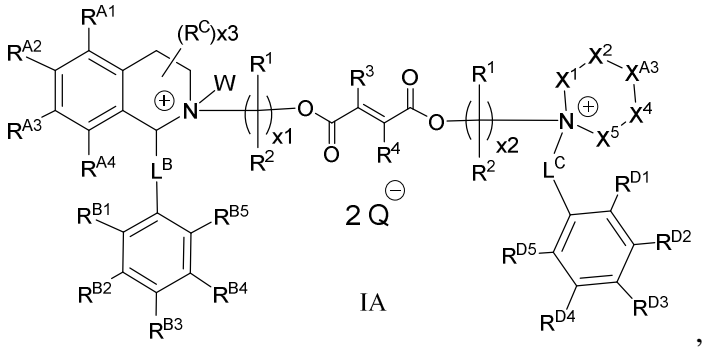
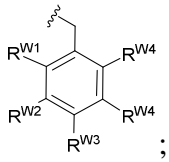
Claims

1. A compound represented by formula IA or a pharmaceutically acceptable salt thereof,



,

wherein:

W is selected from the group consisting of -C($R^aR^bR^c$) or  ;

each $Q^{\ominus}$ is independently selected from the group consisting of pharmaceutically acceptable anions;

R^3 and R^4 are each independently selected from the group consisting of hydrogen, halogen, C_{1-6} alkyl, or C_{1-6} alkoxy, wherein the C_{1-6} alkyl or C_{1-6} alkoxy is optionally substituted with one or more halogen, hydroxy, mercapto, carboxy, amino, or cyano;

L^B and L^C are each independently selected from the group consisting of -C($R^aR^bR^c$) or alkylene, wherein the alkylene is optionally substituted with one or more halogen, hydroxy, mercapto, nitro, carboxy, amino, cyano, C_{1-6} alkyl, C_{1-6} alkoxy, oxo, thioxo, or sulfonyl, and the C_{1-6} alkyl or C_{1-6} alkoxy is optionally substituted with one or more halogen, hydroxy, mercapto, carboxy, amino, or cyano;

when L^B is -C($R^aR^bR^c$), the phenyl with R^{B1} to R^{B5} substituents is absent;

when L^C is -C($R^aR^bR^c$), the phenyl with R^{D1} to R^{D5} substituents is absent;

X^{A3} is selected from the group consisting of a chemical bond, -O-, -C(R^dR^e)-, -N(R^f)-, or -$S(O)_2$-;

X^1 and X^5 are each independently -C(R^gR^h)-;

X^2 and X^4 are each independently -C(R^iR^j)-;

R^f is selected from the group consisting of hydrogen, C_{1-6} alkyl, or C_{1-6} alkoxy, wherein the C_{1-6} alkyl or C_{1-6} alkoxy is optionally substituted with one or more halogen, hydroxy, mercapto, carboxy, amino, or cyano;

R^1, R^2, R^{A1}, R^{A2}, R^{A3}, R^{A4}, R^{B1}, R^{B2}, R^{B3}, R^{B4}, R^{B5}, R^C, R^{D1}, R^{D2}, R^{D3}, R^{D4}, R^{D5}, R^{W1}, R^{W2}, R^{W3}, R^{W4}, R^{W5}, R^a, R^b, R^c, R^d, R^e, R^g, R^h, R^i, and R^j are each independently selected from the group consisting of hydrogen, halogen, hydroxy, mercapto, carboxy, amino, cyano, C_{1-6} alkyl, C_{1-6} alkoxy, -C(O)-C_{1-6} alkyl, -C(O)-C_{1-6} alkoxy, methanesulfonyl, a 3- to 10-membered carbocyclic ring, a 3- to 10-membered heterocyclic ring, a 6- to 10-membered aromatic ring, or a 5- to 10-membered heteroaromatic ring, wherein the C_{1-6} alkyl, C_{1-6} alkoxy, 3- to 10-membered carbocyclic ring, 3- to 10-membered heterocyclic ring, 6- to 10-membered aromatic ring, or 5- to 10-membered heteroaromatic ring is optionally substituted with one or more halogen, hydroxy, mercapto, carboxy, amino, or cyano,

or alternatively, one or more pairs of R^1 and R^2, R^d and R^e, R^g and R^h, or R^i and R^j together with the atoms to which they are attached form oxo, thioxo, a 3- to 10-membered carbocyclic ring, a 3- to 10-membered heterocyclic ring, a 6- to 10-membered aromatic ring, or a 5- to 10-membered heteroaromatic ring, wherein the 3- to 10-membered carbocyclic ring, 3- to 10-membered heterocyclic ring, 6- to 10-membered aromatic ring, or 5- to 10-membered heteroaromatic ring is optionally substituted with one or more halogen, hydroxy, mercapto, carboxy, amino, cyano, C_{1-6} alkyl, or C_{1-6} alkoxy, and the C_{1-6} alkyl or C_{1-6} alkoxy is optionally substituted with one or more halogen, hydroxy, mercapto, carboxy, amino, or cyano,

or alternatively, R^g and R^i together with the atoms to which they are attached form a 3- to 10-membered carbocyclic ring, a 3- to 10-membered heterocyclic ring, a 6- to 10-membered aromatic ring, or a 5- to 10-membered heteroaromatic ring, wherein the 3- to 10-membered carbocyclic ring, 3- to 10-membered heterocyclic ring, 6- to 10-membered aromatic ring, or 5- to 10-membered heteroaromatic ring is optionally substituted with one or more halogen, hydroxy, mercapto, carboxy, amino, cyano, C_{1-6} alkyl, or C_{1-6} alkoxy, and the C_{1-6} alkyl or C_{1-6} alkoxy is optionally substituted with one or more halogen, hydroxy, mercapto, carboxy, amino, or cyano,

or alternatively, any two adjacent groups of R^{A1}, R^{A2}, R^{A3}, and R^{A4} together form methylenedioxy, ethylenedioxy, or -CH_2-O-CH_2-,

or alternatively, any two adjacent groups of R^{B1}, R^{B2}, R^{B3}, R^{B4}, and R^{B5} together form methylenedioxy, ethylenedioxy, or -CH_2-O-CH_2-,

or alternatively, any two adjacent groups of R^{D1}, R^{D2}, R^{D3}, R^{D4}, and R^{D5} together form methylenedioxy, ethylenedioxy, or -CH_2-O-CH_2-,

or alternatively, any two adjacent groups of R^{W1}, R^{W2}, R^{W3}, R^{W4}, and R^{W5} together form methylenedioxy, ethylenedioxy, or -CH_2-O-CH_2-;

when X^{A3} is selected from the group consisting of a chemical bond or -$C(R^dR^e)$-,

(i) R^d and R^e cannot both be hydrogen, or alternatively,

(ii) one or more pairs of R^d and R^e, R^g and R^h, or R^i and R^j together with the atoms to which they are attached form oxo, thioxo, a 3- to 10-membered carbocyclic ring, a 3- to 10-membered heterocyclic ring, a 6- to 10-membered aromatic ring, or a 5- to 10-membered heteroaromatic ring, wherein the 3- to 10-membered carbocyclic ring, 3- to 10-membered heterocyclic ring, 6- to 10-membered aromatic ring, or 5- to 10-membered heteroaromatic ring is optionally substituted with one or more halogen, hydroxy, mercapto, carboxy, amino, cyano, C_{1-6} alkyl, or C_{1-6} alkoxy, and the C_{1-6} alkyl or C_{1-6} alkoxy is optionally substituted with one or more halogen, hydroxy, mercapto, carboxy, amino, or cyano, or alternatively,

(iii) R^g and R^i together with the atoms to which they are attached form a 3- to 10-membered carbocyclic ring, a 3- to 10-membered heterocyclic ring, a 6- to 10-membered aromatic ring, or a 5- to 10-membered heteroaromatic ring, wherein the 3- to 10-membered carbocyclic ring, 3- to 10-membered heterocyclic ring, 6- to 10-membered aromatic ring, or 5- to 10-membered heteroaromatic ring is optionally substituted with one or more halogen, hydroxy, mercapto, carboxy, amino, cyano, C_{1-6} alkyl, or C_{1-6} alkoxy, and the C_{1-6} alkyl or C_{1-6} alkoxy is optionally substituted with one or more halogen, hydroxy, mercapto, carboxy, amino, or cyano;

when X^{A3} is -O-,

(i) one or both pairs of R^g and R^h or R^i and R^j together with the atoms to which they are attached form oxo, thioxo, a 3- to 10-membered carbocyclic ring, a 3- to 10-membered heterocyclic ring, a 6- to 10-membered aromatic ring, or a 5- to 10-membered heteroaromatic ring, wherein the 3- to 10-membered carbocyclic ring, 3- to 10-membered heterocyclic ring, 6- to 10-membered aromatic ring, or 5- to 10-membered heteroaromatic ring is optionally substituted with one or more halogen, hydroxy, mercapto, carboxy, amino, cyano, C_{1-6} alkyl, or C_{1-6} alkoxy, and the C_{1-6} alkyl or C_{1-6} alkoxy is optionally substituted with one or more halogen, hydroxy, mercapto, carboxy, amino, or cyano, or alternatively,

