

**SUBSTITUTED INDENO[1,2-c]ISOQUINOLINE
DERIVATIVES AND METHODS OF USE THEREOF**

This application is a continuation-in-part of U.S. Application No. 09/944,524, filed August 31, 2001, which is incorporated by reference herein in its entirety.

1. FIELD OF THE INVENTION

The invention relates to indeno[1,2-c]isoquinoline compounds; compositions comprising an indeno[1,2-c]isoquinoline compound; and methods for treating or preventing an inflammatory disease or a reperfusion disease.

2. BACKGROUND OF THE INVENTION

Inflammatory diseases, such as arthritis, colitis, and autoimmune diabetes, typically manifest themselves as disorders distinct from those associated with reperfusion diseases, *e.g.*, stroke and heart attack, and can clinically manifest themselves as different entities. However, there can be common underlying mechanisms between these two types of disorders. In particular, inflammatory disease and reperfusion disease can induce proinflammatory cytokine and chemokine synthesis which can, in turn, result in production of cytotoxic free radicals such as nitric oxide and superoxide. NO and superoxide can react to form peroxynitrite (ONOO⁻) (Szabó *et al.*, Shock 6:79-88, 1996).

The ONOO⁻-induced cell necrosis observed in inflammatory disease and in reperfusion disease involves the activation of the nuclear enzyme poly (ADP-ribose) synthetase (PARS). Activation of PARS is thought to be an important step in the cell-mediated death observed in inflammation and reperfusion disease (Szabó *et al.*, Trends Pharmacol. Sci. 19: 287-98, 1998).

A number of PARS inhibitors have been described in the art. See, *e.g.*, Banasik *et al.*, J. Biol. Chem., 267:1569-75, 1992, and Banasik *et al.*, Mol. Cell. Biochem., 138:185-97, 1994; WO 00/39104; WO 00/39070; WO 99/59975; WO 99/59973; WO 99/11649; WO 99/11645; WO 99/11644; WO 99/11628; WO 99/11623; WO 99/11311; WO 00/42040; Zhang *et al.*, Biochem. Biophys. Res. Commun., 278:590-98, 2000; White *et al.*, J. Med. Chem., 43 :4084-4097, 2000; Griffin *et al.*, J. Med. Chem., 41:5247-5256, 1998; Shinkwin *et al.*, Bioorg. Med. Chem., 7:297-308, 1999; and Soriano *et al.*, Nature Medicine, 7:108-113, 2001. Adverse effects associated with administration of PARS inhibitors have been discussed in Milan *et al.*, Science, 223:589-591, 1984.

Indeno[1,2-c]isoquinoline derivatives have been previously discussed in the art. For example, cytotoxic non-camptothecin topoisomerase I inhibitors are reported in Cushman *et al.*, J. Med. Chem., 43:3688-3698, 2000 and Cushman *et al.*, J. Med. Chem. 42:446-57, 1999; indeno[1,2-c]isoquinolines are reported as antineoplastic agents in Cushman *et al.*, WO 00/21537; and as neoplasm inhibitors in Hrbata *et al.*, WO 93/05023.

Syntheses of indeno[1,2-c]isoquinoline derivatives have been reported. For example, see Wawzonek *et al.*, Org. Prep. Proc. Int. 14:163-8, 1982; Wawzonek *et al.*, Can. J. Chem. 59:2833, 1981; Andoi *et al.*, Bull. Chem. Soc. Japan, 47:1014-17, 1974; Dusemund *et al.*, Arch. Pharm (Weinheim, Ger.), 3 17:381-2, 1984; and Lal *et al.*, Indian J. Chem., Sect. B, 38B:33-39, 1999.

There remains, however, a need in the art for compounds useful for treating or preventing inflammatory diseases or reperfusion diseases.

Citation of any reference in Section 2 of this application is not an admission that the reference is prior art.

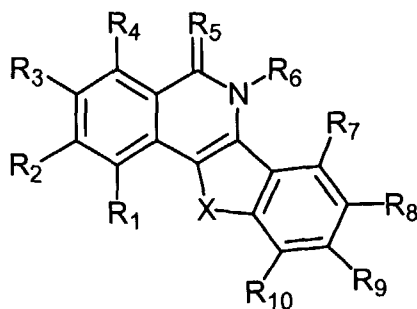
3. SUMMARY OF THE INVENTION

The invention is based in part on the discovery of novel substituted tetracyclic benzamide derivatives and their demonstrated effects in the treatment of inflammation, cell death and in treating shock and reperfusion diseases.

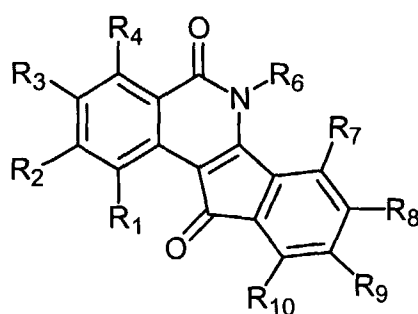
Accordingly, in one aspect the invention includes a compound of Formula I, Formula Ia, Formula Ib, Formula II or Formula III, or a pharmaceutically acceptable salt or hydrate thereof (an "Indeno[1,2-c]isoquinoline Compound") as set forth below in the Detailed Description of the Invention.

Also provided by the invention is a method for treating or preventing an inflammatory disease or a reperfusion disease in a subject, comprising administering to a subject in need of such treatment or prevention an effective amount of an Indeno[1,2-c]isoquinoline Compound.

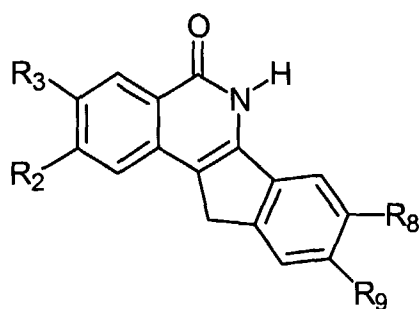
In a further aspect, the invention also includes a method for making an Indeno[1,2-c]isoquinoline Compound.



(I, Ia and Ib)



(II)



(III)

The Indeno[1,2-c]isoquinoline Compounds can be used to treat or prevent a variety of conditions and diseases, including, but not limited to, an inflammatory disease or a reperfusion disease.

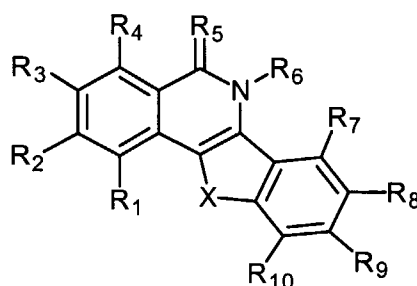
The invention also includes pharmaceutical compositions that comprise an effective amount of an Indeno[1,2-c]isoquinoline Compound and a pharmaceutically acceptable

carrier. The compositions are useful for treating or preventing an inflammatory disease or a reperfusion disease. The invention includes an Indeno[1,2-c]isoquinoline Compound when provided as a pharmaceutically acceptable prodrug, a hydrated salt, such as a pharmaceutically acceptable salt, or mixtures thereof.

The details of the invention are set forth in the accompanying description below. Although any methods and materials similar or equivalent to those described herein can be used in the practice or testing of the present invention, illustrative methods and materials are now described. Other features, objects, and advantages of the invention will be apparent from the description and from the claims. In the specification and the appended claims, the singular forms also include the plural unless the context clearly dictates otherwise. Unless defined otherwise, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. All patents and publications cited in this specification are incorporated by reference.

4. DETAILED DESCRIPTION OF THE INVENTION

The present invention provides a novel class of Indeno[1,2-c]isoquinoline Compounds according to Formula I, Formula Ia, Formula Ib, Formula II and Formula II, as set forth below:



(I)

and pharmaceutically acceptable salts and hydrates thereof,
wherein:

R_5 is O, NH or S;

R_6 is -H or C_1 - C_4 alkyl;

X is -C(O)-, -CH₂-, -CH(halo)-, -CH(OH)(CH₂)_n-, -CH(OH)-arylene-, -O-, -NH-, -S- or -CH(NR₁₁R₁₂)-, wherein n is an integer ranging from 0-5;

R_{11} and R_{12} are independently -hydrogen or - C_1 - C_9 alkyl, or N, R_{11} and R_{12} are taken together to form a heterocyclic amine;

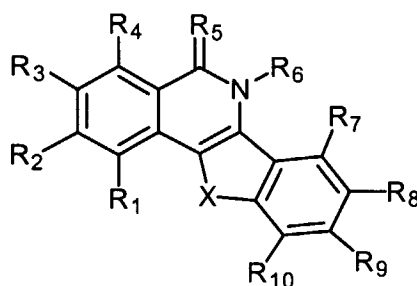
R_1 , R_2 , R_3 , R_4 , R_7 , R_8 , R_9 and R_{10} are independently -hydrogen, -halo, -hydroxy, -O-(C_1 - C_5 alkyl), - C_1 - C_{10} alkyl, -alkylhalo, - C_2 - C_{10} alkenyl, - C_3 - C_8 carbocycle, -aryl, - NH_2 , -alkylamino, -C(O)OH, -C(O)O(C_1 - C_5 alkyl), -OC(O)(C_1 - C_5 alkyl), NO_2 or -A-B;

wherein A is - SO_2 -, - SO_2NH -, - $NHCO$ -, - $NHCONH$ -, -O-, -CO-, -OC(O)-, -C(O)O-, -CONH-, -CON(C_1 - C_4 alkyl)-, -NH-, - CH_2 -, -S- or -C(S)-;

B is - C_1 - C_{10} alkyl, - C_2 - C_{10} alkenyl, -heterocycle, - C_3 - C_8 carbocycle, -aryl, - NZ_1Z_2 , -alkylamino, -aminodialkyl, -alkylheterocycle, -arylamido, -C(O)OH, -C(O)O-(C_1 - C_5 alkyl) or -C(O)O-phenyl, any of which are unsubstituted or substituted with one or more of -O-(C_1 - C_5 alkyl), -halo, -alkylhalo, -alkanol, -alkylamino, -hydroxy, - NO_2 , - NH_2 , -aminoalkyl, -aminodialkyl, -heterocyclic amine, - C_1 - C_{10} alkyl, - C_2 - C_{10} alkenyl, - C_2 - C_{10} alkynyl, -aryl, -benzyl, -alkylamido, -alkylcarboxy, - C_1 - C_5 alkylene-C(O)O- C_1 - C_5 alkyl or - C_1 - C_5 alkylene-OC(O)- C_1 - C_5 alkyl groups; and

Z_1 and Z_2 are independently -H or - C_1 - C_{10} alkyl, which is unsubstituted or substituted with one or more of -halo, -OH or -N(Z_3)(Z_4), where Z_3 and Z_4 are independently, -H or - C_1 - C_5 alkyl, which is unsubstituted or substituted with one or more of -halo, -hydroxy or - NH_2 ; or N, Z_3 and Z_4 are taken together to form an unsubstituted or substituted heterocyclic amine; or N, Z_1 and Z_2 are taken together to form a heterocyclic amine.

The invention also relates to a compounds of formula (Ia):



(Ia)

and pharmaceutically acceptable salts and hydrates thereof,

wherein:

R₅ is NH or S;

R₆ is -H or C₁-C₄ alkyl;

X is -C(O)-, -CH₂-, -CH(halo)-, -CH(OH)(CH₂)_n-, -CH(OH)-arylene-, -O-, -NH-, -S- or -CH(NR₁₁R₁₂)-, wherein n is an integer ranging from 0-5;

R₁₁ and R₁₂ are independently -hydrogen or -C₁-C₉ alkyl, or N, R₁₁ and R₁₂ are taken together to form a heterocyclic amine;

R₁, R₂, R₃, R₄, R₇, R₈, R₉ and R₁₀ are independently -hydrogen, -halo, -hydroxy, -O-(C₁-C₅ alkyl), -C₁-C₁₀ alkyl, -alkylhalo, -C₂-C₁₀ alkenyl, -C₃-C₈ carbocycle, -aryl, -NH₂, -alkylamino, -C(O)OH, -C(O)O(C₁-C₅ alkyl), -OC(O)(C₁-C₅ alkyl), NO₂ or -A-B;

wherein A is -SO₂-, -SO₂NH-, -NHCO-, -NHCONH-, -O-, -CO-, -OC(O)-, -C(O)O-, -CONH-, -CON(C₁-C₄ alkyl)-, -NH-, -CH₂-, -S- or -C(S)-;

B is -C₁-C₁₀ alkyl, -C₂-C₁₀ alkenyl, -heterocycle, -C₃-C₈ carbocycle, -aryl, -NZ₁Z₂, -alkylamino, -aminodialkyl, -alkylheterocycle, -arylamido, -C(O)OH, -C(O)O-(C₁-C₅ alkyl) or -C(O)O-phenyl, any of which are unsubstituted or substituted with one or more of -O-(C₁-C₅ alkyl), -halo, -alkylhalo, -alkanol, -alkylamino, -hydroxy, -NO₂, -NH₂, -aminoalkyl, -aminodialkyl, -heterocyclic amine, -C₁-C₁₀ alkyl, -C₂-C₁₀ alkenyl, -C₂-C₁₀ alkynyl, -aryl, -benzyl, -alkylamido, -alkylcarboxy, -C₁-C₅ alkylene-C(O)O-C₁-C₅ alkyl or -C₁-C₅ alkylene-OC(O)-C₁-C₅ alkyl groups; and

Z₁ and Z₂ are independently -H or -C₁-C₁₀ alkyl, which is unsubstituted or substituted with one or more of -halo, -OH or -N(Z₃)(Z₄), where Z₃ and Z₄ are independently, -H or -C₁-C₅ alkyl, which is unsubstituted or substituted with one or more of -halo, -hydroxy or -NH₂; or N, Z₃ and Z₄ are taken together to form an unsubstituted or substituted heterocyclic amine; or N, Z₁ and Z₂ are taken together to form a heterocyclic amine.

In one embodiment, A is -SO₂-.

In another embodiment, R₁, R₂, R₃, R₄, R₇, R₈, R₉ and R₁₀ are independently arylalkyl.

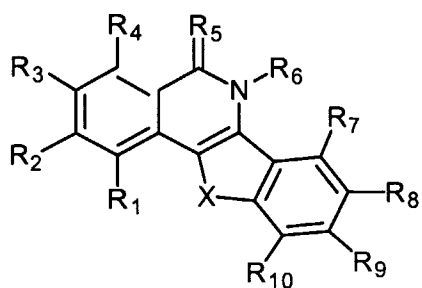
In other illustrative embodiments R⁵ and X in a compound of formula Ia are as set forth below:

<u>R⁵</u>	<u>X</u>
NH	-C(O)-

NH	-CH ₂ -
NH	-CH(halo)-
NH	-CH(OH)(CH ₂) _n -
NH	-CH(arylene)(OH)-
NH	-O-
NH	-NH-
NH	-S-
NH	-CH(NR ¹¹ R ¹²)-

<u>R⁵</u>	<u>X</u>
S	-C(O)-
S	-CH ₂ -
S	-CH(halo)-
S	-CH(OH)(CH ₂) _n -
S	-CH(arylene)(OH)-
S	-O-
S	-NH-
S	-S-
S	-CH(NR ¹¹ R ¹²)-

The invention also relates to compounds of Formula Ib:



(Ib)

and pharmaceutically acceptable salts and hydrates thereof,

wherein:

R_5 is O, NH or S;

R_6 is -H or C_1 - C_4 alkyl;

X is $-CH_2-$, $-CH(halo)-$, $-CH(OH)(CH_2)_n-$, $-CH(OH)-arylene-$, $-O-$, $-NH-$, $-S-$ or $-CH(NR_{11}R_{12})-$, wherein n is an integer ranging from 0-5;

R_{11} and R_{12} are independently -hydrogen or $-C_1$ - C_9 alkyl, or N, R_{11} and R_{12} are taken together to form a heterocyclic amine.

