The role of computed tomography in the evaluation of pulmonary complications in children submitted to autologous and allogeneic bone marrow transplantation

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Purpose

The bone marrow transplant (BMT) is a established technique to the treatment of hematological disorders and pulmonary diseases are among the most serious post-BMT complications.Computed tomography (CT) scan plays an important role in the evaluation of patients with pulmonary symptoms in the post-transplant period, detecting pulmonary abnormalities in patients with normal radiographs, exceeding this method also in determine the pattern and extent of the injury. Although chest CT is a method of excellence, the findings may be nonspecific and the time post-BMT that the complication occurred can target the most likely diagnosis.

The first phase (until day 30) represents a period of severe neutropenia, increasing the risk of infections. However, non-infectious pulmonary complications, such as pulmonary edema and diffuse pulmonary hemorrhage are also common during this phase. During the second stage post-BMT (from 30 ° to 100 ° day) predominates viral infections, and pneumonia caused by cytomegalovirus (CMV) is very common. The third post-BMT phase (after 100 days) is characterized by chronic non-infectious diseases such as restrictive and obstructive airways diseases, including bronchiolitis obliterans and bronchiolitis obliterans with organizing pneumonia (BOOP).

Our purpose is demonstrate the importance of computed tomography (CT) in the diagnosis of pulmonary complications after autologous and allogeneic bone marrow transplantation in pediatric patients and to correlate the main CT findings of pulmonary complications with clinical and epidemiological aspects, defining the most common adverse events.
Methods and Materials

This study included 158 patients after autologous and allogeneic bone marrow transplantation from January 2008 to October 2011. Patients were selected using the medical records of the Pediatric Oncology Institute/ Support Group for Children and Adolescents with Cancer (GRAACC), Federal University of São Paulo.

The chest CT scans performed over a period of up to 6 months post-BMT were analyzed by a radiologist with experience in pediatric radiology oncology.

We evaluated the presence or absence of some CT findings as ground glass attenuation, consolidation, nodules, ground glass halo, cavitation of the nodule, tree-in-bud, pleural effusion, atelectasis, cardiomegaly, pericardial effusion and septal thickening. From these findings, we propose the most likely diagnosis between pulmonary edema, fungal, viral and bacterial, or unspecific infection, bronchiolitis obliterans and other diagnoses.
Results

The average age of the 158 patients at the time of transplantation was 10.7 years and included 60 (38.0%) female and 98 (62.0%) male patients. The allogeneic transplantation was performed in 90 (57.0%) patients, while the autologous was performed in 68 (43.0%) patients.

The most frequent underlying diseases observed among patients were leukemias (32.9%), non-Hodgkin lymphoma (15.8%), tumors of the central nervous system (10.8%), aplastic anemia (10.1%), neuroblastoma (8.9%), Ewing’s sarcoma (7.0%) and Hodgkin’s lymphoma (5.7%), and other diseases were observed in 8.9% of patients.

Of the 63 patients who developed post-transplant pulmonary complications, 55 (87.3%) underwent chest CT, while 8 (12.7%) underwent chest radiography only. Our study evaluated the main CT findings of pulmonary complications after bone marrow transplantation and excluded from inferential analyzes the eight patients who underwent chest radiography only.

The relationship between the underlying disease and type of transplant and the presence of pulmonary complications is shown below.

<table>
<thead>
<tr>
<th>Disease</th>
<th>Pulmonary Complication</th>
<th>p*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes (%)</td>
<td>No (%)</td>
</tr>
<tr>
<td>Leukemia</td>
<td>25 (15.8%)</td>
<td>27 (17.1%)</td>
</tr>
<tr>
<td>Non-Hodgkin lymphoma</td>
<td>16 (10.1%)</td>
<td>9 (5.7%)</td>
</tr>
<tr>
<td>Tumors of the CNS</td>
<td>14 (8.9%)</td>
<td>3 (1.9%)</td>
</tr>
<tr>
<td>Aplastic anemia</td>
<td>10 (6.3%)</td>
<td>6 (3.8%)</td>
</tr>
<tr>
<td>Neuroblastoma</td>
<td>12 (7.6%)</td>
<td>2 (1.3%)</td>
</tr>
<tr>
<td>Ewing’s sarcoma</td>
<td>6 (3.8%)</td>
<td>5 (3.2%)</td>
</tr>
</tbody>
</table>
The distribution of patients according to time after transplantation and diagnosis proposed is illustrated in Table 1.