(ii) R^g and R^i together with the atoms to which they are attached form a 3- to 10-membered carbocyclic ring, a 3- to 10-membered heterocyclic ring, a 6- to 10-membered aromatic ring, or a 5- to 10-membered heteroaromatic ring, wherein the 3- to 10-membered carbocyclic ring, 3- to 10-membered heterocyclic ring, 6- to 10-membered aromatic ring, or 5- to 10-membered heteroaromatic ring is optionally substituted with one or more halogen, hydroxy, mercapto, carboxy, amino, cyano, C_{1-6} alkyl, or C_{1-6} alkoxy, and the C_{1-6} alkyl or C_{1-6} alkoxy is optionally substituted with one or more halogen, hydroxy, mercapto, carboxy, amino, or cyano;

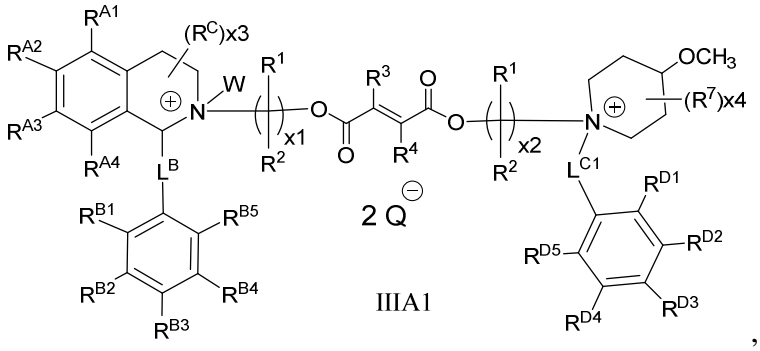
x1 is selected from the group consisting of 1, 2, 3, 4, 5, or 6;

x2 is selected from the group consisting of 1, 2, 3, 4, 5, or 6; and

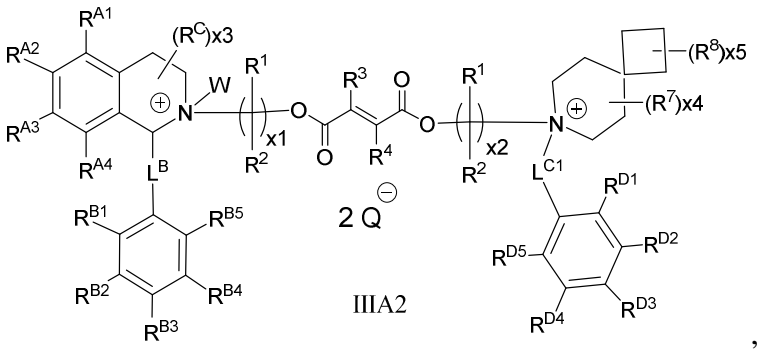
x3 is selected from the group consisting of 0, 1, 2, 3, 4, or 5.

2. The compound or the pharmaceutically acceptable salt thereof according to claim 1, wherein X^{A3} is selected from the group consisting of a chemical bond, $-C(R^dR^e)-$, or $-S(O)_2-$, wherein R^d and R^e are as defined in claim 1.

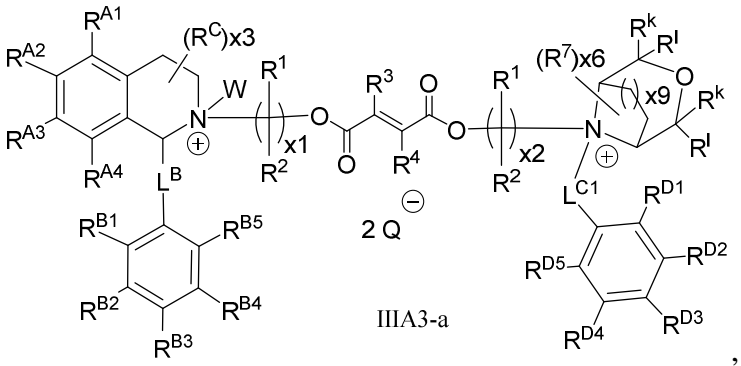
3. The compound or the pharmaceutically acceptable salt thereof according to claim 1 or 2, wherein the compound represented by formula IA is selected from the group consisting of the compound represented by formula IIIA1, formula IIIA2, formula IIIA3, formula IIIA4, or formula IIIA5, or a pharmaceutically acceptable salt thereof,



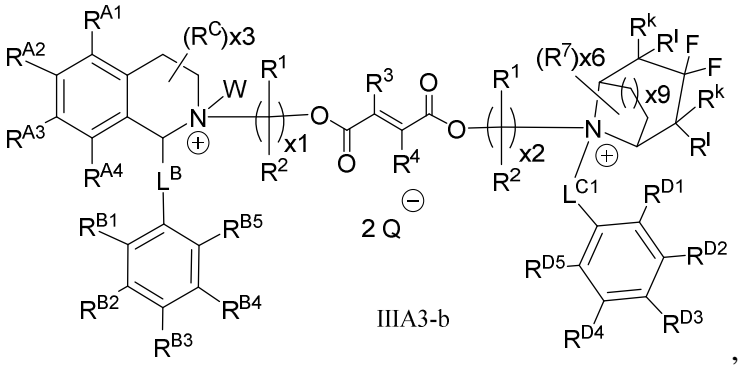
IIIA1 ,



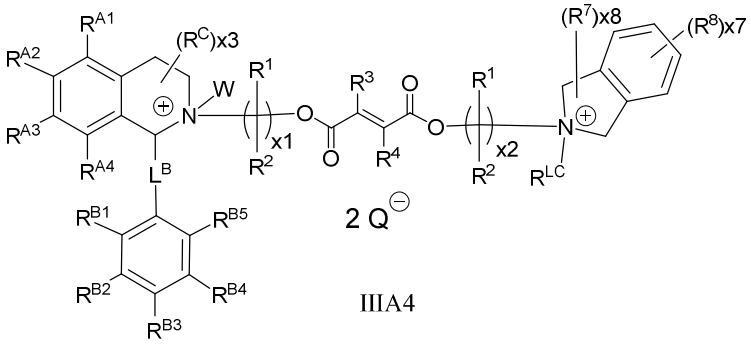
IIIA2 ,



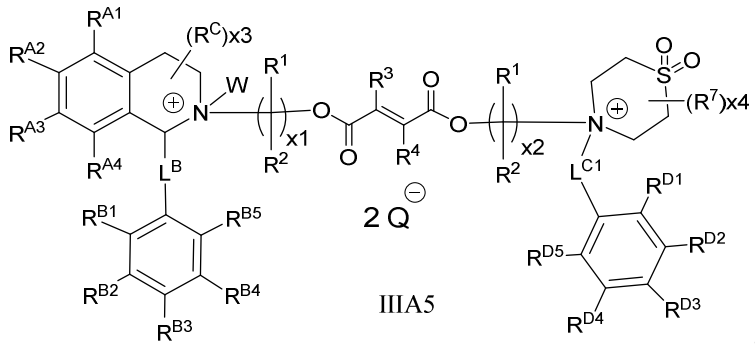
IIIA3-a ,



IIIA3-b ,



IIIA4 , or



IIIA5

, wherein

R^k and R^l are each independently selected from the group consisting of hydrogen, halogen, hydroxy, mercapto, carboxy, amino, cyano, C_{1-6} alkyl, C_{1-6} alkoxy, -C(O)-C_{1-6} alkyl, -C(O)-C_{1-6} alkoxy, methanesulfonyl, a 3- to 10-membered carbocyclic ring, a 3- to 10-membered heterocyclic ring, a 6- to 10-membered aromatic ring, or a 5- to 10-membered heteroaromatic ring, wherein the C_{1-6} alkyl, C_{1-6} alkoxy, 3- to 10-membered carbocyclic ring, 3- to 10-membered heterocyclic ring, 6- to 10-membered aromatic ring, or 5- to 10-membered heteroaromatic ring is optionally substituted with one or more halogen, hydroxy, mercapto, carboxy, amino, or cyano,

or alternatively, R^k and R^l together with the atoms to which they are attached form oxo, thioxo, a 3- to 10-membered carbocyclic ring, a 3- to 10-membered heterocyclic ring, a 6- to 10-membered aromatic ring, or a 5- to 10-membered heteroaromatic ring, wherein the 3- to 10-membered carbocyclic ring, 3- to 10-membered heterocyclic ring, 6- to 10-membered aromatic ring, or 5- to 10-membered heteroaromatic ring is optionally substituted with one or more halogen, hydroxy, mercapto, carboxy, amino, cyano, C_{1-6} alkyl, or C_{1-6} alkoxy, and the C_{1-6} alkyl or C_{1-6} alkoxy is optionally substituted with one or more halogen, hydroxy, mercapto, carboxy, amino, or cyano;

L^{C1} is alkylene, wherein the alkylene is optionally substituted with one or more halogen, hydroxy, mercapto, nitro, carboxy, amino, cyano, C_{1-6} alkyl, C_{1-6} alkoxy, oxo, thioxo, or sulfonyl, and the C_{1-6} alkyl or C_{1-6} alkoxy is optionally substituted with one or more halogen, hydroxy, mercapto, carboxy, amino, or cyano;