R_1 , R_2 , R_3 , R_4 , R_7 , R_8 , R_9 and R_{10} are independently -hydrogen, -halo, -hydroxy, $-O-(C_1-C_5 \text{ alkyl})$, $-C_1-C_{10}$ alkyl, -alkylhalo, $-C_2-C_{10}$ alkenyl, $-C_3-C_8$ carbocycle, -aryl, $-NH_2$, -alkylamino, $-C(O)OH$, $-C(O)O(C_1-C_5 \text{ alkyl})$, $-OC(O)(C_1-C_5 \text{ alkyl})$, NO_2 or -A-B;

wherein A is $-SO_2-$, $-SO_2NH-$, $-NHCO-$, $-NHCONH-$, $-O-$, $-CO-$, $-OC(O)-$, $-C(O)O-$, $-CONH-$, $-CON(C_1-C_4 \text{ alkyl})-$, $-NH-$, $-CH_2-$, $-S-$ or $-C(S)-$;

B is $-C_1-C_{10}$ alkyl, $-C_2-C_{10}$ alkenyl, -heterocycle, $-C_3-C_8$ carbocycle, -aryl, $-NZ_1Z_2$, -alkylamino, -aminodialkyl, -alkylheterocycle, -arylamido, $-C(O)OH$, $-C(O)O-(C_1-C_5 \text{ alkyl})$ or $-C(O)O$ -phenyl, any of which are unsubstituted or substituted with one or more of $-O-(C_1-C_5 \text{ alkyl})$, -halo, -alkylhalo, -alkanol, -alkylamino, -hydroxy, $-NO_2$, $-NH_2$, -aminoalkyl, -aminodialkyl, -heterocyclic amine, $-C_1-C_{10}$ alkyl, $-C_2-C_{10}$ alkenyl, $-C_2-C_{10}$ alkynyl, -aryl, -benzyl, -alkylamido, -alkylcarboxy, $-C_1-C_5$ alkylene- $C(O)O-C_1-C_5$ alkyl or $-C_1-C_5$ alkylene- $OC(O)-C_1-C_5$ alkyl groups; and

Z_1 and Z_2 are independently -H or $-C_1-C_{10}$ alkyl, which is unsubstituted or substituted with one or more of -halo, -OH or $-N(Z_3)(Z_4)$, where Z_3 and Z_4 are independently, -H or $-C_1-C_5$ alkyl, which is unsubstituted or substituted with one or more of -halo, -hydroxy or $-NH_2$; or N, Z_3 and Z_4 are taken together to form an unsubstituted or substituted heterocyclic amine; or N, Z_1 and Z_2 are taken together to form a heterocyclic amine.

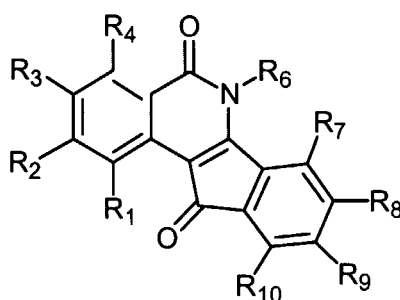
In one embodiment, A is $-SO_2-$.

In another embodiment, R_1 , R_2 , R_3 , R_4 , R_7 , R_8 , R_9 and R_{10} are independently arylalkyl.

In illustrative embodiments R^5 and X in a compound of formula Ib are as set forth below:

$\underline{R^5}$	$\underline{X}$
O	-CH ₂ -
O	-CH(halo)-
O	-CH(OH)(CH ₂) _n -
O	-CH(arylene)(OH)-
O	-O-
O	-NH-
O	-S-
O	-CH(NR ¹¹ R ¹²)-

The invention also relates to compounds of Formula II:



(II)

and pharmaceutically acceptable salts and hydrates thereof,
wherein:

R_6 is -H or C₁-C₄ alkyl;

R_1 , R_2 , R_3 , R_4 , R_7 , R_8 , R_9 and R_{10} are independently -hydrogen, -halo, -hydroxy, -O-(C₁-C₅ alkyl), -C₁-C₁₀ alkyl, -alkylhalo, -C₂-C₁₀ alkenyl, -C₃-C₈ carbocycle, -aryl, -NH₂, -alkylamino, -C(O)OH, -C(O)O(C₁-C₅ alkyl), -OC(O)(C₁-C₅ alkyl), NO₂ or -A-B; wherein at least one of R^1 , R^4 and R^{10} is other than hydrogen;

A is -SO₂-, -SO₂NH-, -NHCO-, -NHCONH-, -O-, -CO-, -OC(O)-, -C(O)O-, -CONH-, -CON(C₁-C₄ alkyl)-, -NH-, -CH₂-, -S- or -C(S)-;

B is -C₁-C₁₀ alkyl, -C₂-C₁₀ alkenyl, -heterocycle, -C₃-C₈ carbocycle, -aryl, -NH₂, -alkylamino, -aminodialkyl, -alkylheterocycle, -arylamido, -C(O)OH,

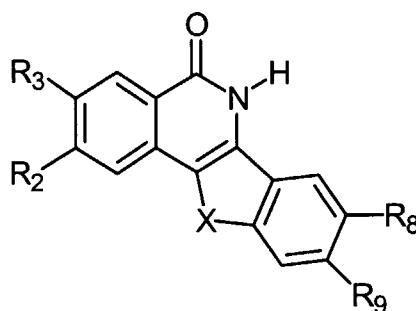
$-\text{C}(\text{O})\text{O}-(\text{C}_1\text{-C}_5 \text{ alkyl}), -\text{C}(\text{O})\text{O-phenyl}$ or $-\text{NZ}_1\text{Z}_2$; and

Z_1 and Z_2 are independently $-\text{H}$ or $-\text{C}_1\text{-C}_{10}$ alkyl, which is unsubstituted or substituted with one or more of $-\text{halo}$, $-\text{OH}$ or $-\text{N}(\text{Z}_3)(\text{Z}_4)$, where Z_3 and Z_4 are independently, $-\text{H}$ or $-\text{C}_1\text{-C}_5$ alkyl, which is unsubstituted or substituted with one or more of $-\text{halo}$, $-\text{hydroxy}$ or $-\text{NH}_2$; or N , Z_3 and Z_4 are taken together to form an unsubstituted or substituted heterocyclic amine; or N , Z_1 and Z_2 are taken together to form a heterocyclic amine.

In one embodiment, B is a heterocyclic amine.

In another embodiment, B is arylalkyl.

The invention also relates to compounds of Formula III:



(III)

and pharmaceutically acceptable salts and hydrates thereof,
wherein:

X is $-\text{CH}_2-$ or $-\text{O}-$;

R_2 and R_3 are independently $-\text{hydrogen}$, $-\text{halo}$, $-\text{alkylhalo}$, $-\text{hydroxy}$, $-\text{O}-(\text{C}_1\text{-C}_5 \text{ alkyl})$, $-\text{C}_1\text{-C}_3 \text{ alkyl}$, $-\text{NO}_2$, $-\text{NH}_2$, $-\text{CONH}_2$, $-\text{C}(\text{O})\text{OH}$, $-\text{OC}(\text{O})-\text{C}_1\text{-C}_5 \text{ alkyl}$ or $-\text{C}(\text{O})\text{O}-\text{C}_1\text{-C}_5 \text{ alkyl}$;

R_8 and R_9 are independently $-\text{hydrogen}$ and $-\text{A-B}$;

A is $-\text{SO}_2-$, $-\text{SO}_2\text{NH}-$ or $-\text{NHCO}-$; and

B is $-\text{C}_1\text{-C}_3 \text{ alkyl}$, $-\text{NZ}_1\text{Z}_2$, $-\text{heterocycle}$ or $-\text{alkylamino}$, each unsubstituted or substituted with one or more of $-\text{alkanol}$, $-\text{alkylamino}$, $-\text{aminoalkyl}$, $-\text{aminodialkyl}$ or $-\text{heterocycle}$, each unsubstituted or substituted with $-\text{C}_1\text{-C}_{10} \text{ alkyl}$ or $-\text{alkanol}$; and

Z_1 and Z_2 are independently -hydrogen or $-C_1-C_8$ alkyl, which is unsubstituted or substituted with one or more of -hydroxy or $-NZ_3Z_4$, where Z_3 and Z_4 are independently -H or $-C_1-C_3$ alkyl, which is unsubstituted or substituted with one or more of -hydroxy or $-NH_2$, or N, Z_3 and Z_4 are taken together to a heterocyclic amine, or N, Z_1 and Z_2 are taken together to form a heterocyclic amine.

In one embodiment, -X- is $-CH_2-$.

In another embodiment, -X- is $-O-$.

In one embodiment, R^8 is hydrogen and R^9 is -A-B.

In another embodiment, R^8 is -A-B and R^9 is hydrogen.

In one embodiment, either R^8 is hydrogen and R^9 is -A-B, or R^8 is -A-B and R^9 is hydrogen.

In one embodiment, R^3 , R^8 and R^9 are hydrogen and R^2 is -A-B, wherein A is -NHC(O)-.

In another embodiment, R^2 , R^8 and R^9 are hydrogen and R^3 is -A-B, wherein A is -NHC(O)-.

In still another embodiment R^2 , R^3 and R^8 are hydrogen and R^9 is -A-B, wherein A is $-SO_2-$ or $-SO_2NH-$.

4.1 DEFINITIONS

“ C_1-C_3 alkyl” refers to a straight or branched chain saturated hydrocarbon containing 1-3 carbon atoms. Examples of a C_1-C_3 alkyl group include, but are not limited to, methyl, ethyl, propyl and isopropyl

“ C_1-C_4 alkyl” refers to a straight or branched chain saturated hydrocarbon containing 1-4 carbon atoms. Examples of a C_1-C_4 alkyl group include, but are not limited to, methyl, ethyl, propyl, butyl, isopropyl, isobutyl, *sec*-butyl and *tert*-butyl.

“ C_1-C_5 alkyl” refers to a straight or branched chain saturated hydrocarbon containing 1-4 carbon atoms. Examples of a C_1-C_5 alkyl group include, but are not limited to, methyl, ethyl, propyl, butyl, pentyl, isopropyl, isobutyl, *sec*-butyl and *tert*-butyl, isopentyl and neopentyl.

“ C_1-C_8 alkyl” refers to a straight or branched chain saturated hydrocarbon containing 1-8 carbon atoms. Examples of a C_1-C_8 alkyl group include, but are not limited to, methyl,

ethyl, propyl, butyl, pentyl, hexyl, heptyl, octyl, isopropyl, isobutyl, *sec*-butyl and *tert*-butyl, isopentyl, neopentyl, isohexyl, isoheptyl and isooctyl.

“C₁-C₉ alkyl” refers to a straight or branched chain saturated hydrocarbon containing 1-9 carbon atoms. Examples of a C₁-C₉ alkyl group include, but are not limited to, methyl, ethyl, propyl, butyl, pentyl, hexyl, heptyl, octyl, nonyl, isopropyl, isobutyl, *sec*-butyl and *tert*-butyl, isopentyl, neopentyl, isohexyl, isoheptyl, isooctyl and isononyl.

“C₁-C₁₀ alkyl” refers to a straight or branched chain saturated hydrocarbon containing 1-10 carbon atoms. Examples of a C₁-C₁₀ alkyl group include, but are not limited to, methyl, ethyl, propyl, butyl, pentyl, hexyl, heptyl, octyl, nonyl, decyl, isopropyl, isobutyl, *sec*-butyl and *tert*-butyl, isopentyl, neopentyl, isohexyl, isoheptyl, isooctyl, isononyl and isodecyl.

“C₂-C₁₀ alkenyl” refers to a straight or branched chain unsaturated hydrocarbon containing 2-10 carbon atoms and at least one double bond. Examples of a C₂-C₁₀ alkenyl group include, but are not limited to, ethylene, propylene, 1-butylene, 2-butylene, isobutylene, *sec*-butylene, 1-pentene, 2-pentene, isopentene, 1-hexene, 2-hexene, 3-hexene, isohexene, 1-heptene, 2-heptene, 3-heptene, 1-octene, 2-octene, 3-octene, 4-octene, 1-nonene, 2-nonene, 3-nonene, 4-nonene, 1-decene, 2-decene, 3-decene, 4-decene and 5-decene.

“C₂-C₁₀ alkynyl” refers to a straight or branched chain unsaturated hydrocarbon containing 2-10 carbon atoms and at least one triple bond. Examples of a C₂-C₁₀ alkynyl group include, but are not limited to, acetylene, propyne, 1-butyne, 2-butyne, isobutyne, *sec*-butyne, 1-pentyne, 2-pentyne, isopentyne, 1-hexyne, 2-hexyne, 3-hexyne, isohexyne, 1-heptyne, 2-heptyne, 3-heptyne, 1-octyne, 2-octyne, 3-octyne, 4-octyne, 1-nonyne, 2-nonyne, 3-nonyne, 4-nonyne, 1-decyne, 2-decyne, 3-decyne, 4-decyne and 5-decyne.

“C₁-C₄ alkylene” refers to a C₁-C₄ alkyl group in which one of the C₁-C₄ alkyl group's hydrogen atoms has been replaced with a bond. Examples of a C₁-C₄ alkylene include -CH₂-, -CH₂ CH₂-, -CH₂CH₂CH₂- and -CH₂CH₂CH₂CH₂-.

“C₁-C₅ alkylene” refers to a C₁-C₅ alkyl group in which one of the C₁-C₅ alkyl group's hydrogen atoms has been replaced with a bond. Examples of a C₁-C₄ alkylene include -CH₂-, -CH₂ CH₂-, -CH₂CH₂CH₂- and -CH₂CH₂CH₂CH₂-. Examples of a C₁-C₅ alkylene include -CH₂-, -CH₂ CH₂-, -CH₂CH₂CH₂-, -CH₂CH₂CH₂CH₂- and -CH₂CH₂CH₂CH₂CH₂-.

“Alkylhalo” refers to a C₁-C₅ alkyl group, as defined above, wherein one or more of the C₁-C₅ alkyl group’s hydrogen atoms has been replaced with -F, -Cl, -Br or -I.

