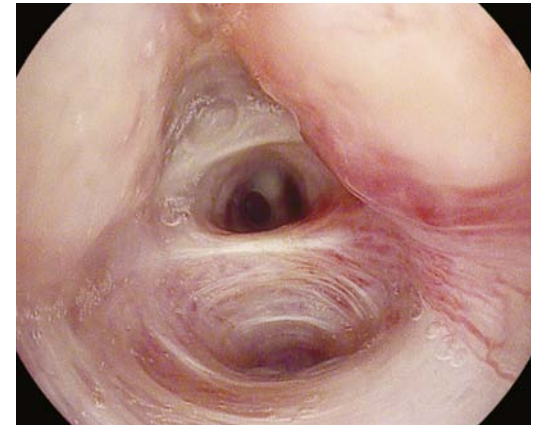


Image 2:

i-scan 2 (SE and TE) helps to demarcate areas of high infiltration.

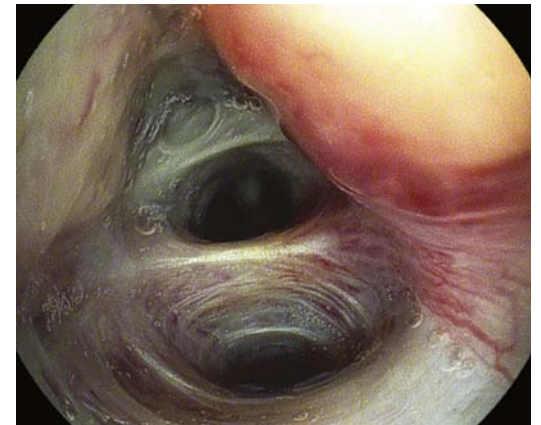
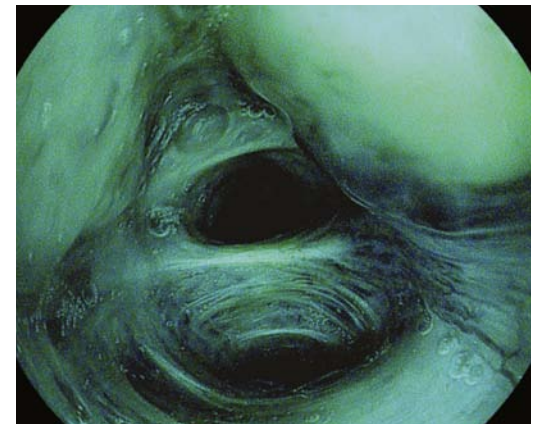


Image 3:

i-scan 3 (SE and TE) enhances the area to treat.



Dr. Javier Cosano

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Adenoid cystic carcinoma of the left main bronchus with i-scan

Patient history

A 64 year old female with a history sarcoidosis was referred to a chest physician with slowly progressive dyspnea upon exercise and variable loss of phonation.

Endoscopic findings

HD+ white light bronchoscopy revealed a highly vascularised tumour in the left main bronchus, resulting in a near total occlusion. Abnormal vascular patterns were found in the distal trachea and most cranial parts of the right main bronchus.

Further examination using i-scan 1 (SE) accentuated tumour margins and epithelial changes in the tumour site.

Using i-scan 2 (SE and TE) and i-scan 3 (SE and TE) the tumour could be further characterised showing characteristic vessel patterns, consistent with adenoid cystic carcinoma tumour demarcation at the tumour margins, defining the area to treat.

Patient outcome and follow-up

Biopsy confirmed the presence of adenoid cystic carcinoma with a wild type KRAS, EGFR and no EML4-ALK translocation. Locoregional invasion into adjacent lymph nodes was suspected. A sleeve pneumonectomy of the left lung (with resection of the distal trachea and initial part of the right main bronchus) was performed, resulting in a surgical anastomosis of the distal trachea to the right main bronchus.

But as expected, the microscopic evaluation of the resections margins showed microscopic invasion. Postoperative radiotherapy (67 Gy) was given. Yearly follow-up CT scans and HD+ bronchoscopy are scheduled.

Summary

In this case, HD+ bronchoscopy with the use of i-scan improved tumour demarcation and characterisation, defining the area invaded with this superficial spreading rare tumour and defining the extent of the resection.

Image 1:

Superficial growing highly vascularised tumour of the left main bronchus and distal trachea. Detailed evaluation with i-scan 1 (SE) shows tumour patterns and epithelial changes within the tumour area.



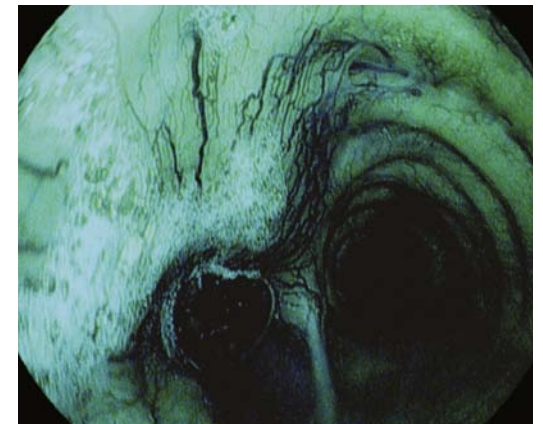
Image 2:

i-scan-2 (SE and TE) improves tumour demarcation and accentuates abnormal vessel patterns in the distal trachea and proximal right main bronchus.



Image 3:

i-scan 3 (SE and TE) accentuates vessel structures indicating potential sites for bleeding upon treatment or biopsy.



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Malignant mesenchymal tumour with i-scan

Patient history

A 32 year old female patient presented with dyspnea, which was progressive over the past 2 months. She had a history of left upper lobe resection, for a malignant mesenchymal tumour of the lung 3 years earlier. The thoracic CT scan showed masses at the left tracheal wall, with a normal left upper lobe stump.