R^{LC} is C_{1-6} alkyl, wherein the C_{1-6} alkyl is optionally substituted with one or more halogen, hydroxy, mercapto, carboxy, amino, or cyano;

R^7 and R^8 are each independently selected from the group consisting of hydrogen, halogen, hydroxy, mercapto, carboxy, amino, cyano, C_{1-6} alkyl, C_{1-6} alkoxy, -C(O)-C_{1-6} alkyl, -C(O)-C_{1-6} alkoxy, methanesulfonyl, a 3- to 10-membered

carbocyclic ring, a 3- to 10-membered heterocyclic ring, a 6- to 10-membered aromatic ring, or a 5- to 10-membered heteroaromatic ring, wherein the C_{1-6} alkyl, C_{1-6} alkoxy, 3- to 10-membered carbocyclic ring, 3- to 10-membered heterocyclic ring, 6- to 10-membered aromatic ring, or 5- to 10-membered heteroaromatic ring is optionally substituted with one or more halogen, hydroxy, mercapto, carboxy, amino, or cyano;

each x4 is independently selected from the group consisting of 0, 1, 2, 3, 4, 5, 6, 7, or 8;

x5 is selected from the group consisting of 0, 1, 2, 3, or 4;

each x6 is independently selected from the group consisting of 0, 1, 2, 3, 4, 5, or 6;

x7 is selected from the group consisting of 0, 1, 2, 3, or 4;

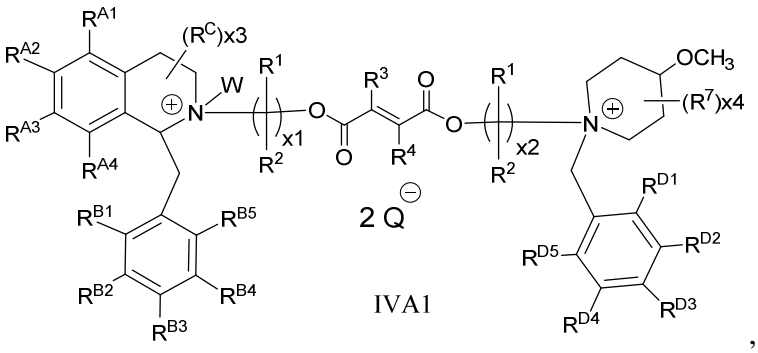
x8 is selected from the group consisting of 0, 1, 2, 3, or 4;

x9 is selected from the group consisting of 0, 1, 2, or 3;

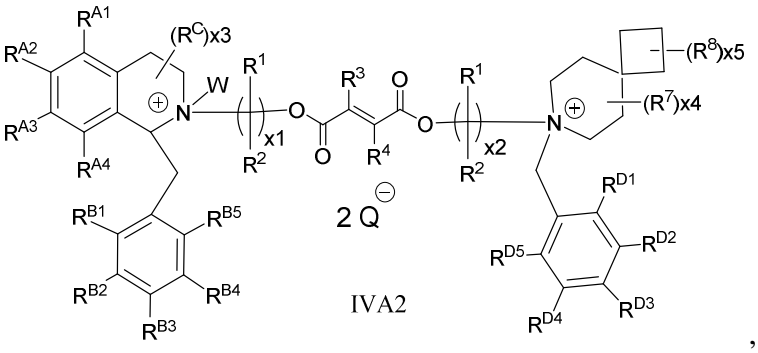
W, $Q^{\ominus}$, L^B, R^1, R^2, R^3, R^4, R^{A1}, R^{A2}, R^{A3}, R^{A4}, R^{B1}, R^{B2}, R^{B3}, R^{B4}, R^{B5}, R^C, R^{D1}, R^{D2}, R^{D3}, R^{D4}, R^{D5}, x1, x2, and x3 are as defined in claim 1.

4. The compound or the pharmaceutically acceptable salt thereof according to any one of claims 1 to 3, wherein each L^B or each L^{C1} is independently selected from the group consisting of a chemical bond or C_{1-6} alkylene, preferably a chemical bond, methylene, ethylene, or propylene, preferably methylene.

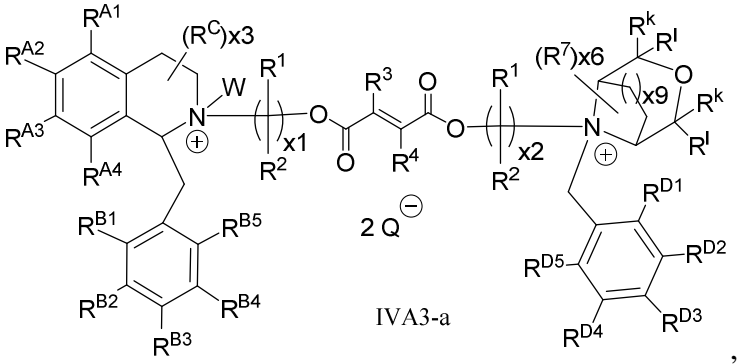
5. The compound or the pharmaceutically acceptable salt thereof according to any one of claims 1 to 8, wherein the compound represented by formula IA is selected from the group consisting of the compound represented by formula IVA1, formula IVA2, formula IVA3-a, formula IVA3-b, formula IVA4, or formula IVA5, or a pharmaceutically acceptable salt thereof,



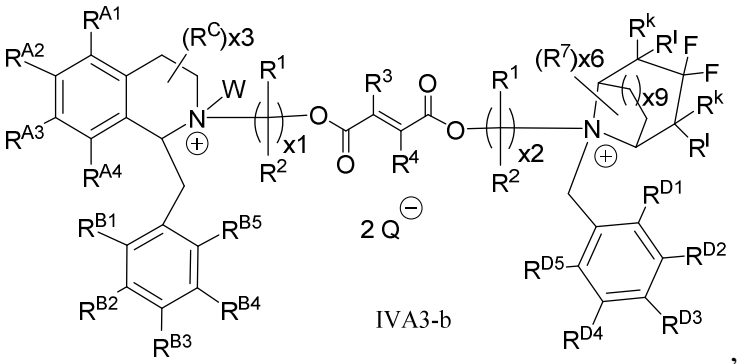
IVA1 ,



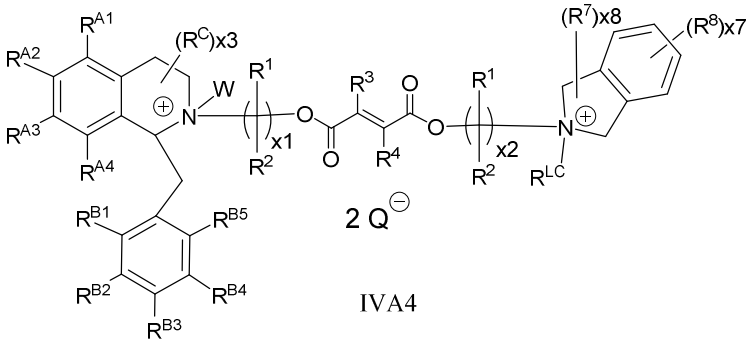
IVA2 ,



IVA3-a ,

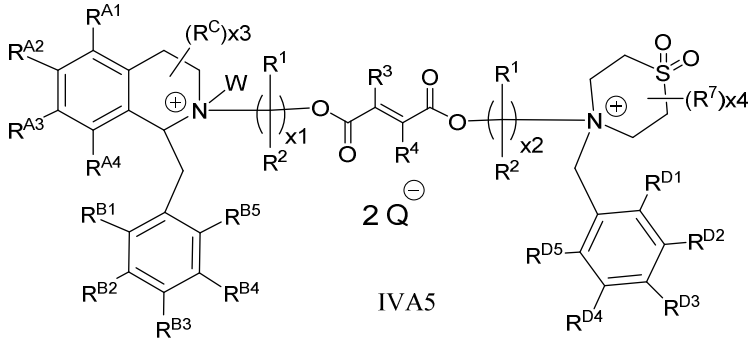


IVA3-b ,



IVA4

, or



IVA5

, wherein

W, $Q^{\ominus}$, R^1, R^2, R^3, R^4, R^{A1}, R^{A2}, R^{A3}, R^{A4}, R^{B1}, R^{B2}, R^{B3}, R^{B4}, R^{B5}, R^C, R^{D1}, R^{D2}, R^{D3}, R^{D4}, R^{D5}, x1, x2, and x3 are as defined in claim 1, R^k, R^l, R^{LC}, R^7, R^8, x4, x5, x6, x7, x8, and x9 are as defined in claim 3.

6. The compound or the pharmaceutically acceptable salt thereof according to any one of claims 1 to 5, wherein R^{A1}, R^{A4}, R^{B1}, R^{B2}, R^{B5}, R^{D1}, R^{D4}, and R^{D5} are all hydrogen.