Representative examples of an alkylhalo group include, but are not limited to -CH₂F, -CCl₃, -CF₃, -CH₂Cl, -CH₂CH₂Br, -CH₂CH₂I, -CH₂CH₂CH₂F, -CH₂CH₂CH₂Cl, -CH₂CH₂CH₂CH₂Br, -CH₂CH₂CH₂CH₂I, -CH₂CH₂CH₂CH₂CH₂Br, -CH₂CH₂CH₂CH₂CH₂I, -CH₂CH(Br)CH₃, -CH₂CH(Cl)CH₂CH₃, -CH(F)CH₂CH₃ and -C(CH₃)₂(CH₂Cl).

“Alkylamino” refers to a C₁-C₄ alkyl group, as defined above, wherein one or more of the C₁-C₄ alkyl group’s hydrogen atoms has been replaced with -NH₂. Representative examples of an alkylamino group include, but are not limited to -CH₂NH₂, -CH₂CH₂NH₂, -CH₂CH₂CH₂NH₂, -CH₂CH₂CH₂CH₂NH₂, -CH₂CH(NH₂)CH₃, -CH₂CH(NH₂)CH₂CH₃, -CH(NH₂)CH₂CH₃ and -C(CH₃)₂(CH₂NH₂).

“Aminoalkyl” refers to an -NH group, the nitrogen atom of said group being attached to a C₁-C₄ alkyl group, as defined above. Representative examples of an aminoalkyl group include, but are not limited to -NHCH₃, -NHCH₂CH₃, -NHCH₂CH₂CH₃, -NHCH₂CH₂CH₂CH₃, -NHCH(CH₃)₂, -NHCH₂CH(CH₃)₂, -NHCH(CH₃)CH₂CH₃ and -NH-C(CH₃)₃.

“Aminodialkyl” refers to a nitrogen atom which has attached to it two C₁-C₄ alkyl groups, as defined above. Representative examples of a aminodialkyl group include, but are not limited to, -N(CH₃)₂, -N(CH₂CH₃)(CH₃), -N(CH₂CH₃)₂, -N(CH₂CH₂CH₃)₂, -N(CH₂CH₂CH₂CH₃)₂, -N(CH(CH₃)₂)₂, -N(CH(CH₃)₂)(CH₃), -N(CH₂CH(CH₃)₂)₂, -NH(CH(CH₃)CH₂CH₃)₂, -N(C(CH₃)₃)₂ and -N(C(CH₃)₃)(CH₃).

“Aryl” refers to a phenyl or pyridyl group. Examples of an aryl group include, but are not limited to, phenyl, N-pyridyl, 2-pyridyl, 3-pyridyl and 4-pyridyl. An aryl group can be unsubstituted or substituted with one or more of the following groups:

-C₁-C₅ alkyl, halo, -alkylhalo, hydroxy, -O-C₁-C₅ alkyl, -NH₂, -aminoalkyl, -aminodialkyl, -COOH, -C(O)O-(C₁-C₅ alkyl), -OC(O)-(C₁-C₅ alkyl), -N-amidoalkyl, -C(O)NH₂, -carboxamidoalkyl, or -NO₂.

“Arylalkyl” refers to an aryl group, as defined above, wherein one of the aryl group’s hydrogen atoms has been replaced with a C₁-C₅ alkyl group, as defined above.

Representative examples of an arylalkyl group include, but are not limited to, 2-methylphenyl, 3-methylphenyl, 4-methylphenyl, 2-ethylphenyl, 3-ethylphenyl, 4-ethylphenyl, 2-propylphenyl, 3-propylphenyl, 4-propylphenyl, 2-butylphenyl, 3-butylphenyl, 4-butylphenyl, 2-pentylphenyl, 3-pentylphenyl, 4-pentylphenyl, 2-isopropylphenyl, 3-

isopropylphenyl, 4-isopropylphenyl, 2-isobutylphenyl, 3-isobutylphenyl, 4-isobutylphenyl, 2-sec-butylphenyl, 3-sec-butylphenyl, 4-sec-butylphenyl, 2-t-butylphenyl, 3-t-butylphenyl and 4-t-butylphenyl,

“Arylamido” refers to an aryl group, as defined above, wherein one of the aryl group’s hydrogen atoms has been replaced with one or more $-C(O)NH_2$ groups.

Representative examples of an arylamido group include 2- $C(O)NH_2$ -phenyl, 3- $C(O)NH_2$ -phenyl, 4- $C(O)NH_2$ -phenyl, 2- $C(O)NH_2$ -pyridyl, 3- $C(O)NH_2$ -pyridyl and 4- $C(O)NH_2$ -pyridyl,

“Alkylheterocycle” refers to a C_1 - C_5 alkyl group, as defined above, wherein one of the C_1 - C_5 alkyl group’s hydrogen atoms has been replaced with a heterocycle.

Representative examples of an alkylheterocycle group include, but are not limited to, $-CH_2CH_2$ -morpholine, $-CH_2CH_2$ -piperidine, $-CH_2CH_2CH_2$ -morpholine and $-CH_2CH_2CH_2$ -imidazole.

“Alkylamido” refers to a C_1 - C_5 alkyl group, as defined above, wherein one of the C_1 - C_5 alkyl group’s hydrogen atoms has been replaced with a $-C(O)NH_2$ group. Representative examples of an alkylamido group include, but are not limited to, $-CH_2C(O)NH_2$, $-CH_2CH_2C(O)NH_2$, $-CH_2CH_2CH_2C(O)NH_2$, $-CH_2CH_2CH_2CH_2C(O)NH_2$, $-CH_2CH_2CH_2CH_2CH_2C(O)NH_2$, $-CH_2CH(C(O)NH_2)CH_3$, $-CH_2CH(C(O)NH_2)CH_2CH_3$, $-CH(C(O)NH_2)CH_2CH_3$ and $-C(CH_3)_2CH_2C(O)NH_2$.

“Alkanol” refers to a C_1 - C_5 alkyl group, as defined above, wherein one of the C_1 - C_5 alkyl group’s hydrogen atoms has been replaced with a hydroxyl group. Representative examples of an alkanol group include, but are not limited to, $-CH_2OH$, $-CH_2CH_2OH$, $-CH_2CH_2CH_2OH$, $-CH_2CH_2CH_2CH_2OH$, $-CH_2CH_2CH_2CH_2CH_2OH$, $-CH_2CH(OH)CH_3$, $-CH_2CH(OH)CH_2CH_3$, $-CH(OH)CH_2CH_3$ and $-C(CH_3)_2CH_2OH$.

“Alkylcarboxy” refers to a C_1 - C_5 alkyl group, as defined above, wherein one of the C_1 - C_5 alkyl group’s hydrogen atoms has been replaced with a $-COOH$ group. Representative examples of an alkylcarboxy group include, but are not limited to, $-CH_2COOH$, $-CH_2CH_2COOH$, $-CH_2CH_2CH_2COOH$, $-CH_2CH_2CH_2CH_2COOH$, $-CH_2CH(COOH)CH_3$, $-CH_2CH_2CH_2CH_2CH_2COOH$, $-CH_2CH(COOH)CH_2CH_3$, $-CH(COOH)CH_2CH_3$ and $-C(CH_3)_2CH_2COOH$.

“N-amidoalkyl” refers to a $-NHC(O)-$ group in which the carbonyl carbon atom of said group is attached to a C_1 - C_5 alkyl group, as defined above. Representative examples of a N-amidoalkyl group include, but are not limited to, $-NHC(O)CH_3$, $-NHC(O)CH_2CH_3$,

-NHC(O)CH₂CH₂CH₃, -NHC(O)CH₂CH₂CH₂CH₃, -NHC(O)CH₂CH₂CH₂CH₂CH₃,
 -NHC(O)CH(CH₃)₂, -NHC(O)CH₂CH(CH₃)₂, -NHC(O)CH(CH₃)CH₂CH₃, -NHC(O)-
 C(CH₃)₃ and -NHC(O)CH₂C(CH₃)₃.

“Carboxamidoalkyl” refers to a -C(O)NH- group in which the nitrogen atom of said group is attached to a C₁-C₅ alkyl group, as defined above. Representative examples of a carboxamidoalkyl group include, but are not limited to, -C(O)NHCH₃, -C(O)NHCH₂CH₃, -C(O)NHCH₂CH₂CH₃, -C(O)NHCH₂CH₂CH₂CH₃, -C(O)NHCH₂CH₂CH₂CH₂CH₃, -C(O)NHCH(CH₃)₂, -C(O)NHCH₂CH(CH₃)₂, -C(O)NHCH(CH₃)CH₂CH₃, -C(O)NH-C(CH₃)₃ and -C(O)NHCH₂C(CH₃)₃.

An “Arylene” group is a phenyl group in which one of the phenyl group’s hydrogen atoms has been replaced with a bond. An arylene group may be in an ortho, meta, or para configuration and may be unsubstituted or independently substituted with one or more of the following groups: -C₁-C₅ alkyl, halo, -alkylhalo, hydroxy, -O-C₁-C₅ alkyl, -NH₂, -aminoalkyl, -aminodialkyl, -COOH, -C(O)O-(C₁-C₅ alkyl), -OC(O)-(C₁-C₅ alkyl), -N-amidoalkyl, -C(O)NH₂, -carboxamidoalkyl or -NO₂.

A “C₃-C₈ Carbocycle” is a non-aromatic, saturated hydrocarbon ring containing 3-8 carbon atoms. Representative examples of a C₃-C₈ carbocycle include, but are not limited to, cyclopropyl, cyclobutyl, cyclopentyl, cyclohexyl, cycloheptyl and cyclooctyl. A C₃-C₈ carbocycle may be unsubstituted or independently substituted with one or more of the following groups: -C₁-C₅ alkyl, halo, -alkylhalo, hydroxy, -O-C₁-C₅ alkyl, -NH₂, -aminoalkyl, -aminodialkyl, -COOH, -C(O)O-(C₁-C₅ alkyl), -OC(O)-(C₁-C₅ alkyl), -N-amidoalkyl, -C(O)NH₂, -carboxyamidoalkyl or -NO₂.

“Heterocycle” refers to a 5- to 10-membered aromatic or non-aromatic carbocycle in which 1-4 of the ring carbon atoms have been independently replaced with a N, O or S atom. Representative examples of a heterocycle group include, but are not limited to, piperidinyl, piperazinyl, morpholinyl, pyrrolyl, oxazinyl, thiazinyl, diazinyl, triazinyl, tetrazinyl, imidazolyl, benzimidazolyl, tetrazolyl, indolyl, isoquinolinyl, quinolinyl, quinazolinyl, pyrrolidinyl, purinyl, isoxazolyl, benzisoxazolyl, furanyl, furazanyl, pyridinyl, oxazolyl, benzoxazolyl, thiazolyl, benzthiazolyl, thiophenyl, pyrazolyl, triazolyl, benzodiazolyl, benzotriazolyl, pyrimidinyl, isoindolyl and indazolyl. A heterocycle group may be unsubstituted or substituted with one or more of the following groups: -C₁-C₅ alkyl, halo, -alkylhalo, hydroxy, -O-C₁-C₅ alkyl, -NH₂, -aminoalkyl, -aminodialkyl, -COOH, -C(O)O-(C₁-C₅ alkyl), -OC(O)-(C₁-C₅ alkyl),

-N-amidoalkyl, -C(O)NH₂, -carboxamidoalkyl or -NO₂.

A "Heterocyclic amine" is a heterocycle, defined above, having 1-4 ring nitrogen atoms. Representative examples of heterocyclic amines include, but are not limited to, piperidinyl, piperazinyl, pyrrolyl, oxazinyl, thiazinyl, diazinyl, triazinyl, tetrazinyl, imidazolyl, benzimidazolyl, tetrazolyl, indolyl, isoquinolinyl, quinolinyl, quinazolinyl, pyrrolidinyl, purinyl, isoxazolyl, benzisoxazolyl, pyridinyl, oxazolyl, benzoxazolyl, thiazolyl, benzthiazolyl, pyrazolyl, triazolyl, benzodiazolyl, benzotriazolyl, pyrimidinyl, isoindolyl, indazolyl and morpholinyl; each of which may be unsubstituted or substituted with one or more of -N-(C₁-C₅ alkyl), -C(O)-(C₁-C₅ alkyl), -N-C(O)(C₁-C₄ alkyl), -O-(C₁-C₅ alkyl), -halo, -alkylhalo, -alkanol, -alkylamino, -hydroxy, -NO₂, -NH₂, -aminoalkyl, -aminodialkyl, -heterocyclic amine, -C₁-C₁₀ alkyl, -C₂-C₁₀ alkenyl, -C₂-C₁₀ alkynyl, -aryl, -benzyl, -alkylamido, -alkylcarboxy, -COOH, -C₁-C₅ alkylene-OC(O)-C₁-C₅ alkyl, -C₁-C₅ alkylene-C(O)O-C₁-C₅ alkyl, or a heterocycle or C₃-C₈ carbocycle which may be unsubstituted or substituted with one or more of -C₁-C₁₀ alkyl, -O-(C₁-C₅ alkyl), -halo, -alkylhalo, -alkanol, -alkylamino, -hydroxy, -NO₂ or -NH₂.

"Halo" is -F, -Cl, -Br or -I.

A "subject" is a mammal, *e.g.*, a human, mouse, rat, guinea pig, dog, cat, horse, cow, pig, or non-human primate.

The invention also includes pharmaceutical compositions comprising an Indeno[1,2-c]isoquinoline Compound and a pharmaceutically acceptable carrier. The invention includes an Indeno[1,2-c]isoquinoline Compound when provided as a pharmaceutically acceptable prodrug, hydrated salt, such as a pharmaceutically acceptable salt, or mixtures thereof.

Representative "pharmaceutically acceptable salts" include, *e.g.*, water-soluble and water-insoluble salts, such as the acetate, amsonate (4,4-diaminostilbene-2, 2'-disulfonate), benzenesulfonate, benzonate, bicarbonate, bisulfate, bitartrate, borate, bromide, butyrate, calcium edetate, camsylate, carbonate, chloride, citrate, clavulinate, dihydrochloride, edetate, edisylate, estolate, esylate, fiunarate, gluceptate, gluconate, glutamate, glycolylarsanilate, hexafluorophosphate, hexylresorcinate, hydrabamine, hydrobromide, hydrochloride, hydroxynaphthoate, iodide, isothionate, lactate, lactobionate, laurate, malate, maleate, mandelate, mesylate, methylbromide, methylnitrate, methylsulfate, mucate, napsylate, nitrate, N-methylglucamine ammonium salt, 3-hydroxy-2-naphthoate, oleate, oxalate, palmitate, pamoate (1,1'-methene-bis-2-hydroxy-3-naphthoate, einbonate), pantothenate, phosphate/diphosphate, picrate, polygalacturonate, propionate,

p-toluenesulfonate, salicylate, stearate, subacetate, succinate, sulfate, sulfosalicylate, suramate, tannate, tartrate, teoclate, tosylate, triethiodide, and valerate salts.

An "effective amount" when used in connection an Indeno[1,2-c]isoquinoline Compound is an amount effective for treating or preventing an inflammatory disease or a reperfusion disease.

