Preparation of routine automated synthesis of $[^{11}C]$choline
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Introduction
$[^{11}C]$choline is a very effective PET radiopharmaceutical for the study of prostate cancer. To support the increasing demand for $[^{11}C]$choline, several different synthetic approaches have been described in the literature, including different automated production methods using remote-controlled synthesis modules [1–4]. The most popular method uses a C18 Sep-Pak as solid support for methylation and, subsequently, a CM Sep-Pak for purification [2]. We report an optimized method for producing $[^{11}C]$choline using only one CM Sep-Pak for both reaction and purification as was shown in the literature [4]. For synthesis of $[^{11}C]$choline we used two modules Tracerlab FXC for preparation of methylation reagent $[^{11}C]$CH$_3$I and GPF-101 for $[^{11}C]$choline synthesis.

Material and Methods
TracerlabFXC GE, GPF-101 Veenstra Instrument, 2-(dimethylamino)-ethanol (DMAE) ABX, Sep-Pak Light Accell Plus CM cation-exchange cartridges Waters used without conditioning, precursor 50 µL of DMAE dissolved in 25 µL of ethanol and loaded on a CM Sep-Pak. Schematic diagram of the automated system for the production of $[^{11}C]$choline is given below. $[^{11}C]$CH$_4$ was produced in two standard Nitra target IBA irradiation of mixture 90% N$_2$/10% H$_2$ with 15 MeV protons using dual beam.

Results and Conclusion
$[^{11}C]$CH$_4$ was prepared in the targets and connected with Tracerlab FXC. $[^{11}C]$CH$_3$I was prepared in a loop in which allowed to react of elemental iodine at a temperature 720 °C. Conversion to $[^{11}C]$CH$_3$I usually is around 50% uncorrected activity. Activity is within the range 15–18 GBq of $[^{11}C]$CH$_3$I and time of production 10 min. Synthesis of $[^{11}C]$choline is based on the reaction DMAE with $[^{11}C]$CH$_3$I on a Accell Plus CM cation-exchange column which serves both as a support for reaction and for separation of choline from DMAE by ethanol washing. The basic parameters are shown in TABLE 1.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beam current 2X</td>
<td>20 µA</td>
</tr>
<tr>
<td>Irradiation time</td>
<td>30 min</td>
</tr>
<tr>
<td>DMAE</td>
<td>50 µl</td>
</tr>
<tr>
<td>Synthesis time from EOB</td>
<td>25 min</td>
</tr>
<tr>
<td>Absolute yield without correction</td>
<td>6.6 GBq</td>
</tr>
<tr>
<td>Radiochemical purity</td>
<td>&gt; 99 %</td>
</tr>
<tr>
<td>Residual DMAE in product</td>
<td>&lt; 5 ppm</td>
</tr>
<tr>
<td>Ethanol</td>
<td>&lt; 1000 mg/L</td>
</tr>
<tr>
<td>pH</td>
<td>4.5–8.5</td>
</tr>
</tbody>
</table>

TABLE 1. Reaction parameters and result of production of $[^{11}C]$choline syntheses

Conclusion
We have applied a simple synthesis method for $[^{11}C]$choline preparation using automated commercial equipments with one column used both for reaction and separation purpose. The main advantage of using one column is lower contamination of the product $[^{11}C]$choline with DMAE. When for synthesis of $[^{11}C]$choline two columns C18 for synthesis and CM for separation is used, higher contamination of DMAE can be found in the product due to a release of DMAE from C18 column.

Acknowledgements
The BIONT gratefully acknowledges for receiving fund from Cancer Research Foundation, Bratislava for targets and research development.

References

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