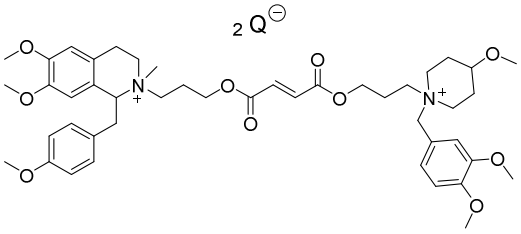
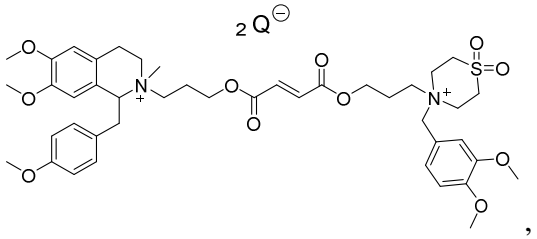
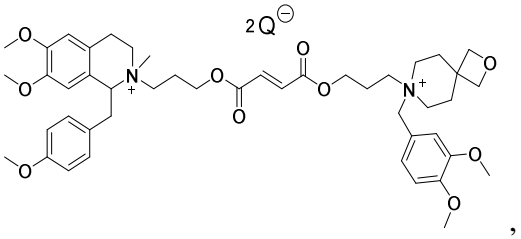
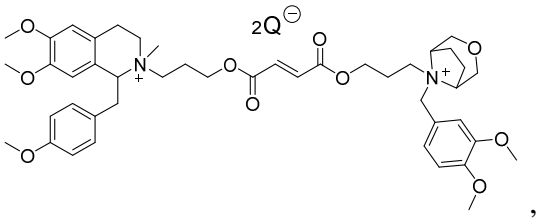
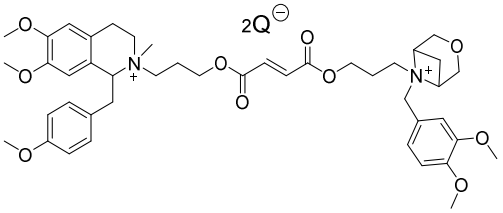
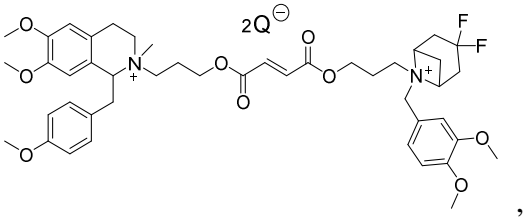
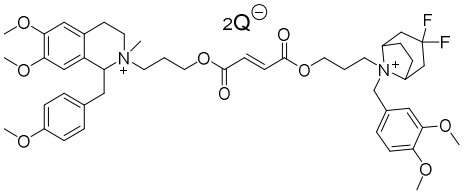
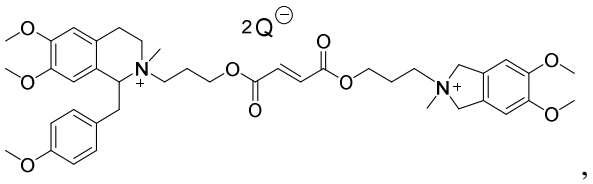
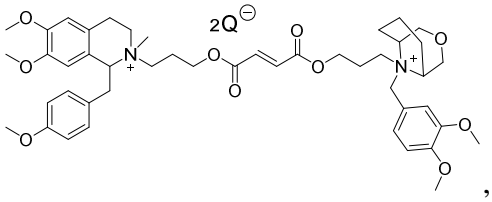
7. The compound or the pharmaceutically acceptable salt thereof according to any one of claims 1 to 6, wherein R^{A2}, R^{A3}, R^{B3}, and R^{B4} are each independently selected from the group consisting of hydrogen or C_{1-6} alkoxy, preferably hydrogen, methoxy, ethoxy, or propoxy, and most preferably hydrogen or methoxy.

8. The compound or the pharmaceutically acceptable salt thereof according to any one of claims 1 to 7, wherein W is methyl.

9. The compound or the pharmaceutically acceptable salt thereof according to any one of claims 1 to 8, wherein R^{D2} and R^{D3} are each independently selected from the group consisting of hydrogen, halogen, -C(O)-C_{1-6} alkyl, C_{1-6}

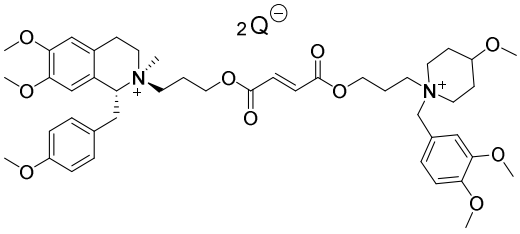
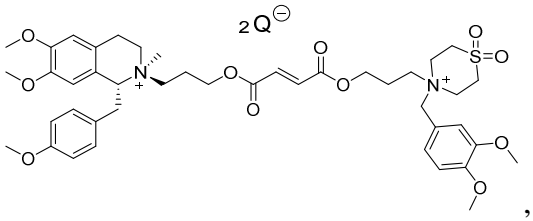
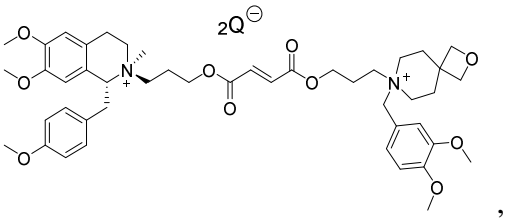
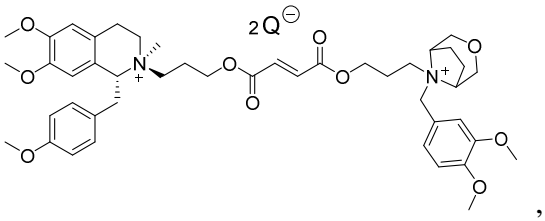
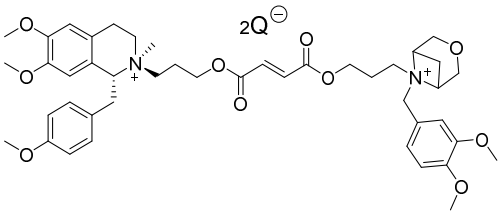
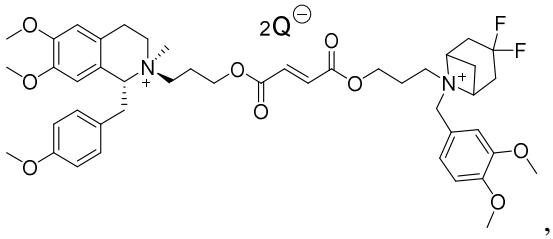
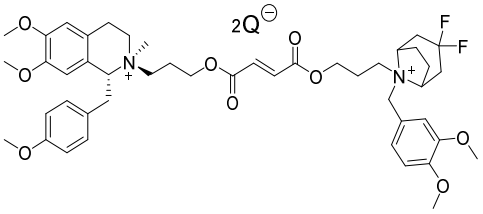
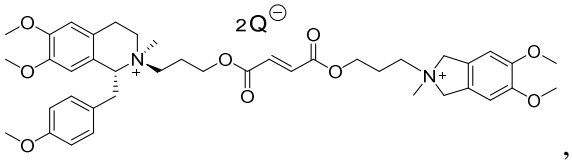
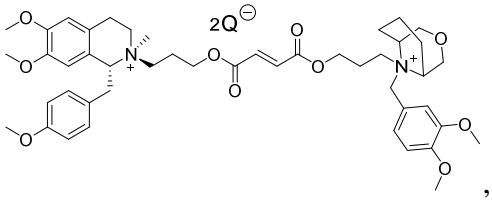
alkoxy, or methanesulfonyl, preferably hydrogen, fluorine, chlorine, bromine, iodine, -C(O)-methyl, -C(O)-ethyl, methoxy, ethoxy, or methanesulfonyl, and most preferably hydrogen, fluorine, bromine, -C(O)-ethyl, methoxy, or methanesulfonyl.

10. The compound represented by formula IA or the pharmaceutically acceptable salt thereof, selected from the group consisting of the following compounds or pharmaceutically acceptable salts thereof,


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or , wherein

$Q^{\ominus}$ is as defined in claim 1.

11. The compound represented by formula IA or the pharmaceutically acceptable salt thereof, selected from the group consisting of the following compounds or pharmaceutically acceptable salts thereof,

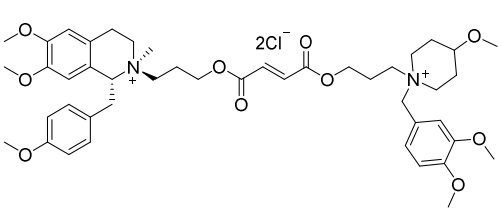

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or
, wherein

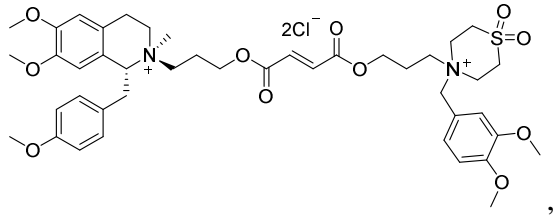
$Q^{\ominus}$ is as defined in claim 1.