The following abbreviations are used herein and have the indicated definitions: AcOH is acetic acid, CEP is Cecal Ligation and Puncture, DMEM is Dulbecco's Modified Eagle Medium, DMF is *N,N*-dimethylformamide, DMSO is dimethylsulfoxide, EtOAc is ethyl acetate, EtOH is ethanol, HEPES is 4-(2-hydroxyethyl)-1-piperazineethanesulfonic acid, LPS is lipopolysaccharide, MeOH is methanol, MS is mass spectrometry, NMR is nuclear magnetic resonance, PBS is phosphate-buffered saline (pH 7.4), PARS is poly(ADP-ribose)synthetase, Py is pyridine, SDS is dodecyl sulfate (sodium salt), STZ is streptozotocin, TCA is trichloroacetic acid, TFA is trifluoroacetic acid, TLC is thin-layer chromatography, TNF is tumor necrosis factor and TRIS is Tris(hydroxymethyl)aminomethane.

Methods for using Indeno[1,2-c]isoquinoline Compounds

The invention also includes methods for inhibiting PARS in a cell. PARS, which is also known as poly(ADP-ribose)synthetase, PARP ((poly(ADP-ribose) polymerase, EC 2.4.99) and ADP-ribosyltransferase (ADPRT, EC 2.4.2.30), is a nuclear enzyme that catalyzes a transfer of the ADP ribose moiety of NAD⁺ to an acceptor protein.

In one embodiment the method comprises contacting a cell with an Indeno[1,2-c]isoquinoline Compound in an amount sufficient to inhibit PARS in the cell. In general, any cell having, or capable of having, PARS activity or capable of expressing PARS can be used. The cell can be provided in any form. For example, the cell can be provided *in vitro*, *ex vivo*, or *in vivo*. PARS activity can be measured using any method known in the art, *e.g.*, methods as described in Banasik *et al.*, J. Biol. Chem. 267:1569-75 (1991). Illustrative examples of cells capable of expressing PARS include, but are not limited to muscle, bone, gum, nerve, brain, liver, kidney, pancreas, lung, heart, bladder, stomach, colon, rectal, small intestine, skin, esophageal, eye, larynx, uterine, ovarian, prostate, tendon, bone marrow, blood, lymph, testicular, vaginal and neoplastic cells.

Also provided in the invention is a method for inhibiting, preventing, or treating inflammation or an inflammatory disease in a subject. The inflammation can be associated

with an inflammatory disease. Inflammatory diseases can arise where there is an inflammation of the body tissue. These include local inflammatory responses and systemic inflammation. Examples of such diseases include: organ transplant rejection; reoxygenation injury resulting from organ transplantation (see Grupp et al. J. Mol. Cell Cardiol. 31:297-303 (1999)) including, but not limited to, transplantation of the following organs: heart, lung, liver and kidney; chronic inflammatory diseases of the joints, including arthritis, rheumatoid arthritis, osteoarthritis and bone diseases associated with increased bone resorption; inflammatory bowel diseases such as ileitis, ulcerative colitis, Barrett's syndrome, and Crohn's disease; inflammatory lung diseases such as asthma, adult respiratory distress syndrome, and chronic obstructive airway disease; inflammatory diseases of the eye including corneal dystrophy, trachoma, onchocerciasis, uveitis, sympathetic ophthalmitis and endophthalmitis; chronic inflammatory diseases of the gum, including gingivitis and periodontitis; tuberculosis; leprosy; inflammatory diseases of the kidney including uremic complications, glomerulonephritis and nephrosis; inflammatory diseases of the skin including sclerodermitis, psoriasis and eczema; inflammatory diseases of the central nervous system, including chronic demyelinating diseases of the nervous system, multiple sclerosis, AIDS-related neurodegeneration and Alzheimer's disease, infectious meningitis, encephalomyelitis, Parkinson's disease, Huntington's disease, amyotrophic lateral sclerosis and viral or autoimmune encephalitis; autoimmune diseases including Type I and Type II diabetes mellitus; diabetic complications, including, but not limited to, diabetic cataract, glaucoma, retinopathy, nephropathy, such as microalbuminuria and progressive diabetic nephropathy, polyneuropathy, gangrene of the feet, atherosclerotic coronary arterial disease, peripheral arterial disease, nonketotic hyperglycemic-hyperosmolar coma, mononeuropathies, autonomic neuropathy, foot ulcers, joint problems, and a skin or mucous membrane complication, such as an infection, a shin spot, a candidal infection or necrobiosis lipoidica diabetorum; immune-complex vasculitis, systemic lupus erythematosus (SLE); inflammatory diseases of the heart such as cardiomyopathy, ischemic heart disease hypercholesterolemia, and atherosclerosis; as well as various other diseases that can have significant inflammatory components, including preeclampsia; chronic liver failure, brain and spinal cord trauma, and cancer. The inflammatory disease can also be a systemic inflammation of the body, exemplified by gram-positive or gram negative shock, hemorrhagic or anaphylactic shock, or shock induced by cancer chemotherapy in response to pro-inflammatory cytokines, *e.g.*, shock associated with pro-inflammatory cytokines.

Such shock can be induced, *e.g.*, by a chemotherapeutic agent that is administered as a treatment for cancer.

In one embodiment, a reoxygenation injury resulting from organ transplantation occurs during the organ transplantation.

The invention also includes methods for treating, preventing, or otherwise inhibiting reperfusion disease in a subject in need of treatment, prevention, or inhibition thereof. The method comprises administering an Indeno[1,2-c]isoquinoline Compound in an amount sufficient to treat, prevent or inhibit reperfusion disease in the subject. Reperfusion refers to the process whereby blood flow in the blood vessels is resumed following ischemia, such as occurs following constriction or obstruction of the vessel. Reperfusion disease can result following a naturally occurring episode, such as a myocardial infarction, stroke, or during a surgical procedure where blood flow in vessels is intentionally or unintentionally blocked.

In some embodiments, the subject is administered an effective amount of an Indeno[1,2-c]isoquinoline Compound.

The invention also includes pharmaceutical compositions useful for treating or preventing an inflammatory disease or a reperfusion disease, or for inhibiting PARS activity, or more than one of these activities. The compositions can be suitable for internal use and comprise an effective amount of an Indeno[1,2-c]isoquinoline Compound and a pharmaceutically acceptable carrier. The Indeno[1,2-c]isoquinoline Compounds are especially useful in that they demonstrate very low peripheral toxicity or, no peripheral toxicity.

The Indeno[1,2-c]isoquinoline Compounds can be administered in amounts that are sufficient to treat or prevent an inflammatory disease or a reperfusion disease and/or prevent the development thereof in subjects.

Administration of the Indeno[1,2-c]isoquinoline Compounds can be accomplished via any mode of administration for therapeutic agents. These modes include systemic or local administration such as oral, nasal, parenteral, transdermal, subcutaneous, vaginal, buccal, rectal or topical administration modes.

Depending on the intended mode of administration, the compositions can be in solid, semi-solid or liquid dosage form, such as, for example, injectables, tablets, suppositories, pills, time-release capsules, elixirs, tinctures, emulsions, syrups, powders, liquids, suspensions, or thelike, preferably in unit dosages and consistent with conventional pharmaceutical practices. Likewise, they can also be administered in intravenous (both

bolus and infusion), intraperitoneal, subcutaneous or intramuscular form, all using forms well known to those skilled in the pharmaceutical arts.

Illustrative pharmaceutical compositions are tablets and gelatin capsules comprising an Indeno[1,2-c]isoquinoline Compound and a pharmaceutically acceptable carrier, such as a) a diluent, *e.g.*, lactose, dextrose, sucrose, mannitol, sorbitol, cellulose, sodium, saccharin, glucose and/or glycine; b) a lubricant, *e.g.*, silica, talcum, stearic acid, its magnesium or calcium salt, sodium oleate, sodium stearate, magnesium stearate, sodium benzoate, sodium acetate, sodium chloride and/or polyethylene glycol; for tablets also c) a binder, *e.g.*, magnesium aluminum silicate, starch paste, gelatin, tragacanth, methylcellulose, sodium carboxymethylcellulose, magnesium carbonate, natural sugars such as glucose or beta-lactose, corn sweeteners, natural and synthetic gums such as acacia, tragacanth or sodium alginate, waxes and/or polyvinylpyrrolidone; if desired d) a disintegrant, *e.g.*, starches, agar, methyl cellulose, bentonite, xanthan gum, algiic acid or its sodium salt, or effervescent mixtures; and/or e) absorbent, colorant, flavorant and sweetener.

Liquid, particularly injectable, compositions can, for example, be prepared by dissolution, dispersion, etc. For example, the Indeno[1,2-c]isoquinoline Compound is dissolved in or mixed with a pharmaceutically acceptable solvent such as, for example, water, saline, aqueous dextrose, glycerol, ethanol, and the like, to thereby form an injectable isotonic solution or suspension.

The Indeno[1,2-c]isoquinoline Compounds can be also formulated as a suppository that can be prepared from fatty emulsions or suspensions; using polyalkylene glycols such as propylene glycol, as the carrier.

The Indeno[1,2-c]isoquinoline Compounds can also be administered in the form of liposome delivery systems, such as small unilamellar vesicles, large unilamellar vesicles and multilamellar vesicles. Liposomes can be formed from a variety of phospholipids, containing cholesterol, stearylamine or phosphatidylcholines. In some embodiments, a film of lipid components is hydrated with an aqueous solution of drug to a form lipid layer encapsulating the drug, as described in United States Patent No. 5,262,564.

Indeno[1,2-c]isoquinoline Compounds can also be delivered by the use of monoclonal antibodies as individual carriers to which the Indeno[1,2-c]isoquinoline Compound molecules are coupled. The Indeno[1,2-c]isoquinoline Compounds can also be coupled with soluble polymers as targetable drug carriers. Such polymers can include polyvinylpyrrolidone, pyran copolymer, polyhydroxypropylmethacrylamide-phenol,

polyhydroxyethylaspanamidephenol, or polyethyleneoxidepolylysine substituted with palmitoyl residues. Furthermore, the Indeno[1,2-c]isoquinoline Compounds can be coupled to a class of biodegradable polymers useful in achieving controlled release of a drug, for example, polylactic acid, polyepsilon caprolactone, polyhydroxy butyric acid, polyorthoesters, polyacetals, polydihydropyrans, polycyanoacrylates and cross-linked or amphipathic block copolymers of hydrogels.

Parental injectable administration is generally used for subcutaneous, intramuscular or intravenous injections and infusions. Injectables can be prepared in conventional forms, either as liquid solutions or suspensions or solid forms suitable for dissolving in liquid prior to injection.

One embodiment for parenteral administration employs the implantation of a slow-release or sustained-released system, according to U.S. Pat. No. 3,710,795, incorporated herein by reference.

The compositions can be sterilized or contain non-toxic amounts of adjuvants, such as preserving, stabilizing, wetting or emulsifying agents, solution promoters, salts for regulating the osmotic pressure pH buffering agents, and other substances, including, but not limited to, sodium acetate or triethanolamine oleate. In addition, they can also contain other therapeutically valuable substances.

Compositions can be prepared according to conventional mixing, granulating or coating methods, respectively, and the present pharmaceutical compositions can contain from about 0.1% to about 99%, preferably from about 1% to about 70% of the Indeno[1,2-c]isoquinoline Compound by weight or volume.

The dosage regimen utilizing the Indeno[1,2-c]isoquinoline Compound is selected in accordance with a variety of factors including type, species, age, weight, sex and medical condition of the patient; the severity of the condition to be treated; the route of administration; the renal or hepatic function of the patient; and the particular Indeno[1,2-c]isoquinoline Compound employed. An physician or veterinarian of ordinary skill in the art can readily determine and prescribe the effective amount of the drug required to prevent, counter or arrest the progress of the condition.

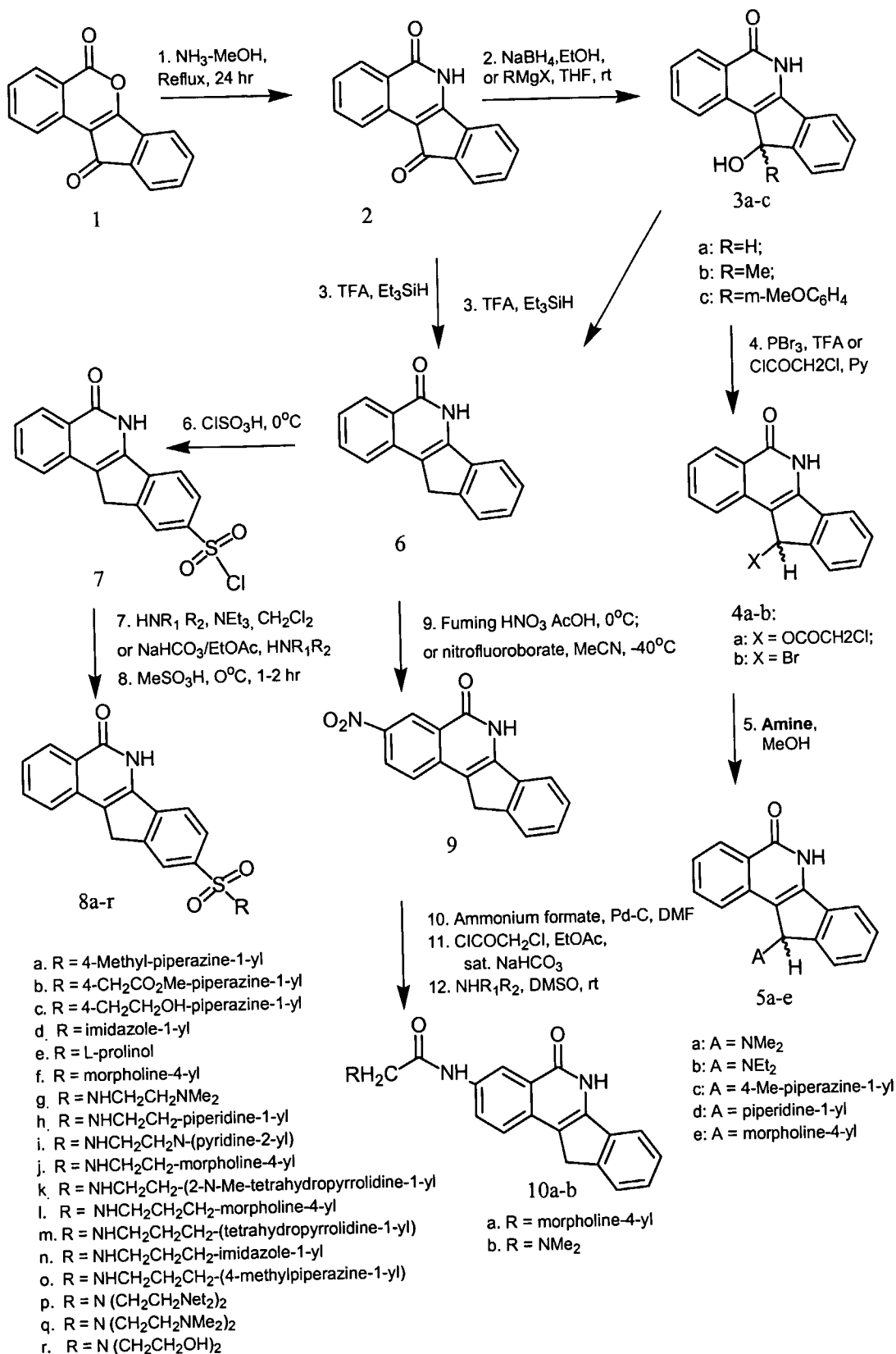
Effective dosage amounts of the present invention, when used for the indicated effects, range from about 0.05 to about 1000 mg of Indeno[1,2-c]isoquinoline Compound per day. The compositions can contain about 0.5, 1.0, 2.5, 5.0, 10.0, 15.0, 25.0, 50.0, 100.0, 250.0, 500.0 or 1000.0 mg of Indeno[1,2-c]isoquinoline Compound. In one embodiment,

the compositions are in the form of a tablet that can be scored. Effective plasma levels of the Indeno[1,2-c]isoquinoline Compounds can range from about 0.002 mg to about 50 mg per kg of body weight per day.