Endoscopic findings

A round non-ulcerating mass was seen in the distal part of the trachea on the left lateral wall, using the HD+ white light bronchoscopy.

Additional examination with i-scan 1 (SE) increased the visibility of the tumour border, i-scan 2 (SE and TE) clearly shows that the tumor is highly perfused and i-scan 3 (SE and TE) further improved visibility of the vascular structures.

Patient outcome and follow-up

Immediately following this diagnostic procedure, the nodule was extracted using forceps with argon plasma coagulation and cryotherapy. The entire tumour could be resected endoscopically. Additional systemic treatment was started.

Summary

HD+ bronchoscopy, with additional i-scan technology, guided us to detect this nodule and helped to determine this as a metastatic site. With the additional i-scan settings, we were able to clearly demarcate the area to treat.

Image 1:

Round non-ulcerating mass; image with i-scan 1 (SE).



Image 2:

Marked border of tumour and normal tissue; image with i-scan 2 (SE and TE).



Image 3:

Increased vascular shadow; image with i-scan 3 (SE and TE).



Prof. Mustafa Erelel, M.D.

*Pulmonologist
Istanbul Medical Faculty
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i-scan and NSCLC: Adenocarcinoma

Patient history

A 66 years old male was referred with acute onset disorientation, dysarthria, aphasia and generalised tonic seizures since 1 day. He was an active smoker. The CT scan of the brain showed possible brain metastases. The chest CT scan detected a mass of 50 mm in diameter in the posterior segment of the right upper lobe, and stenosis of the apical segmental bronchus with possible infiltration of the posterior mediastinum.

Endoscopic findings

HD+ white light bronchoscopy revealed a tumour in the right bronchial tree. The tumour surface was smooth and occluded the right upper lobe apical segment. Furthermore, a slight extrinsic compression of the RUL bronchus was noted, but there were no signs of infiltration.

The i-scan 1 (SE) improved delineation of the tumour mass and adjacent mucosa differentiation. i-scan 2 (SE and TE) improved visualisation of vascular components of the mass and i-scan 3 (SE and TE) showed the absence of neovascularisation on normal adjacent mucosa, allowing a better characterisation of the lesion.

Patient outcome and follow-up

Biopsy of the mass in the apical RUL segment showed non-small cell carcinoma, with intense necrosis. Intense necrosis suggests that it is a squamous cell carcinoma, but the immunohistochemical phenotype corresponds to an adenocarcinoma.

The patient was referred to medical oncology to start systemic chemotherapy, combined with radiotherapy of the primary tumor and cranial radiotherapy.

Summary

HD+ clearly demarked the tumour from the adjacent mucosa, allowing better appreciation of the endoscopic tumour boundaries. i-scan 1 (SE) and especially i-scan 2 (SE and TE) and i-scan 3 (SE and TE), enhanced the visualisation of vascular components of neovascularisation and allowed better treatment.

Image 1:

Visualisation with i-scan 1 (SE) of exophytic, smooth and hypervascular mass, occludes the apical segmental bronchus of the right upper lobe bronchus from its origin.



Image 2:

i-scan 2 (SE and TE) better demarcates vascular components of the hypervascular mass.



Image 3:

Characterisation of the bronchial mucosa using i-scan 3 (SE and TE).



Dr. Javier Cosano

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NSCLC-Squamous cell carcinoma with i-scan

Patient history

A 70 year old male with no clinical history was referred to our centre for worsening dyspnoea with respiratory failure. A chest CT scan showed a solid right hilar mass with mediastinal adenopathy, which causes compression of the trachea, right main bronchus and upper lobe bronchus.

Endoscopic findings

With HD+ white light imaging, a reduction in calibre of the distal third of the trachea was observed and a neoplastic obstruction was detected at the origin of the right main bronchus. An endobronchial biopsy was performed.

The i-scan 1 (SE) showed an irregular surface without necrosis. Using i-scan 2 (SE and TE), great value is added to the vascularisation, enhancing a small vascular lesion of the anterior wall of the right main bronchus.

With i-scan 3 (SE and TE), the proximal extension of the lesion is better defined.

Patient outcome and follow-up

We proceeded with laser assisted mechanical resection with rigid bronchoscopy of the endobronchial mass under general anaesthesia. A Y tracheobronchial silicon stent was then placed to guarantee airway patency.

Right after treatment, respiratory failure was solved and the patient experienced a great subjective benefit.

The mass was histologically defined as a squamous cell carcinoma of the lung.

Summary

Great emphasis to margins and extension of malignant lesion is given with HD+ and i-scan enhancements.

Image 1:

Neoplastic obstruction in the right main bronchus; image with i-scan 1 (SE).



Image 2:

Vascularisation of the neoplastic lesion with i-scan 2 (SE and TE).

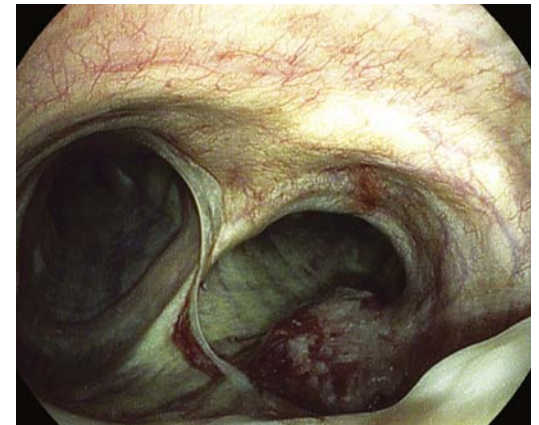


Image 3:

Definition of the proximal extension of the lesion with i-scan 3 (SE and TE).



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