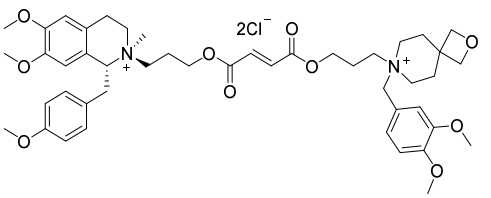
12. The compound or the pharmaceutically acceptable salt thereof according to any one of claims 1 to 11, wherein each $Q^{\ominus}$ is independently selected from the group consisting of halide ions, acetate, formate, benzoate, benzenesulfonate, camphorsulfonate, citrate, ethanedisulfonate, fumarate, glucoheptonate, gluconate, glucuronate, isethionate, lactate, lactobionate, lauryl sulfate, malate, maleate, methanesulfonate, naphthoate, naphthalenesulfonate, nitrate, stearate, oleate, oxalate, pamoate, phosphate, hydrogen phosphate, dihydrogen phosphate, polygalacturonate, succinate, sulfate, sulfosalicylate, tartrate, toluenesulfonate, or trifluoroacetate, preferably chloride ion, bromide ion, fluoride

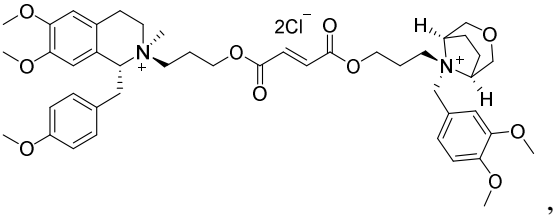
ion, iodide ion, trifluoroacetate, formate, methanesulfonate, or benzenesulfonate, and most preferably chloride ion, bromide ion, trifluoroacetate, formate, methanesulfonate, or benzenesulfonate.

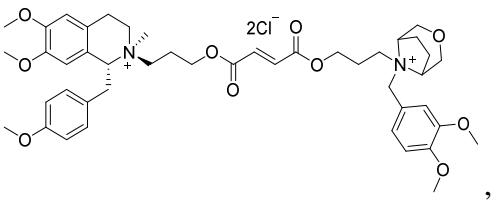
13. The compound represented by formula IA or the pharmaceutically acceptable salt thereof, selected from the group consisting of the following compounds or pharmaceutically acceptable salts thereof,

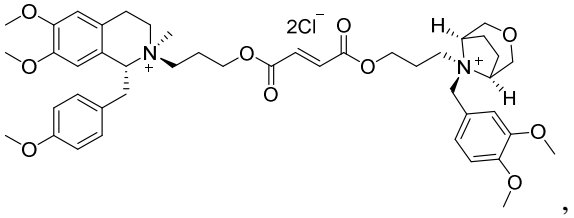


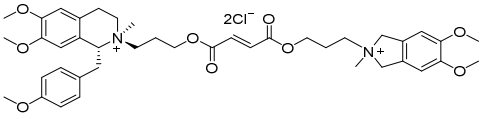
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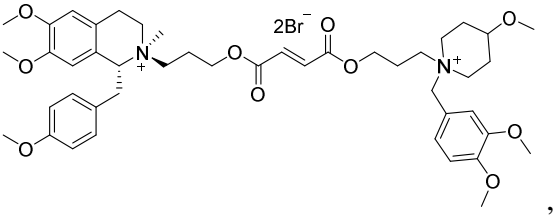
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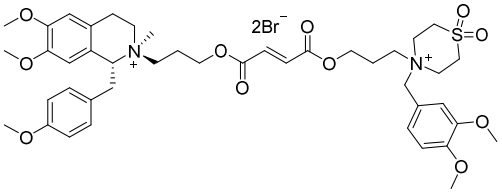
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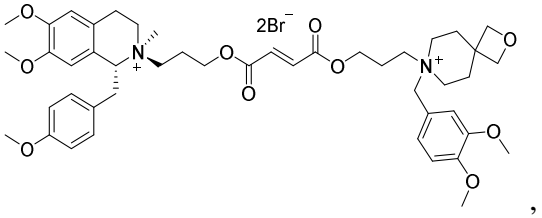
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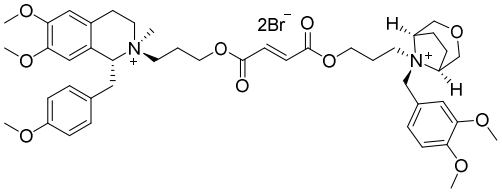
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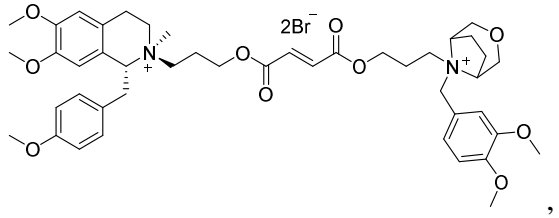
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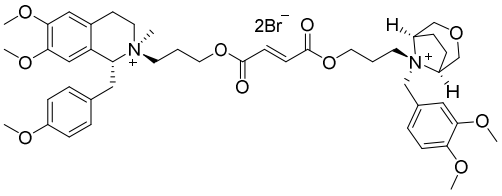
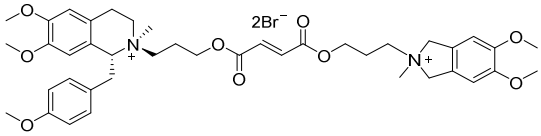
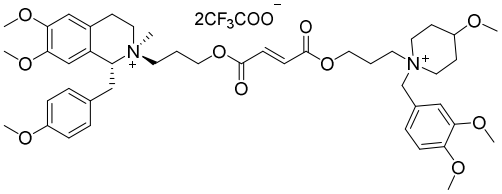
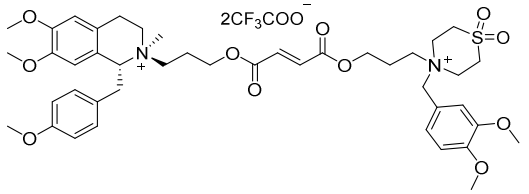
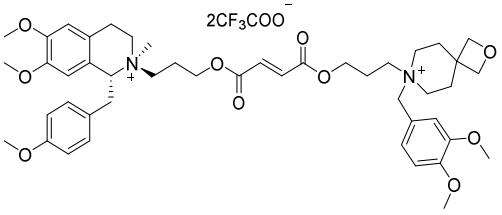
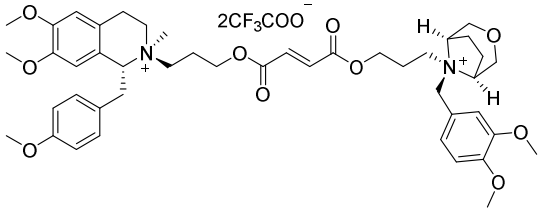
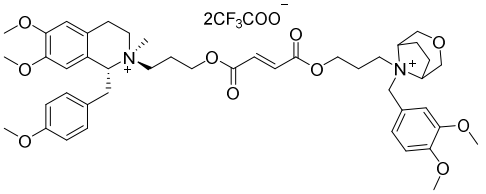
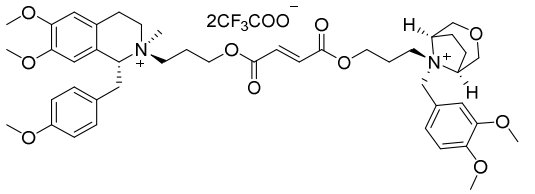
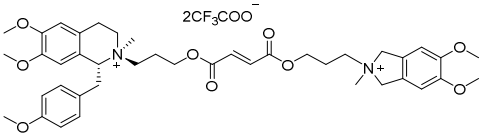
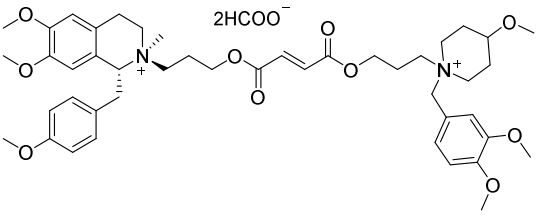
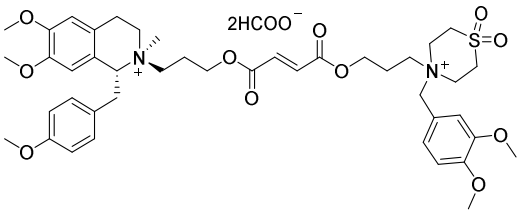
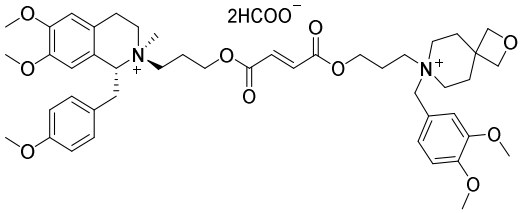
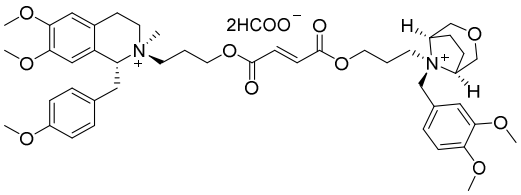
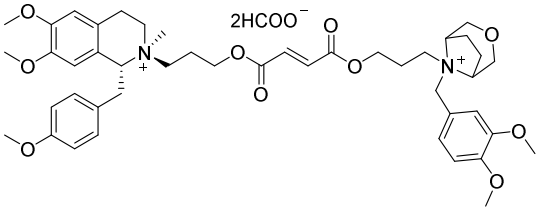
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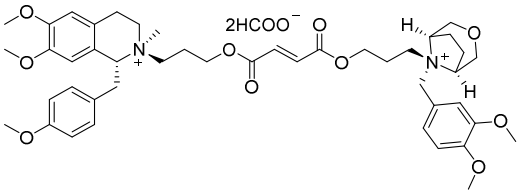
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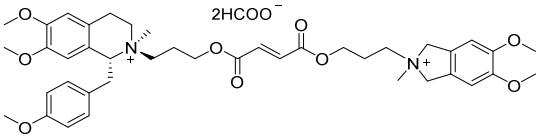
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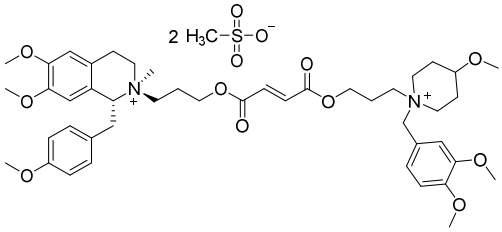
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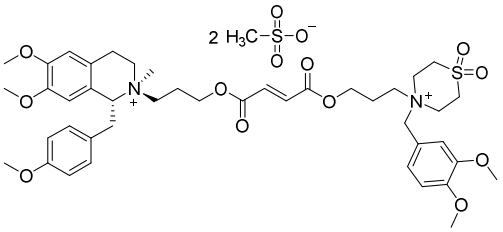
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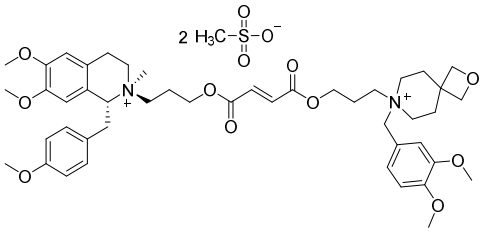