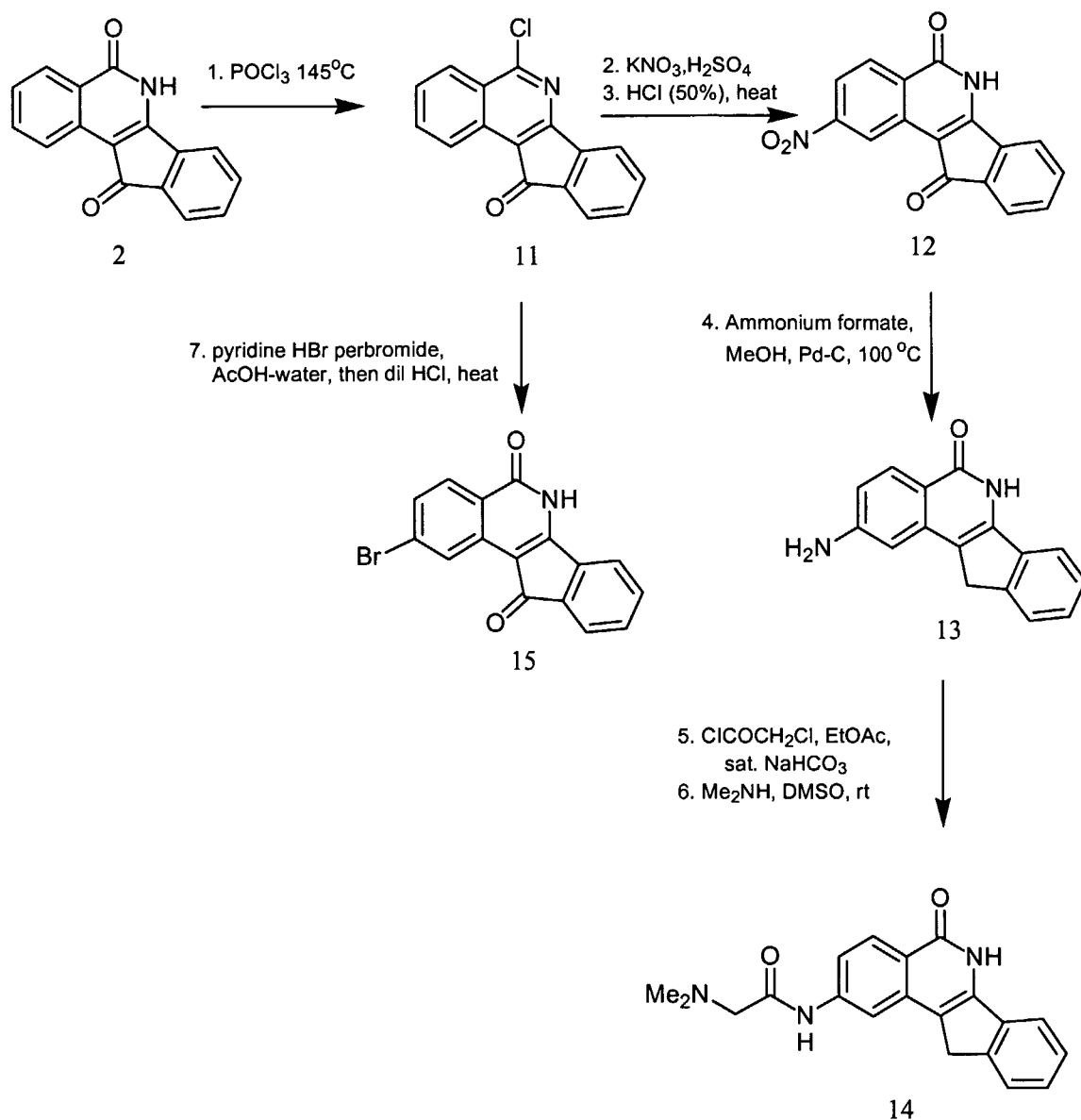
Indeno[1,2-c]isoquinoline Compounds can be administered in a single daily dose, or the total daily dosage may be administered in divided doses of two, three or four times daily. Furthermore, Indeno[1,2-c]isoquinoline Compounds can be administered in intranasal form via topical use of suitable intranasal vehicles, or via transdermal routes, using those forms of transdermal skin patches well known to those of ordinary skill in that art. To be administered in the form of a transdermal delivery system, the dosage administration can be continuous rather than intermittent throughout the dosage regimen. Other illustrative topical preparations include creams, ointments, lotions, aerosol sprays and gels, wherein the concentration of Indeno[1,2-c]isoquinoline Compound ranges from about 0.1% to about 15%, w/w or w/v.

Methods for making Indeno[1,2-c]isoquinoline Compounds

Examples of synthetic pathways useful for making Indeno[1,2-c]isoquinoline Compounds are set forth in the Examples, below and generalized in **Schemes 1** and **2**.



Scheme 1



Scheme 2

5,6-dihydro-5,11-diketo-11*H*-indeno[1,2-*c*]isoquinoline was prepared by reacting compound **1** (Aldrich Chemical, Milwaukee, WI) with ammonia in methanol.

(±) 11-hydroxy-5,6-dihydro-5-oxo-11*H*-indeno[1,2-*c*]isoquinoline (**3a**) was prepared by reacting **2** with NaBH_4 in ethanol.

(±) 11-hydroxy-11-methyl-5,6-dihydro-5-oxo-11*H*-indeno[1,2-*c*]isoquinoline (**3b**) was prepared by reacting **2** with MeMgI .

(±) 11-hydroxy-11-(*m*-methoxyphenyl)-5,6-dihydro-5-oxo-11*H*-indeno[1,2-*c*]isoquinoline (**3c**) was prepared from **2** using *m*- $\text{MeO-C}_6\text{H}_4\text{MgI}$.

(±) 11-*N,N*-dimethylamino-5,6-dihydro-5-oxo-11*H*-indeno [1,2-*c*]isoquinoline (**5a**) was prepared from **3a** using chloroacetylchloride followed by reacting with dimethylamine. Similarly prepared are: (±) 11-*N,N*-diethylamino-5,6-dihydro-5-oxo-11*H*-indeno [1,2-*c*]isoquinoline (**5b**), (±) 11-*N*-(piperidino-1-yl)-5,6-dihydro-5-oxo-11*H*-indeno[1,2-*c*] isoquinoline (**5d**), (±) 11-*N*-(4-methylpiperazino-1-yl)-5,6-dihydro-5-oxo-11*H*-indeno[1,2-*c*] isoquinoline (**5c**), (±) 11-*N*-(morpholino-4-yl)-5,6-dihydro-5-oxo-11*H*-indeno[1,2-*c*]isoquinoline (**5e**). (+) 11-*N*-(morpholino-4-yl)-5,6-dihydro-5-oxo-11*H*-indeno[1,2-*c*]isoquinoline (**5e**) was also prepared from (±) 11-bromo-5,6-dihydro-5-oxo-11*H*-indeno[1,2-*c*]isoquinoline (**4b**).

5,6-Dihydro-5-oxo-11*H*-indeno-[1,2-*c*]isoquinoline (**6**) is prepared by reduction of 5,6-dihydro-5,11-diketo-11*H*-indeno[1,2-*c*]isoquinoline (**2**) or (±) 11-hydroxy-5,6-dihydro-5-oxo-11*H*-indeno[1,2-*c*]isoquinoline (**3a**) using CF₃COOH/triethylsilane. 9-Chlorosulphonyl-5,6-dihydro-5-oxo-11*H*-indeno-[1,2-*c*] isoquinoline (**7**) was prepared by chlorosulfonation of 5,6-dihydro-5-oxo-11*H*-indeno- [1,2-*c*]isoquinoline (**6**). 9-[*N*-(4-methylpiperazine-1-yl)sulphonyl]-5,6-dihydro-5-oxo-11*H*-indeno-[1,2-*c*] isoquinoline (**8a**) was prepared from 9-chlorosulphonyl-5,6-dihydro-5-oxo-11*H*-indeno-[1,2-*c*]isoquinoline (**7**), and *N*-methylpiperazine. Similarly prepared are: 9-[*N*-(4-carbomethoxymethylenepiperazino-1-yl)sulphonyl]-5,6-dihydro-5-oxo-11*H*-indeno-[1,2-*c*]isoquinoline (**8b**), 9-[*N*-(4-(2-hydroxyethyl)piperazino-1-yl)-sulphonyl]-5,6-dihydro-5-oxo-11*H*-indeno-[1,2-*c*]isoquinoline (**8c**), 9-[*N*-(imidazolo-1-yl)sulphonyl]-5,6-dihydro-5-oxo-11*H*-indeno[1,2-*c*]isoquinoline (**8d**), 9-[*N*-(2-hydroxyprolinyl)sulphonyl]-5,6-dihydro-5-oxo-11*H*-indeno[1,2-*c*]isoquinoline (**8e**), 9-[*N*-morpholinesulphonyl]-5,6-dihydro-5-oxo-11*H*-indeno-[1,2-*c*]isoquinoline (**8f**), 9-[*N*-(2-[*N,N*-dimethylamino]ethyl)-aminosulphonyl]-5,6-dihydro-5-oxo-11*H*-indeno[1,2-*c*]isoquinoline (**8g**), 9-[*N*-(2-[piperidino-1-yl]ethyl)-aminosulphonyl]-5,6-dihydro-5-oxo-11*H*-indeno[1,2-*c*]isoquinoline (**8h**), 9-[*N*-(2-(pyridino-2-yl)-ethyl)-aminosulphonyl]-5,6-dihydro-5-oxo-11*H*-indeno[1,2-*c*]isoquinoline (**8i**), 9-[*N*-(2-[morpholino-4-yl]ethyl)-aminosulphonyl]-5,6-dihydro-5-oxo-11*H*-indeno[1,2-*c*]isoquinoline (**8j**), 9-[*N*-(2-[*N*-methyltetrahydropyrrolidino-1-yl]ethyl)aminosulphonyl]-5,6-dihydro-5-oxo-11*H*-indeno-[1,2-*c*]isoquinoline (**8k**), 9-[*N*-(3-[morpholino-4-yl]propyl)-aminosulphonyl]-5,6-dihydro-5-oxo-11*H*-indeno-[1,2-*c*]isoquinoline (**8l**), 9-[*N*-(3-[tetrahydropyrrolodino-1-yl]propyl)aminosulphonyl]-5,6-dihydro-5-oxo-11*H*-indeno-[1,2-*c*] isoquinoline (**8m**), 9-[*N*-(3-[imidazolo-1-yl]propyl)-aminosulphonyl]-5,6-dihydro-5-oxo-11*H*-indeno-[1,2-*c*]isoquinoline (**8n**), 9-[*N*-(3-(4-

methylpiperazino-1-yl]propyl)-aminosulphonyl]-5,6-dihydro-5-oxo-11H-indeno-[1,2-c]isoquinoline (**8o**), 9-[*N,N*-di-(2-[*N,N*-diethylamino]ethyl)-aminosulphonyl]-5,6-dihydro-5-oxo-11H-indeno-[1,2-c]isoquinoline (**8p**), 9-[*N,N*-di-(2-[*N,N*-dimethylamino]ethyl)-aminosulphonyl]-5,6-dihydro-5-oxo-11H-indeno-[1,2-c]isoquinoline (**8q**), and 9-[*N,N*-di-(2-[*N,N*-dihydroxyethylamino]ethyl)-aminosulphonyl]-5,6-dihydro-5-oxo-11H-indeno-[1,2-c]isoquinoline (**8r**).

The amide derivatives 3-morpholin-4-yl-*N*-(5-oxo-5,11-dihydro-6*H*-indeno[1,2-c]isoquinolin-3-yl)-acetamide (**10a**), 3-dimethylamino-*N*-(5-oxo-5,11-dihydro-6*H*-indeno[1,2-c]isoquinolin-3-yl)-acetamide (**10b**) and 2-dimethylamino-*N*-(5-oxo-5,11-dihydro-6*H*-indeno[1,2-c]isoquinolin-2-yl)-acetamide (**14**) were prepared from 5,6-dihydro-5-oxo-11H-indeno[1,2-c]isoquinoline (**6**) and 5-chloro-11H-indeno[1,2-c]isoquinoline (**11**) using nitration, then reduction, and followed by amination of the chloroacetamide intermediate. 2-bromo-5,6-dihydro-5-oxo-11H-indeno[1,2-c]isoquinoline (**15**) was prepared by bromination of chloroamidate **11**.

The invention is further described in the following examples, which do not limit the scope of the invention described in the claims. The following examples illustrate the synthesis of illustrative Indeno[1,2-c]isoquinoline Compounds of the invention, and demonstrates their usefulness for treating or preventing an inflammatory disease or reperfusion disease.