The most prevalent findings on chest CT scans are illustrated in Table 2.

Based on the findings of chest CT, the most frequent proposed diagnoses were edema in 29 (52.7%) patients, fungal infection in 7 (12.7%), viral infection in 6 (10.9%), bacterial infection in 4 (7.3%), nonspecific infection in 4 (7.3%), bronchiolitis obliterans in only 2 (3.6%) and other diagnoses were observed in 3 (5.5%) patients, including bleeding and pulmonary atelectasis.

The diagnosis of pulmonary edema, fungal and bacterial infections were more common in the first 30 days post-BMT, whereas viral infection presented its peak incidence between 30 and 100 days. After 100 days, there was a predominance of infectious complications. Only 2 (3.5%) patients were diagnosed with bronchiolitis obliterans, both in the first 100 days post-BMT.

There was a statistically significant correlation between viral infection and ground glass attenuation when compared to other diagnoses (p = 0.006), as well as pleural effusion and pulmonary edema (p <0.001), consolidation and bacterial infection (p <0.001), pulmonary nodule and fungal infection or obliterative bronchiolitis (p = 0.002) and ground glass halo and fungal infection (p = 0.001).

In acute lung congestion, it is observed on chest CT ground-glass attenuation, septal thickening and pleural effusion, mostly bilateral (Figure 1 A e B).

In most fungal infections was confirmed diagnosis of angioinvasive aspergillosis. In CT, it is observed nodules surrounded by a halo with ground-glass attenuation (Figure 2A).
Another finding in *Aspergillus* infections are cavitation, which can be associated with the air crescent sign, which indicates a good response to infection (Figure 2B).

In bacterial infection, the most common findings on chest CT are areas of consolidation (Figure 3), followed by ground-glass opacities and centrilobular nodules.

Among viral infections, CMV pneumonitis is the most prevalent and the CT findings include diffuse bilateral asymmetric ground-glass attenuation and centrilobular nodules (Figure 4).
Images for this section:

Table 1: Distribution of patients according to time after transplantation and diagnosis proposed.

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Table 2: Most prevalent findings on chest CT scans.

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Fig. 1: Pulmonary edema. A) Peribronchovascular ground-glass attenuation associated with smooth septal thickening and bilateral pleural effusion. B) Further evidence of pleural effusion.

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Fig. 2: Aspergillus infection. A) Pulmonary nodules surrounded by a halo with ground-glass attenuation ("halo sign"). B) Cavitated pulmonary nodule with "air crescent sign".

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Fig. 3: Bacterial infection. Extensive area of pulmonary consolidation.

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**Fig. 4:** CMV infection. Bilateral and asymmetrical opacities with ground-glass attenuation.

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Conclusion

The etiologies related to pulmonary complications after bone marrow transplantation in our series had similarly incidence and time course to that described in the literature. A chest CT proved to be an important auxiliary method for identifying the cause of pulmonary complications. Despite the overlap of CT manifestation between the various etiologies, some findings, such as pleural effusion, ground glass attenuation, consolidation, nodules and ground glass halo, associated with time post-BMT and clinical evaluation allow a narrowing of the differential diagnosis, directing the clinical management of patients.
References


6. Worthy SA, Flint JD, Müller NL. Pulmonary complications after bone marrow transplantation: high-resolution CT and pathologic findings. Radiographics. 1997 Nov-Dec;17(6):1359-71