2Br⁻
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2Br⁻
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2CF3COO⁻
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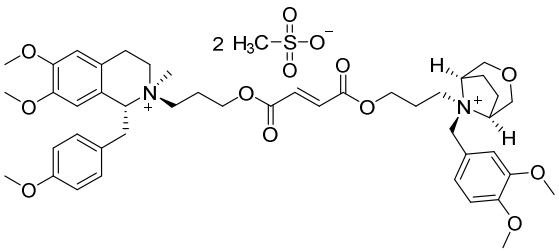

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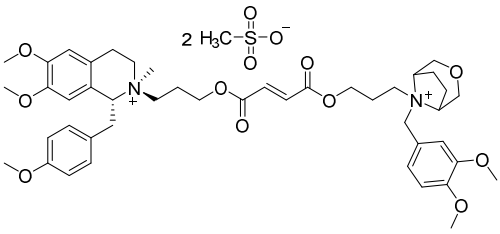

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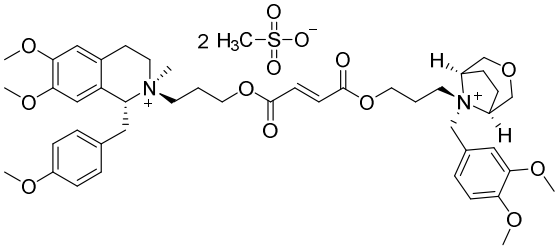

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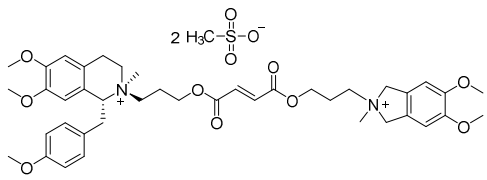

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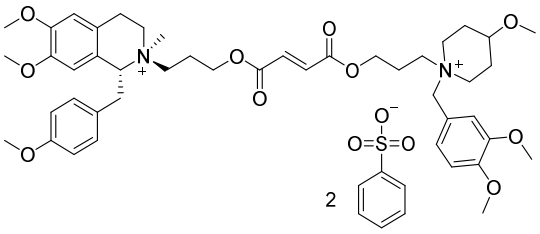

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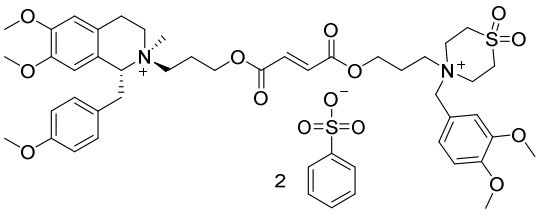
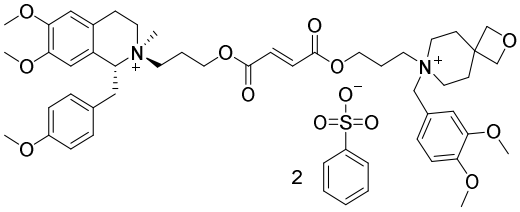
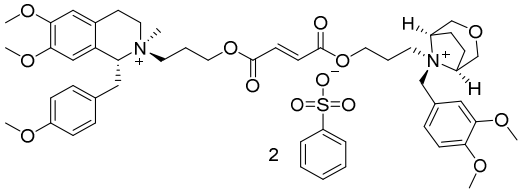
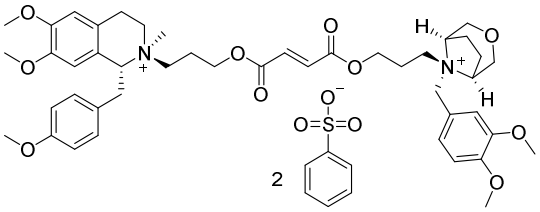
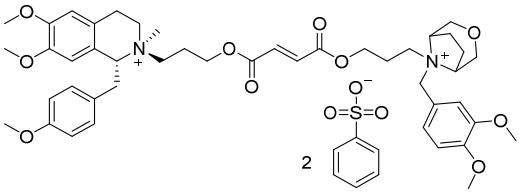
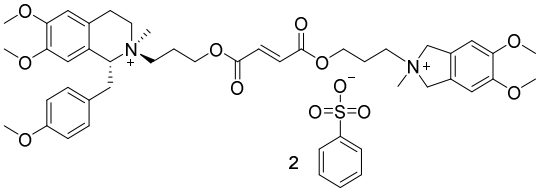
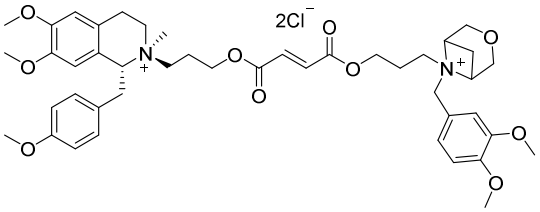
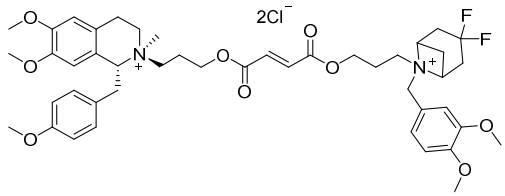
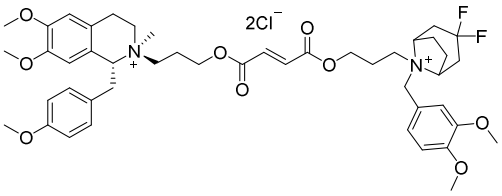
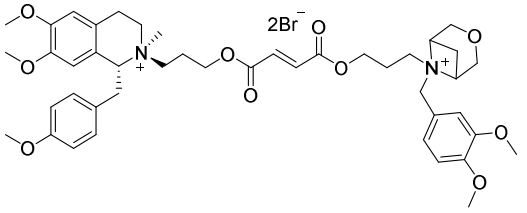
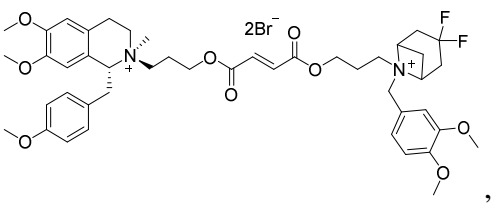
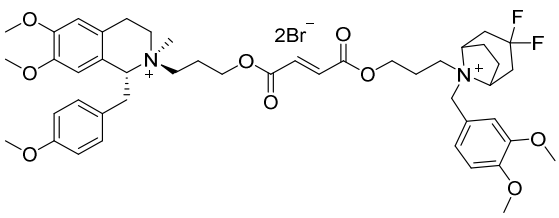

2 H3C–S–O⁻
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2 H3C–S–O⁻
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2 H3C–S–O⁻
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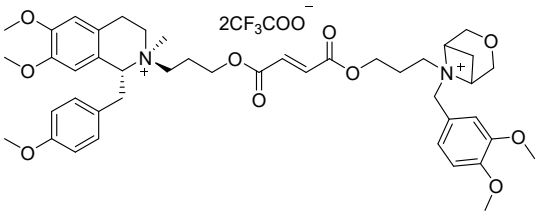