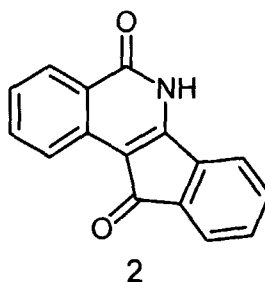
5. EXAMPLES

Example 1: Synthesis of Illustrative Indeno[1,2-c]isoquinoline Compounds

a) General Methods

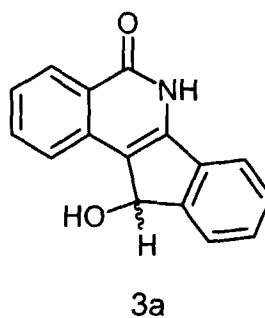
Proton NMR spectra were obtained using a Varian 300 MHz spectrophotometer and chemical shift values (δ) are reported in parts per million (ppm). TLC was performed using TLC plates precoated with silica gel 60 F-254, and preparative TLC was performed using precoated Whatman 60A TLC plates. All intermediates and final compounds were characterized on the basis of ^1H NMR and MS data.

b) Synthesis of 5,6-dihydro-5,11-diketo-11*H*-indeno [1,2-c]isoquinoline (**2**):



A stirred suspension of **1** (55 g, 0.22 mol) in NH_3/MeOH (7.0N, 700 mL) was refluxed 15 for 24 h. The reaction mixture was then allowed to cool to room temperature and was filtered and washed thoroughly with MeOH to provide 46 g of the orange colored above-titled product in 84% yield. ^1H NMR ($\text{DMSO}-d_6$): δ 7.48-7.61 (m, 4H), 7.80-7.88 (m, 1H), 7.86 (d, J = 8.7 Hz, 1H), 8.22 (d, J = 8.4 Hz, 1H), 8.44 (d, J = 7.5 Hz, 1H), 13.05 (s, 1H); ^{13}C NMR ($\text{DMSO}-d_6$): δ 106.33, 121.63, 122.94, 123.27, 124.80, 128.45, 132.17, 133.60, 134.03, 134.68, 134.68, 134.81, 137.09, 156.41, 163.76, 190.57; MS (ES^-): m/z 246.2 ($\text{M}-1$); Anal. Calcd for $\text{C}_{16}\text{H}_9\text{NO}_2$: C, 77.72; H, 3.67; N, 5.67; Found: C, 77.54; H, 3.69, N, 5.69.

c) Synthesis of ($\pm$) 11-hydroxy-5,6-dihydro-5-oxo-11H-indeno[1,2-c] isoquinoline (3a**):**

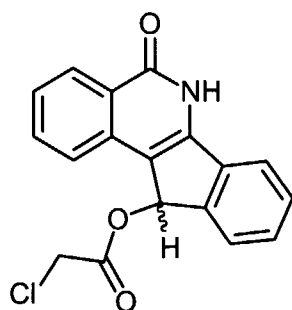


To a stirred suspension of **2** (2.5 g, 0.01 mol) in EtOH (25 mL) was added NaBH_4 (3.75 g, 0.1 mol) at room temperature in small portions over 30 min. The reaction mixture was stirred for an additional 2 h and then cooled to 0°C where it was triturated with dilute HCl (10% soln.). The resulting solid precipitated was filtered and washed with water and MeOH to provide **3a** (2.326 g, 92%). ^1H NMR ($\text{DMSO}-d_6$): δ 5.58 (d, J = 8.1 Hz, 1H), 5.78 (d, J = 8.7 Hz, 1H), 7.33 -7.89 (m, 6H), 7.95 (d, J = 7.8 Hz, 1H), 8.22 (d, J = 7.8 Hz, 1H), 12.29 (s, 1H); ^{13}C NMR ($\text{DMSO}-d_6$): δ 77.44, 118.81, 120.15, 124.28, 125.04, 125.67, 126.34, 128.46, 128.64, 128.95, 133.27, 135.62, 136.12, 139.93, 148.55, 163.69.; MS (ES^+):

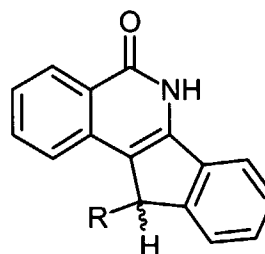
m/z 250.1 (M+1); Anal. Calcd for C₁₆H₁₁NO₂: C, 77.10; H, 4.45; N, 5.62. Found: C, 77.01; H, 4.57, N, 5.59.

Similarly, by reacting **2** with MeMgI and m-MeO-C₆H₄MgBr, respectively, compounds (±) 11-hydroxy-11-methyl-5,6-dihydro-5-oxo-11*H*-indeno[1,2-*c*]isoquinoline (**3b**) and (±) 11-hydroxy-11-(m-methoxyphenyl)-5,6-dihydro-5-oxo-11*H*-indeno[1,2-*c*]isoquinoline (**3c**) were prepared.

d) Synthesis of 11-substituted 5,6-dihydro-5-oxo-11*H*-indeno[1,2-*c*]isoquinolines (5a-e):



4a



5a-e

5a: R = NMe₂

5b: R = NEt₂

5c: R = -piperidine-1-yl

5d: R = -N-methyl-piperidin-4-yl

5e: R = -morpholin-1-yl

To a stirred suspension of **3a** (0.5 g, 0.002 mol) in pyridine (10 mL) was added chloroacetyl chloride (0.81 g, 0.006 mol) at 0°C. The reaction mixture was allowed to warm to room temperature and stir for 24 h. The reaction mixture was then poured on ice and extracted with EtOAc. The organic layer was separated, dried and concentrated to provide crude compound **4a**, which was treated further with dimethylamine and stirred at room temperature for 24 h. The reaction mixture was poured on ice, and treated with 10% HCl. The resulting mixture was then basified using saturated aqueous NaHCO₃ and the resulting solid was filtered to provide the desired product **5a**. ¹H NMR (DMSO-D₆): δ 2.31 (s, 6H), 5.00 (s, 1H), 7.28-7.45 (m, 3H), 7.68 - 7.73 (m, 2H), 7.95 (d, *J* = 6.9 Hz, 1H), 8.10 (d, *J* = 7.8 Hz, 1H), 8.21 (d, *J* = 8.1 Hz, 1H), 12.26 (s, 1H); ¹³C NMR (DMSO-D₆): δ 68.09,

116.28, 120.52, 124.58, 125.74, 126.27, 126.34, 127.68, 128.64, 133.02, 136.27, 144.45, 163.80; MS (ES⁺): m/z 277.2 (M+1).

The following compounds were also prepared by reacting **4a** as above with diethylamine, piperidine, N-methylpiperidine and morpholine, respectively:

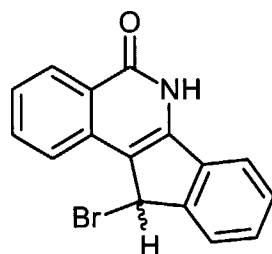
(±) 11-diethylamino-5,6-dihydro-5-oxo-11*H*-indeno[1,2-*c*]isoquinoline (**5b**)

(±) 11-piperidino-5,6-dihydro-5-oxo-11*H*-indeno[1,2-*c*]isoquinoline (**5c**)

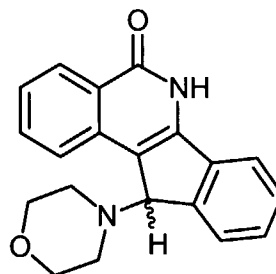
(±) 11-(*m*-methylpiperazino)-5,6-dihydro-5-oxo-11*H*-indeno[1,2-*c*]isoquinoline (**5d**)

(±) 11-morpholino-5,6-dihydro-5-oxo-11*H*-indeno[1,2-*c*]isoquinoline (**5e**).

e) Synthesis of (±) 11-morpholino-5,6-dihydro-5-oxo-11*H*-indeno[1,2-*c*]isoquinolines (5e**) from **4b****



4b



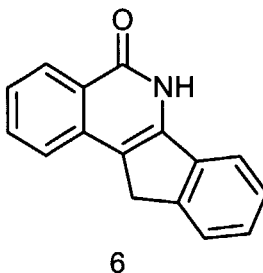
5e

To a stirred suspension of **3a** (0.6 g, 2.4 mmol) in trifluoroacetic acid (5 mL) was added phosphorus tribromide (1.0 M soln. in CH₂Cl₂, 3 mL) at room temperature, and the reaction mixture was stirred for 8 h. The reaction mixture was poured on ice and the resulting solid was filtered to provide bromo compound **4b** (0.61 gm, 76%). ¹H NMR (DMSO-D₆): δ 7.35-7.50 (m, 3H), 7.61 (d, *J* = 6.6 Hz, 1H), 7.73 -7.82 (m, 2H), 7.94 (d, *J* = 6.6 Hz, 1H), 8.23 (d, *J* = 7.8 Hz, 1H), 12.41 (s, 1H); ¹³C NMR (DMSO-D₆): δ 52.06, 79.35, 114.43, 120.56, 123.58, 125.27, 125.50, 126.68, 128.55, 128.86, 129.66, 133.73, 135.91, 136.61, 141.39, 143.95, 163.74.

Compound **4b** (0.5 g) was suspended in MeOH (10 mL) and treated with excess morpholine (~10 eq.) at room temperature and stirred at 60°C for 3 h. The reaction mixture was poured on ice, and diluted with ethyl acetate (40 mL). The organic layer was separated and extracted in dil. HCl (10% soln.), the aqueous layer was then basified with sat. aq. NaHCO₃ and the resulting solid precipitated was filtered and dried to provide **5e** (0.46 g, 90%). ¹H NMR (DMSO-D₆): δ 2.56 (m, 4H), 3.49 (m, 4H), 5.04 (s, 1H), 7.31-7.45 (m, 3H),

7.65 -7.76 (m, 2H), 7.96 (d, $J = 7.2$ Hz, 1H), 8.20-8.24 (m, 2H), 12.29 (s, 1H); ^{13}C NMR (DMSO- D_6): δ 49.36, 67.62, 68.11, 115.20, 120.60, 124.47, 125.84, 126.34, 126.41, 127.76, 128.30, 128.72, 133.09, 136.30, 136.96, 140.35, 144.44, 163.67.

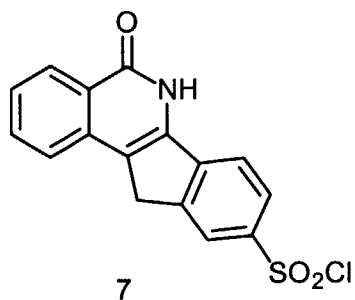
f) Synthesis of 5,6-dihydro-5-oxo-11H-indeno [1,2-c] isoquinoline (6):



Method I: To a stirred solution of the alcohol **3a** (0.35 g, 1.4 mmol) in trifluoroacetic acid (10 mL) was added at room temperature triethylsilane (0.812 g, 7 mmol) and the reaction mixture was stirred for 24 h. Trifluoroacetic acid was evaporated in vacuo and EtOAc was added to the resulting crude product. The resulting solid was filtered and washed with H_2O and EtOAc to provide the above-titled compound **6** (0.285 g, 87 %). ^1H NMR (DMSO- D_6): δ 3.89 (s, 2H), 7.30 - 7.47 (m, 3H), 7.59 (d, $J = 6.9$ Hz, 1H), 7.72 - 7.74 (m, 2H), 7.98 (d, $J = 7.8$ Hz, 1H), 8.23 (d, $J = 8.4$ Hz, 1H), 12.31 (s, 1H); ^{13}C NMR (DMSO- D_6): δ 33.51, 116.50, 120.19, 124.01, 125.51, 125.55, 126.42, 127.50, 127.68, 128.56, 133.45, 136.39, 137.53, 140.18, 143.80, 163.46; MS (ES $^+$): m/z 232.1 (M-1); Anal. Calcd for $\text{C}_{16}\text{H}_{11}\text{NO}$: C, 82.38; H, 4.75; N, 6.00. Found: C, 81.79; H, 4.45; N, 5.99.

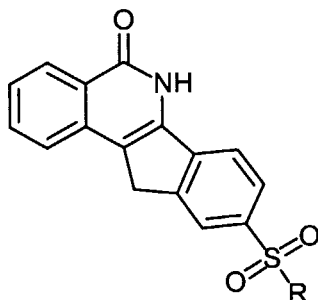
Method II: To a stirred suspension of **2** (40 g, 0.16 mol) in trifluoroacetic acid (2.5 L) was added triethylsilane (94 g, 0.8 mol) in small portions at room temperature and the reaction mixture was stirred for 96 h, during which time the reaction progress was monitored using TLC (eluent - 5% MeOH/ CH_2Cl_2). The reaction mixture was slowly poured on ice, filtered, washed with copious amounts of H_2O and MeOH and dried in vacuo to provide the above-titled compound **6** (33.1 g, 88 %), whose spectral data were identical to those of a sample of compound **6** that was obtained using Method I.

g) Synthesis of 9-chlorosulfonyl-5,6-dihydro-5-oxo-11H-indeno[1,2-c] isoquinoline (7):



Compound **6** (40 g, 0.17 mol) was added in small portions to chlorosulfonyl chloride (112 mL, 1.71 mol) at 0°C and the reaction mixture was allowed to warm to room temperature and stir for 2 h. The reaction mixture was slowly poured on ice and the resulting yellow solid was filtered, washed thoroughly with water and EtOAc and dried in vacuo to provide the above-titled product **7** (52 g, 92 %). ¹H NMR (DMSO-D₆): δ 3.91 (s, 2H), 7.43 - 7.48 (m, 1H), 7.60 (d, *J* = 7.2 Hz, 1H), 7.74 - 7.76 (m, 2H), 7.79 (s, 1H), 7.90 (d, *J* = 7.5 Hz, 1H), 8.23 (d, *J* = 7.8 Hz, 1H), Anal. Calcd for C₁₆H₁₂ClNO₄S: C, 54.94; H, 3.46; N, 4.00. Found: C, 55.28; H, 3.43, N, 3.68, Karl-Fisher, 2.95.

h) Synthesis of 9-sulphonamido derivatives of 5,6-dihydro-5-oxo-11*H*-indeno[1,2-*c*]isoquinolines (8a-r) from 7:



8a-r

- a. R = -*N*-(4-Methyl-piperazine-1-yl)
- b. R = -*N*-(4-CH₂CO₂Me)-piperazine-1-yl
- c. R = -*N*-(4-CH₂CH₂OH)-piperazine-1-yl
- d. R = -*N*-imidazole-1-yl
- e. R = -*N*-L-prolinyl
- f. R = -*N*-morpholin-4-yl
- g. R = -NHCH₂CH₂NMe₂
- h. R = -NHCH₂CH₂-piperidine-1-yl
- i. R = -NHCH₂CH₂-(pyridine-2-yl)
- j. R = -NHCH₂CH₂-morpholin-4-yl
- k. R = -NHCH₂CH₂-(2-*N*-Me-tetrahydropyrrolidine-1-yl)
- l. R = -NHCH₂CH₂CH₂-morpholin-4-yl
- m. R = -NHCH₂CH₂CH₂-(tetrahydropyrrolidine-1-yl)
- n. R = -NHCH₂CH₂CH₂-imidazole-1-yl
- o. R = -NHCH₂CH₂CH₂-(4-methylpiperazine-1-yl)
- p. R = -N(CH₂CH₂Net₂)₂
- q. R = -N(CH₂CH₂NMe₂)₂
- r. R = -N(CH₂CH₂OH)₂

Method I: To a stirred suspension of 3-(4-morpholino)-1-propylamine (17.28 g, 0.12 mol) in EtOAc was added sat. aq. NaHCO₃ (300 mL), and the mixture was allowed to stir for 15 min. Compound 7 (4.0 g, 0.012 mol) was then introduced in small portions at room temperature. The reaction mixture was stirred for 24h; filtered and washed with H₂O, EtOAc and MeOH; refluxed in MeOH for 30 min; filtered while still warm; and washed with MeOH to provide the above-titled product **8l** as a free base (2.330 g, 44%). ¹H NMR(DMSO-D₆): δ 1.47-1.52 (m, 2H), 2.16-2.21 (m, 4H), 2.47-2.48 (m, 2H), 3.44-3.48 (m, 2H), 3.23 (m, 4H), 4.02 (s, 2H), 7.49 - 7.58 (m, 1H), 7.78-7.82 (m, 3H), 7.97 (s, 1H), 8.14 (d, *J* = 7.8 Hz, 1H), 8.26 (d, *J* = 7.8 Hz, 1H), 9.59 (s, 1H), 12.42 (s, 1H).

