Bronchial Thermoplasty in severe asthma
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CHAPTER 10

Radiological abnormalities following Bronchial Thermoplasty: pathophysiology understood?

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To the editor:

We read with great interest the paper by Debray et al, reporting on early radiological lung abnormalities on computed tomography (CT) of the chest after bronchial thermoplasty (BT) [1]. The described findings in 13 patients are in line with our observations in 12 patients with severe asthma treated with BT in the TASMA trial [Clin.Trials.gov nr:NCT02225392]. Transient radiological abnormalities were seen after all 36 BT procedures predominantly consisting of peribronchial consolidations with ground glass opacities (Figure 1A and C), partial occlusions/filling of bronchial lumen and atelectasis. Furthermore, we also observed a residual bronchial dilatation in a single case [2].

In contrast to the results of Debray et al, atelectasis directly after BT was less frequently observed in our patient cohort (38% versus 68% of the BT procedures). We systematically scored endobronchial abnormalities before and immediately after BT by asking the bronchoscopist to score mucosal injury by grading for bronchial edema, inflammatory aspect, secretions, mucus plugging and bleeding using a 0-3 intensity score for each item (0= no abnormalities; 1= minimal-; 2= moderate-; 3= severe- intensity of abnormality). Grading was performed directly after the BT procedure by the interventional pulmonologist (JTA or PIB). In the patients that were evaluated with a chest CT scan immediately after BT (n=16) a significant higher median mucosal injury score was seen in patients with atelectasis as compared to patients without atelectasis [8 (7-8 IQR) versus 6 (5-6.25 IQR) (p=0.0156) respectively]. No significant difference was observed between the number of activations and the presence of atelectasis. Considering the above, the observed difference in the occurrence of atelectasis directly after BT might be related to the vulnerability of the mucosa as is reflected by the endobronchial mucosal injury score.

We can confirm non-BT-treated lobe involvement as described by Debray et al, although we have not observed involvement of the non-BT-treated middle lobe. For the involvement of the non-BT-treated middle lobe Debray et al provide two explanations; 1) diffusion of heat shock along the bronchial tree which might be related to the earlier reported decrease in airway smooth muscle (ASM) area in the non-BT-treated middle lobe [3] or 2) extension of heat shock through (incomplete) fissures to an adjacent lobe.

The first explanation seems unlikely since the decrease in ASM area in non-BT-treated middle lobe could not be confirmed by Pretolani et al investigating ASM decrease after BT in 15 patients [4]. Furthermore, our results show that segmental/subsegmental airways that are not reached by BT, but located adjacent and/or directly distal to BT-treated airways, showed no abnormalities on CT [2]. This observation makes the postulated explanation unlikely and suggest that
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Radiofrequent energy is not diffused along the bronchial tree to other airways. The second explanation, also supported by Boulet and Laviolette, seems a more plausible cause for the abnormalities seen in the non-BT-treated lobe as they were mostly found directly adjacent to incomplete fissures [5].

We postulate a third possible explanation for the radiological abnormalities observed in distal areas of the non-BT treated lobes. The characteristics and distribution properties of these ground glass opacities are compatible with blood, secretions and/or mucus (Figure 1B). This explanation could also explain why in all of our cases the radiological abnormalities were located in the non-BT-treated depending lower lobes only. Furthermore, this is in line with our observation that all cases with abnormalities observed in distal areas of the non-BT-treated lobes had a cumulative intensity score for mucosal bleeding, secretions and mucus after the BT procedure of ≥ 3 and all the cases without involvement of the non-BT-treated lobes had a cumulative intensity score of 1. Therefore, in our opinion, it is very likely that blood, secretions and mucus runs down from the BT treated upper lobes to the depending lower lobes and causes the observed distal areas with ground glass opacities.

In conclusion, immediate radiological abnormalities following BT are common and transient. Direct and indirect radio-frequency energy-mediated pulmonary effects that can explain these radiological abnormalities are described. In addition, the occurrence of atelectasis in BT treated lobes and the occurrence of ground glass opacities in distal areas of non-BT-treated lobes seems related to the severity of endobronchial mucosal injury directly after BT.

Figure 1. Radiological abnormalities seen in the BT-treated upper and non-BT-treated lower lobe. ULD (ultra-low dose) chest CT <24 hours after BT treatment of both upper lobes shows ground glass opacities (cross) restricted to the right upper lobe with a complete fissure (arrowhead) (1A) and ground glass opacities (cross) in a distal area of the non-BT-treated right lower lobe (1B). These opacities were new since the ULD chest CT scan after the BT-treatment of the left lower lobe 3 weeks earlier showed peribronchial consolidations (arrow) with ground glass opacities (cross) in the left lower lobe, but no abnormalities of the previously treated right lower lobe (1C).
REFERENCES