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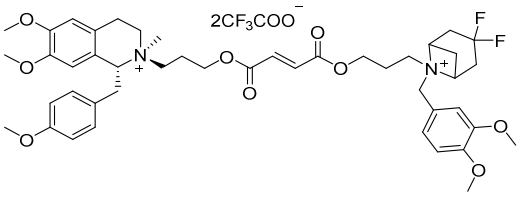

O=S=O
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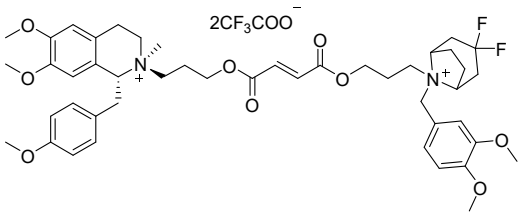

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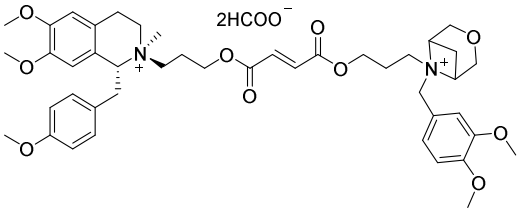
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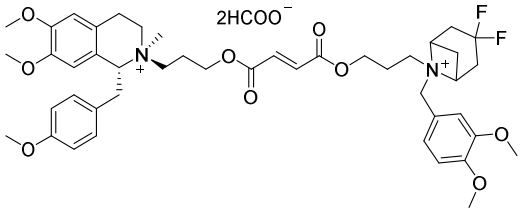
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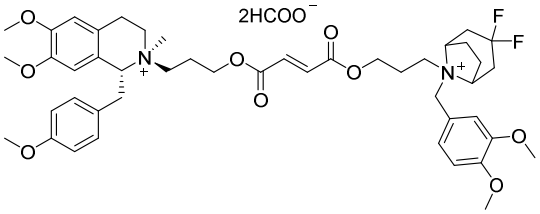

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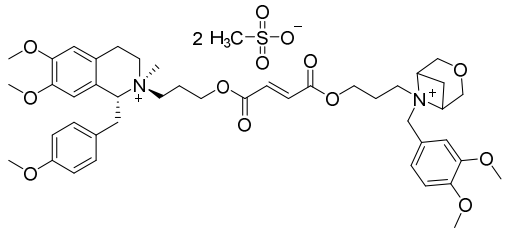

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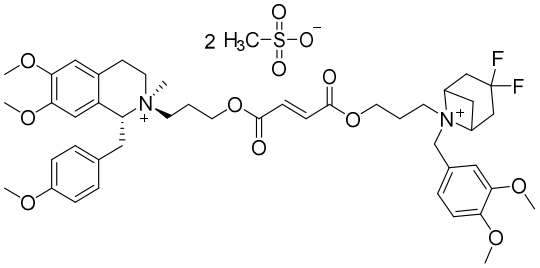

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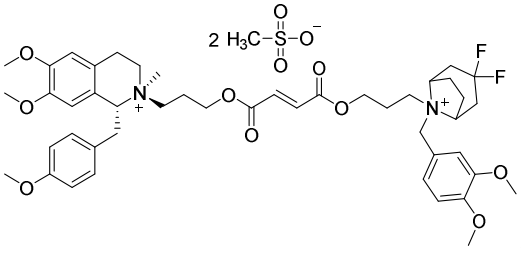

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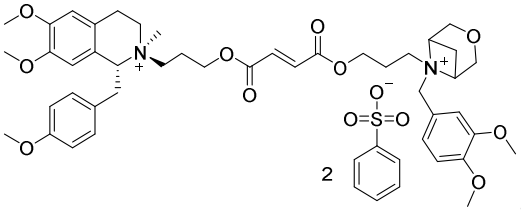

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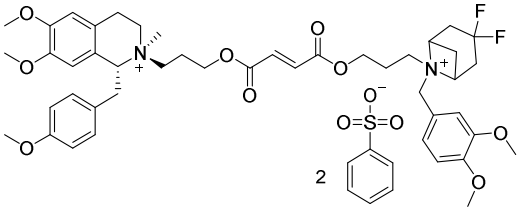

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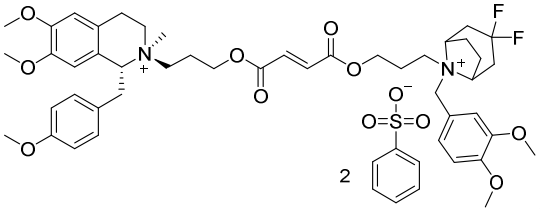

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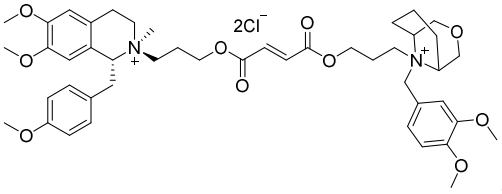

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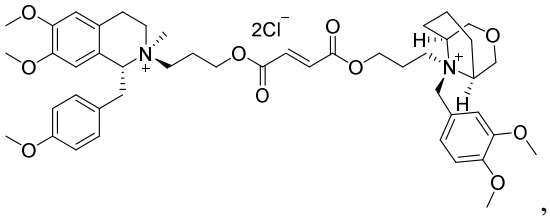

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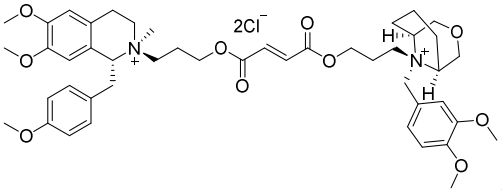

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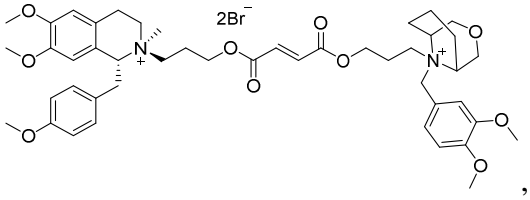

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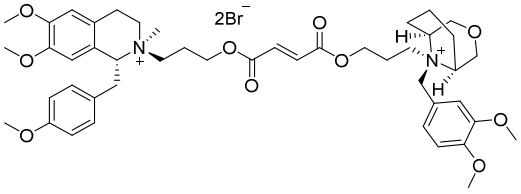

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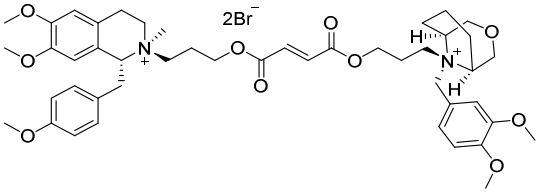

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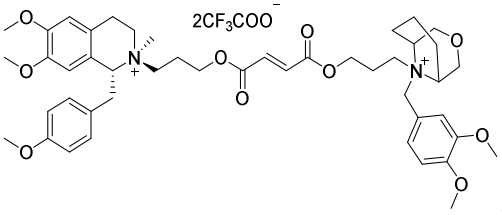

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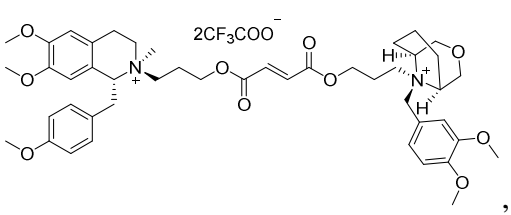

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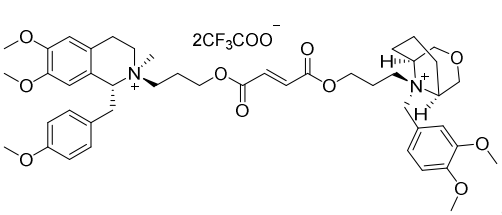

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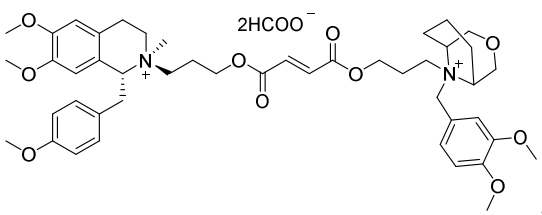

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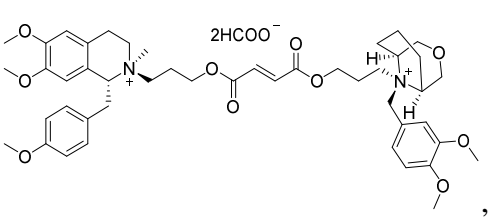

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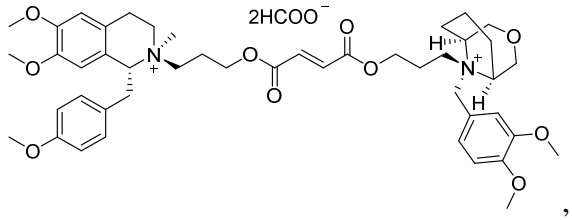