The free bases of **8d**, **8g**, **8h**, **8j**, **8l**, **8m-8r** were also prepared by Method I, but substituting 3-(4-morpholino)-1-propylamine with imidazole, 2-dimethylamino-ethylamine,

2-(*N*-piperidinyl)-ethylamine, 2-(*N*-morpholinyl)-ethylamine, 3-(*N*-morpholinyl)-propylamine, 3-(*N*-tetrahydropyrrolidinyl)-propylamine, 3-(*N*-imidazolyl)-propylamine, 3-(*N*-(4-methylpiperazinyl)-propylamine, di-(2-(diethylamino)-ethyl)amine, di-(2-(dimethylamino)-ethyl)amine and di-(2-hydroxyethyl)amine, respectively.

9-(*N*-sulphonylimidazole)-5,6-dihydro-5oxo-11*H*-indeno[1,2-*c*]isoquinolines (8a-r):

Method II: To a stirred suspension of 3-(4-morpholino)-1-propylamine (4.250 g) in CH₂Cl₂ (100 mL) was added **7** (1.950 g, 5.89 mmol) and the resulting mixture was stirred for 5 minutes. Subsequently, triethylamine (3 mL) was added and the reaction mixture was stirred for 24 hr at room temperature. After this time the precipitate was collected and washed with MeOH (2 x 100 mL) and the crude solid product transferred to a round bottom flask. This material was diluted with MeOH (200 mL), heated to reflux for 30 min. and filtered while still warm. The resulting filtercake was washed with MeOH (200 mL) to provide the desired product as the free base of **8I** (1.460 g, 56%).

The free bases of compounds **8a-r** were prepared using Method II, but substituting 3-(4-morpholino)-1-propylamine with imidazole, 2-dimethylamino-ethylamine, 2-(*N*-piperidinyl)-ethylamine, 2-(*N*-morpholinyl)-ethylamine, 3-(*N*-morpholinyl)-propylamine, 3-(*N*-tetrahydropyrrolidinyl)-propylamine, 3-(*N*-imidazolyl)-propylamine, 3-(*N*-(4-methylpiperazinyl)-propylamine, di-(2-(diethylamino)-ethyl)amine, di-(2-(dimethylamino)-ethyl)amine and di-(2-hydroxyethyl)amine, respectively.

i) General procedure for the preparation of mesylate salts of 8a-r:

Free base **8I** was added to methanesulfonic acid at 0°C and the resulting mixture was allowed to warm to room temperature and stir for 2 h. The reaction mixture was then poured into cold MeOH (between -10°C and 0°C) and the precipitated solid was filtered, washed with MeOH (100 mL) and dried in vacuo. The dried solid was then dissolved in water (~200 mL) and lyophilized to provide the methanesulfonate monohydrate salt **8I**. (1.020 g, 84%). ¹H NMR (DMSO-D₆): δ 1.75-1.85 (m, 2H), 2.35 (s, 3H), 2.78-2.84 (m, 2H), 2.96-3.12 (m, 4H), 3.36 (d, *J* = 12.3 Hz, 2H), 3.61 (t, *J* = 11.4 Hz, 2H), 3.94 (d, *J* = 12.9 Hz, 2H), 4.03 (s, 2H), 7.49 - 7.55 (m, 1H), 7.76-7.84 (m, 3H), 7.99 (d, *J* = 0.9 Hz, 1H), 8.15 (d, *J* = 8.4 Hz, 1H), 8.25 (d, *J* = 8.4 Hz, 1H), 9.59 (s, 1H), 12.42 (s, 1H); ¹³C NMR (DMSO-D₆): δ 24.27, 33.86, 51.89, 54.51, 64.02, 119.70, 120.39, 123.53, 126.09, 126.45, 128.63,

133.66, 135.80, 138.71, 141.21, 144.57, 163.29; Anal. Calcd for $C_{24}H_{31}N_3O_8S_2$: C, 52.06; H, 5.46; N, 7.59, Karl-Fisher, 3.36. Found: C, 51.85; H, 5.35, N, 7.30, Karl-Fisher, 4.32.

Similarly, HCl, H_2SO_4 , CH_3COOH , and succinic acid salts of **8l** were prepared by substituting methanesulfonic acid with HCl, H_2SO_4 and CH_3COOH , respectively.

Example 2. Effect of Illustrative Indeno[1,2-c]isoquinoline Compounds on PARS activity in cultured macrophages, using a whole-cell based assay and a purified enzyme assay.

Demonstration of illustrative Indeno[1,2-c]isoquinoline Compounds' ability to inhibit PARS and prevent peroxynitrite induced cytotoxicity was shown using methods described in Virag et al., *Br J Pharmacol.* 1999, 126(3):769-77; and *Immunology* 1998, 94(3):345-55. RAW mouse macrophages were cultured in DMEM medium with high glucose and supplemented with 10% fetal bovine serum. Cells were used at 80% confluence in 12-well plates. Cells were pretreated with various concentrations (100 nM - 1 μ M) of an Indeno[1,2-c]isoquinoline Compound for 10 min. Peroxynitrite, a prototypical oxidant which induces DNA single strand breakage, was used to induce PARS activation. Peroxynitrite was diluted in phosphate buffered saline (PBS) (pH 11.0) and added to the cells in a bolus of 50 μ l. Cells were then incubated for 20 min. Peroxynitrite was decomposed by incubation for 30 min at pH 7.0, used as a control, and failed to influence the parameter studied. After the 20 min incubation, the cells were spun, the medium was aspirated and the cells were resuspended in 0.5 ml assay buffer (56 mM HEPES pH 7.5, 28 mM KCl, 28 mM NaCl, 2 mM $MgCl_2$, 0.01 % w/v digitonin and 0.125 μ M NAD^+ and 0.5 μ Ci/ml 3H - NAD^+). Following an incubation in assay buffer, (10 min at 37 $^{\circ}C$), PARS activity was measured as follows: 200 μ l ice cold 50 % w/v TCA was added and the samples were incubated for 4 hours at 4 $^{\circ}C$. Samples were then spun (10 min @ 10,000 g) and pellets washed twice with ice cold 5 % w/v TCA and solubilized overnight in 250 μ l 2 % w/v SDS/0.1 N NaOH at 37 $^{\circ}C$. The contents of the tubes were added to 6.5 ml ScintiSafe Plus scintillation liquid (Fisher Scientific) and radioactivity was determined using a liquid scintillation counter (Wallac, Gaithersburg, MD). The results shown in Table 1 demonstrate that the illustrative Indeno[1,2-c]isoquinoline Compounds significantly and dose-dependently inhibit the activation of PARS in the macrophage assay.

Table 1. Inhibitory effect of various novel substituted indeno[1,2-c]isoquinolines on PARS activation in cultured murine macrophages.

Compound No.	% PARS inhibition at 1 μ M	% PARS inhibition at 300 nM	% PARS inhibition at 100 nM
2	60	NT	16
3a	67	NT	8
3b	25	0	NT
3c	21	9	NT
4b	88	NT	51
5a	55	NT	10
5b	33	NT	0
5c	24	NT	0
5d	48	NT	0
5e	21	NT	0
6	65	NT	30
7	50	NT	0
8a	NT	47	NT
8b	NT	NT	NT
8c	NT	27	NT
8d	NT	82	77
8e	NT	68	NT
8f	NT	NT	NT
8g	NT	55	34
8h	NT	76	56
8j	NT	76	34
8k	NT	38	24
8l	NT	84	34
8m	NT	50	NT
8n	NT	82	74
8o	NT	55	48

8p	NT	45	27
8q	NT	28	20
8r	NT	28	20
10a	NT	59	55
10b	NT	17	17

NT = Not tested

The potency of inhibition on purified PARS enzyme was subsequently determined for selected Indeno[1,2-c]isoquinoline Compounds, and the potency was compared with that of 3-aminobenzamide, a prototypical benchmark PARS inhibitor. The assay was performed in 96 well ELISA plates according to instructions provided with a commercially available PARS inhibition assay kit (Trevigen, Gaithersburg, MD). Briefly, wells were coated with 1 mg/mL histone (50 μ l/well) at 4°C overnight. Plates were then washed four times with PBS and then blocked by adding 50 μ l Strep-Diluent (supplied with the kit). After incubation (1h, room temperature), the plates were washed four times with PBS. Appropriate dilutions of PARS inhibitors were combined with 2x PARS cocktail (1.95 mM NAD⁺, 50 μ M biotinylated NAD⁺ in 50 mM TRIS pH 8.0, 25 mM MgCl₂) and high specific activity PARS enzyme (both were supplied with the kit) in a volume of 50 μ l. The reaction was allowed to proceed for 30 min at room temperature. After 4 washes in PBS, incorporated biotin was detected by peroxidase-conjugated streptavidin (1:500 dilution) and TACS Sapphire substrate. The assay confirmed the results of the macrophage-based PARS assay. For example, the PARS inhibitor **8l** exerted 50% inhibition of PARS activity in this assay at 3 nM, and thus was approximately 50,000 times more potent than the reference compound 3-aminobenzamide.

Example 3: Effects of illustrative Indeno[1,2-c]isoquinoline Compounds in various models of inflammatory disease and reperfusion disease

a: Effects of illustrative Indeno[1,2-c]isoquinoline Compounds on in vitro cell disease models

In additional *in vitro* studies in isolated thymocytes, cells were exposed to peroxynitrite or hydrogen peroxide (toxic oxidant species) to induce cytotoxicity. In this system the toxicity is, at least in part, related to activation of the nuclear enzyme PARS. In this oxidant-stimulated thymocyte assay (described, in detail, in Virag et al., *Immunology* 94(3):345-55, 1998), the compounds tested prevented the oxidant-induced suppression of the viability of the cells and did so at the low nanomolar concentration range. An example of this response (Compound **8l**) is shown in Table 2. This assay represents an *in vitro* model of cells dying because of exposure to pro-oxidant species, as it occurs in during the reperfusion of ischemic organs.

Table 2. Reduction of peroxynitrite induced cytotoxicity by 30 nM - 3 μ M of the Indeno[1,2-c]isoquinoline Compound **8l.**

	Control	+ 8l 30 nM	+ 8l 100 nM	+ 8l 300 nM	+ 8l 1 μ M	+ 8l 3 μ M
Cytotoxicity	98%	74%	39%	2%	0%	0%

b: Effect of illustrative Indeno[1,2-c]isoquinoline Compounds on *in vivo* models of inflammatory diseases

In order to substantiate the efficacy of the compounds in inflammatory diseases, the effect of illustrative Indeno[1,2-c]isoquinoline Compounds was demonstrated in a systemic inflammatory model induced by bacterial lipopolysaccharide (LPS), which is reported to be responsible for causing reperfusion diseases and inflammatory diseases such as septic shock and systemic inflammatory response syndrome in animals (*see* Parrillo, *N. Engl. J. Med.*, 328:1471-1478 (1993) and Lamping, *J. Clin. Invest.* 101:2065-2071 (1998)). In a series of experiments, mice were pretreated with intraperitoneal injection of 0.1 and 1 mg/kg of compounds **8l**, **8p** and **8j**, and LPS at 10 mg/kg was injected i.p., and TNF-alpha was measured in the plasma at 90 minutes. As shown in Table 3, all compounds substantially reduced TNF production, indicative of the compounds' anti-inflammatory activity.

Table 3. Reduction of LPS induced TNF production by 0.1 -1 mg/kg intraperitoneal injection of the PARS inhibitor compounds **8L, **8P** and **8J** in mice *in vivo***

	8j (0.1 mg/kg)	8j (1.0 mg/kg)	8p (0.1 mg/kg)	8p (1.0 mg/kg)	8l (0.1 mg/kg)	8l (1.0 mg/kg)	Vehicle
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TNF	3831.6	5038.8	4470.0	5090.8	3714.6	3509.8	6994.0
(ng/ml)	± 385.2	± 377.1	± 184.4	± 203.7	± 300.9	± 311.5	± 904.4

All compounds markedly suppressed LPS induced TNF production when compared to control.

At high doses, LPS causes multiple organ dysfunction resembling of septic shock, and ultimately death (in part because of the early release of TNF-alpha). Similarly, in a model induced by cecal ligation and puncture (CLP), the live bacteria that derive from the intestinal flora induce systemic inflammation and shock. Agents that inhibit inflammatory mediator production, PARS activation, and cell death in this model prevent mortality induced by LPS or CLP. In experiments with Balb/c mice, injection of 100 mg/kg LPS intraperitoneally caused death in 50% of the animals over 24 h, whereas treatment of the animals with 3 mg/kg/day of compound **8l** reduced the endotoxin-induced mortality to 10% under the same experimental conditions. In response to CLP induced shock, compound **8l** (3 mg/kg/day) caused a reduction in the mortality from 100% death to 60% death over 24 hours.

The data demonstrating the reduction of TNF production by illustrative Indeno[1,2-c]isoquinoline Compounds in animals subjected to an inflammation model, coupled with the fact that TNF production is an important trigger of inflammation in various inflammatory diseases (such as, for example, colitis, arthritis and neuroinflammation and shock) indicate that the Indeno[1,2-c]isoquinoline Compounds have therapeutic effects in various systemic and local inflammatory diseases, including the rejection of transplanted organs, which entails both an inflammatory disease component and a reperfusion disease component and, accordingly, are useful for treating or preventing an inflammatory disease or a reperfusion disease.

c: Effect of illustrative Indeno[1,2-c]isoquinoline Compounds on *in vivo* models of reperfusion disease

In order to substantiate the efficacy of the Indeno[1,2-c]isoquinoline Compounds in ischemia-reperfusion conditions, the effect of an illustrative Indeno[1,2-c]isoquinoline Compound in a mouse model of ischemic and reperfused gut was tested. The superior

mesenteric artery was occluded for 45 min, followed by a reperfusion for 1 h. Following the end of the reperfusion, gut permeability was measured with the FD4 method in everted gut sacks (Liaudet et al; *Shock* 2000, 14(2):134-41). Ischemia-reperfusion increased the permeability of the gut from 11 ± 4 to 216 ± 27 ml/min/cm², indicative of severe damage of the reperfused gut. Treatment with Compound **8I** (3 mg/kg i.v., injected 10 min. prior to initiation of reperfusion) reduced the increase in the permeability of the gut by approximately 73%, indicating a marked maintenance of the gut function. The ischemia-reperfusion studies in the gut were associated with a 80% mortality over 12 hours, whereas only 15% mortality was noted in the animals treated with **8I**.

In another set of experiments, the effect of Compound **8I** in a rat model of middle cerebral artery occlusion/reperfusion was assayed as described in Abdelkarim *et al.*, *Int J Mol Med*. 2001, 7(3):255-60. Occlusion lasted for 2 hours, followed by reperfusion for 24 hours. Infarct size was quantified with tetrazolium staining. Compound **8I** was administered at 3 mg/kg/day in 3 divided intraperitoneally injected doses, the first dose being administered 10 min. prior to the initiation of reperfusion. There was an approximately 80% reduction in the degree of cortical necrosis and neuronal death in the animals administered with **8I**, when compared to vehicle-treated controls. This protection also translated into functional benefit, such as neurological improvements in the PARS inhibitor treated group.