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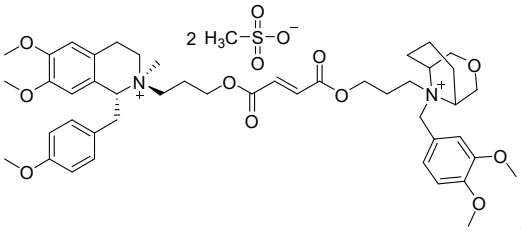

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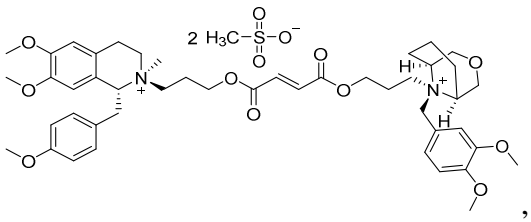

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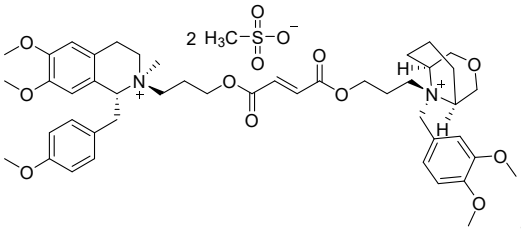

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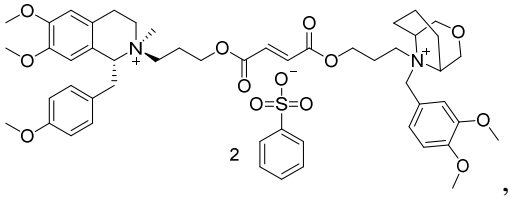


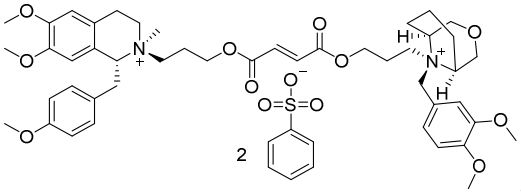
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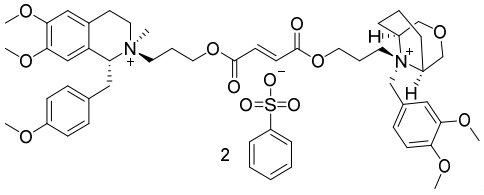
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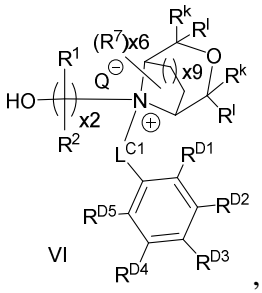
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14. An isotopically substituted compound of the compound or the pharmaceutically acceptable salt thereof according to any one of claims 1 to 13, wherein preferably, the isotopically substituted compound is a deuterated compound.

15. A pharmaceutical composition comprising a therapeutically effective amount of at least one of the compound or the pharmaceutically acceptable salt thereof according to any one of claims 1 to 13, or the isotopically substituted compound according to claim 14, and a pharmaceutically acceptable excipient.

16. Use of the compound or the pharmaceutically acceptable salt thereof according to any one of claims 1 to 13, or the isotopically substituted compound according to claim 14, or the pharmaceutical composition according to claim 15 in the manufacture of a medicament for neuromuscular blockade.

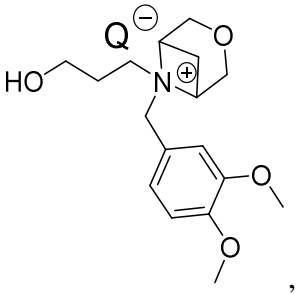
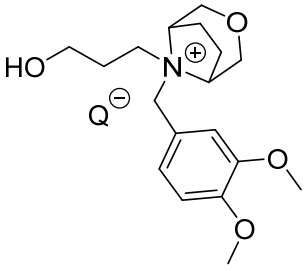
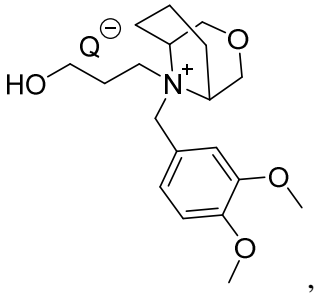
17. A compound represented by formula VI or a pharmaceutically acceptable salt thereof,



VI ,

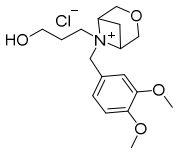
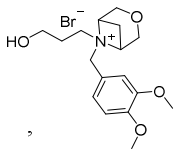
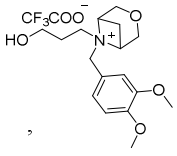
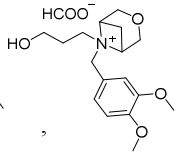
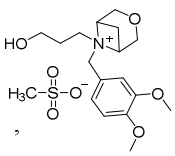
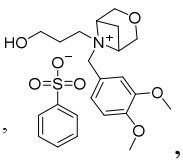
wherein $Q^{\ominus}$, R^1, R^2, R^{D1}, R^{D2}, R^{D3}, R^{D4}, and R^{D5} are as defined in claim 1, R^k, R^l, R^7, L^{C1}, x2, x6, and x9 are as defined in claim 3.

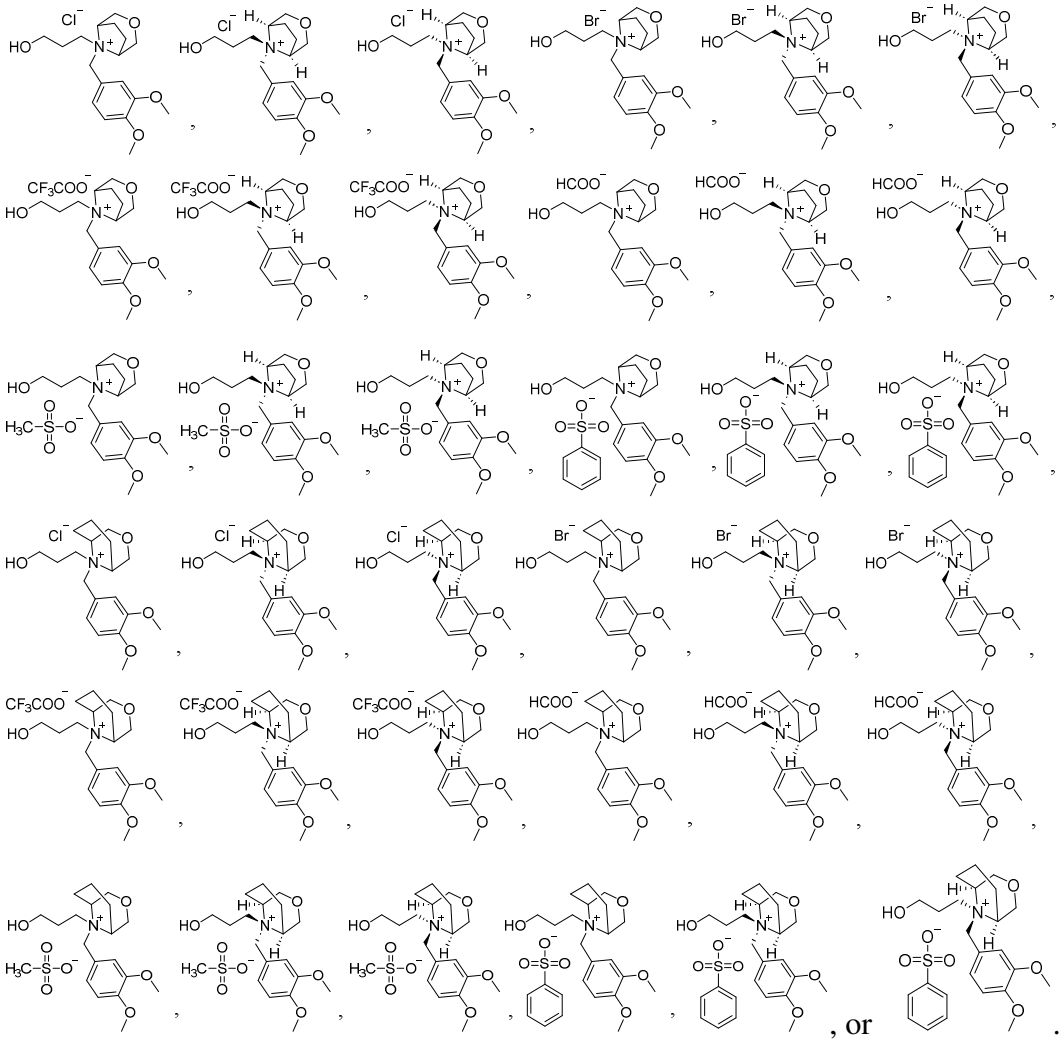
18. The compound represented by formula VI or the pharmaceutically acceptable salt thereof, selected from the group consisting of the following compounds or pharmaceutically acceptable salts thereof,

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wherein $Q^{\ominus}$ is as defined in claim 1.

19. The compound represented by formula VI or the pharmaceutically acceptable salt thereof, selected from the group consisting of the following compounds or pharmaceutically acceptable salts thereof,

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20. Use of the compound or the pharmaceutically acceptable salt thereof according to any one of claims 17 to 19 in the manufacture of a neuromuscular-blocking drug.