These data indicate that the Indeno[1,2-c]isoquinoline Compounds have therapeutic effects in various systemic and local conditions of reperfusion diseases, including the rejection of transplanted organs, which entails both an inflammatory disease component and a reperfusion disease component and, accordingly, are useful for treating or preventing an inflammatory disease or a reperfusion disease.

d: Effect of illustrative Indeno[1,2-c]isoquinoline Compounds in a diabetes model

PARS inhibitors and PARS deficiency are known to reduce the development of diabetes and the incidence of diabetic complications (Mabley et al., *Br J Pharmacol*. 2001, 133(6):909-9; and Soriano et al., *Nat Med*. 2001, 7(1):108-13). In order to substantiate the efficacy of the Indeno[1,2-c]isoquinoline Compounds in a diabetes model, a single high-dose streptozotocin model of diabetes was conducted as previously described. Briefly, 160 mg/kg streptozotocin was injected to mice treated with vehicle or with illustrative

Indeno[1,2-c]isoquinoline Compounds intraperitoneally (3 mg/kg) and 3 days later blood sugar levels were determined using a blood glucose meter. The data shown in Table 4 demonstrate that the illustrative Indeno[1,2-c]isoquinoline Compounds attenuate the streptozotocin-induced onset of diabetes as they reduce the hyperglycemia.

Table 4. Reduction of streptozotocin (STZ) induced hyperglycemia by 3 mg/kg intraperitoneal injection of the PARS inhibitor compounds 8l, 8p and 8j in mice *in vivo*

	Basal	STZ + Vehicle	STZ + 8j	STZ + 8p	8l
Glucose (mg/ml)	153 ± 21	320 ± 13	253 ± 24	264 ± 24	244 ± 21

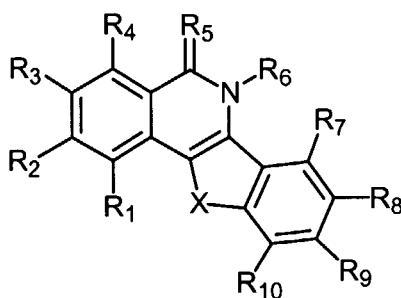
Accordingly, the Indeno[1,2-c]isoquinoline Compounds are useful for treating or preventing diabetes or a diabetic complication.

The present invention is not to be limited in scope by the specific embodiments disclosed in the examples which are intended as illustrations of a few aspects of the invention and any embodiments that are functionally equivalent are within the scope of this invention. Indeed, various modifications of the invention in addition to those shown and described herein will become apparent to those skilled in the art and are intended to fall within the scope of the appended claims.

A number of references have been cited, the entire disclosures of which have been incorporated herein in their entirety.

What is claimed is:

1. A compound of the formula



(Ia)

or a pharmaceutically acceptable hydrate or salt thereof,

wherein:

R_5 is NH or S;

R_6 is -H or C_1 - C_4 alkyl;

X is -C(O)-, -CH₂-, -CH(halo)-, -CH(OH)(CH₂)_n-, -CH(OH)-arylene-, -O-, -NH-, -S- or -CH(NR₁₁R₁₂)-, wherein n is an integer ranging from 0-5;

R₁₁ and R₁₂ are independently -hydrogen or -C₁-C₉ alkyl, or N, R₁₁ and R₁₂ are taken together to form a heterocyclic amine;

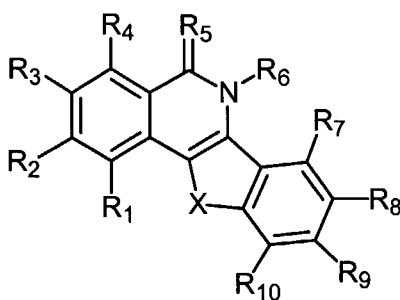
R₁, R₂, R₃, R₄, R₇, R₈, R₉ and R₁₀ are independently -hydrogen, -halo, -hydroxy, -O-(C₁-C₅ alkyl), -C₁-C₁₀ alkyl, -alkylhalo, -C₂-C₁₀ alkenyl, -C₃-C₈ carbocycle, -aryl, -NH₂, -alkylamino, -C(O)OH, -C(O)O(C₁-C₅ alkyl), -OC(O)(C₁-C₅ alkyl), NO₂ or -A-B;

wherein A is -SO₂-, -SO₂NH-, -NHCO-, -NHCONH-, -O-, -CO-, -OC(O)-, -C(O)O-, -CONH-, -CON(C₁-C₄ alkyl)-, -NH-, -CH₂-, -S- or -C(S)-;

B is -C₁-C₁₀ alkyl, -C₂-C₁₀ alkenyl, -heterocycle, -C₃-C₈ carbocycle, -aryl, -NZ₁Z₂, -alkylamino, -aminodialkyl, -alkylheterocycle, -arylamido, -C(O)OH, -C(O)O-(C₁-C₅ alkyl) or -C(O)O-phenyl, any of which are unsubstituted or substituted with one or more of -O-(C₁-C₅ alkyl), -halo, -alkylhalo, -alkanol, -alkylamino, -hydroxy, -NO₂, -NH₂, -aminoalkyl, -aminodialkyl, -heterocyclic amine, -C₁-C₁₀ alkyl, -C₂-C₁₀ alkenyl, -C₂-C₁₀ alkynyl, -aryl, -benzyl, -alkylamido, -alkylcarboxy, -C₁-C₅ alkylene-C(O)O-C₁-C₅ alkyl or -C₁-C₅ alkylene-OC(O)-C₁-C₅ alkyl groups; and

Z_1 and Z_2 are independently -H or $-C_1-C_{10}$ alkyl, which is unsubstituted or substituted with one or more of -halo, -OH or $-N(Z_3)(Z_4)$, where Z_3 and Z_4 are independently, -H or $-C_1-C_5$ alkyl, which is unsubstituted or substituted with one or more of -halo, -hydroxy or $-NH_2$; or N, Z_3 and Z_4 are taken together to form an unsubstituted or substituted heterocyclic amine; or N, Z_1 and Z_2 are taken together to form a heterocyclic amine.

2. A compound of the formula



(Ib)

or a pharmaceutically acceptable hydrate or salt thereof,
wherein:

R_5 is O, NH or S;

R_6 is -H or C_1-C_4 alkyl;

X is $-CH_2-$, $-CH(halo)-$, $-CH(OH)(CH_2)_n-$, $-CH(OH)-arylene-$, $-O-$, $-NH-$, $-S-$ or $-CH(NR_{11}R_{12})-$, wherein n is an integer ranging from 0-5;

R_{11} and R_{12} are independently -hydrogen or $-C_1-C_9$ alkyl, or N, R_{11} and R_{12} are taken together to form a heterocyclic amine.

R_1 , R_2 , R_3 , R_4 , R_7 , R_8 , R_9 and R_{10} are independently -hydrogen, -halo, -hydroxy, $-O-(C_1-C_5 \text{ alkyl})$, $-C_1-C_{10}$ alkyl, -alkylhalo, $-C_2-C_{10}$ alkenyl, $-C_3-C_8$ carbocycle, -aryl, $-NH_2$, -alkylamino, $-C(O)OH$, $-C(O)O(C_1-C_5 \text{ alkyl})$, $-OC(O)(C_1-C_5 \text{ alkyl})$, NO_2 or -A-B;

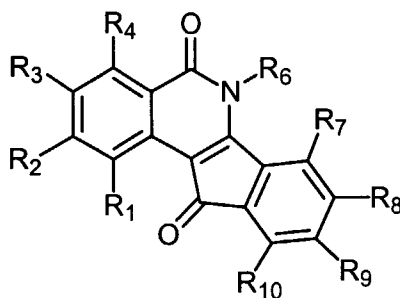
wherein A is $-SO_2-$, $-SO_2NH-$, $-NHCO-$, $-NHCONH-$, $-O-$, $-CO-$, $-OC(O)-$, $-C(O)O-$, $-CONH-$, $-CON(C_1-C_4 \text{ alkyl})-$, $-NH-$, $-CH_2-$, $-S-$ or $-C(S)-$;

B is $-C_1-C_{10}$ alkyl, $-C_2-C_{10}$ alkenyl, -heterocycle, $-C_3-C_8$ carbocycle, -aryl, $-NZ_1Z_2$, -alkylamino, -aminodialkyl, -alkylheterocycle, -arylamido, $-C(O)OH$, $-C(O)O-(C_1-C_5 \text{ alkyl})$ or $-C(O)O$ -phenyl, any of which are unsubstituted or substituted with one or more of

-O-(C₁-C₅ alkyl), -halo, -alkylhalo, -alkanol, -alkylamino, -hydroxy, -NO₂, -NH₂,
 -aminoalkyl, -aminodialkyl, -heterocyclic amine, -C₁-C₁₀ alkyl, -C₂-C₁₀ alkenyl,
 -C₂-C₁₀ alkynyl, -aryl, -benzyl, -alkylamido, -alkylcarboxy,
 -C₁-C₅ alkylene-C(O)O-C₁-C₅ alkyl or -C₁-C₅ alkylene-OC(O)-C₁-C₅ alkyl groups; and

Z₁ and Z₂ are independently -H or -C₁-C₁₀ alkyl, which is unsubstituted or substituted with one or more of -halo, -OH or -N(Z₃)(Z₄), where Z₃ and Z₄ are independently, -H or -C₁-C₅ alkyl, which is unsubstituted or substituted with one or more of -halo, -hydroxy or -NH₂; or N, Z₃ and Z₄ are taken together to form an unsubstituted or substituted heterocyclic amine; or N, Z₁ and Z₂ are taken together to form a heterocyclic amine.

3. A compound of the formula



(II)

or a pharmaceutically acceptable hydrate or salt thereof,
 wherein:

R₆ is -H or C₁-C₄ alkyl;

R₁, R₂, R₃, R₄, R₇, R₈, R₉ and R₁₀ are independently -hydrogen, -halo, -hydroxy, -O-(C₁-C₅ alkyl), -C₁-C₁₀ alkyl, -alkylhalo, -C₂-C₁₀ alkenyl, -C₃-C₈ carbocycle, -aryl, -NH₂, -alkylamino, -C(O)OH, -C(O)O(C₁-C₅ alkyl), -OC(O)(C₁-C₅ alkyl), NO₂ or -A-B; wherein at least one of R¹, R⁴ and R¹⁰ is other than hydrogen;

A is -SO₂-, -SO₂NH-, -NHCO-, -NHCONH-, -O-, -CO-, -OC(O)-, -C(O)O-, -CONH-, -CON(C₁-C₄ alkyl)-, -NH-, -CH₂-, -S- or -C(S)-;

B is -C₁-C₁₀ alkyl, -C₂-C₁₀ alkenyl, -heterocycle, -C₃-C₈ carbocycle, -aryl, -NH₂, -alkylamino, -aminodialkyl, -alkylheterocycle, -arylamido, -C(O)OH, -C(O)O-(C₁-C₅ alkyl), -C(O)O-phenyl or -NZ₁Z₂; and

Z_1 and Z_2 are independently -H or $-C_1-C_{10}$ alkyl, which is unsubstituted or substituted with one or more of -halo, -OH or $-N(Z_3)(Z_4)$, where Z_3 and Z_4 are independently, -H or $-C_1-C_5$ alkyl, which is unsubstituted or substituted with one or more of -halo, -hydroxy or $-NH_2$; or N, Z_3 and Z_4 are taken together to form an unsubstituted or substituted heterocyclic amine; or N, Z_1 and Z_2 are taken together to form a heterocyclic amine.

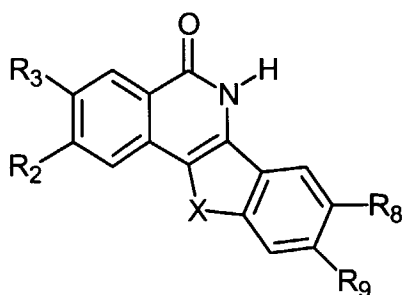
4. The compound of claim 1, 2 or 3 wherein R_5 is O, and R_6 is hydrogen.
5. The compound of claim 1 wherein R_1 , R_2 , R_3 , R_4 , R_7 , R_8 , R_9 , and R_{10} are independently hydrogen, methyl, ethyl, halo, $-NO_2$, hydroxy, methoxy, ethoxy, $-NH_2$, -aminoalkyl, -aminodialkyl or -A-B.
6. The compound of claim 5, wherein either R_8 or R_9 , but not both, is -A-B.
7. The compound of claim 6 wherein R_1 , R_2 , R_3 , R_4 , R_7 , and R_{10} are hydrogen.
8. The compound of claim 1, wherein R_9 is -A-B.
9. The compound of claim 5, wherein R_9 is -A-B.
10. The compound of claim 7, wherein R_9 is -A-B and R_8 is hydrogen.
11. The compound of claim 6, wherein A is $-SO_2-$, $-SO_2NH-$ or $-NHCO-$.
12. The compound of claim 7, wherein A is $-SO_2-$, $-SO_2NH-$ or $-NHCO-$.
13. The compound of claim 8, wherein A is $-SO_2-$, $-SO_2NH-$ or $-NHCO-$.
14. The compound of claim 9, wherein A is $-SO_2-$, $-SO_2NH-$ or $-NHCO-$.
15. The compound of claim 10, wherein A is $-SO_2-$, $-SO_2NH-$ or $-NHCO-$.

16. The compound of claim 1, wherein R₉ is -A-B and B is -C₁-C₈ alkyl, -heterocycle, -C₃-C₈ carbocycle, -aryl, -alkylamino, -alkanol or -alkylheterocycle.
17. The compound of claim 16, wherein B is -C₁-C₅ alkyl.
18. The compound of claim 5, wherein A is -SO₂- and B is -NZ₁Z₂, and Z₁ and Z₂ are independently hydrogen, or -C₁-C₅ alkyl, unsubstituted or substituted with -halo, -hydroxy or -NZ₃Z₄; wherein Z₃ and Z₄ are independently -hydrogen, -C₁-C₅ alkyl, unsubstituted or substituted with one or more of -halo, -hydroxy or -NH₂, or wherein N, Z₁ and Z₂, taken together, form a heterocyclic amine.
19. The compound of claim 18, wherein Z₁ and Z₂ are -(CH₂)_nD; wherein n is an integer ranging from 1-5, and D is hydrogen, hydroxy, heterocyclic amine or -NZ₃Z₄; wherein Z₃ and Z₄ are independently hydrogen, methyl or ethyl.
20. The compound of claim 18, wherein B is a heterocycle, which may be unsubstituted or substituted with one or more of methyl, ethyl, or -alkanol.
21. The compound of claim 18, wherein Z₁ is hydrogen and Z₂ is -NZ₃Z₄ wherein n is an integer ranging from 1-5, and Z₃ and Z₄ are independently methyl or ethyl, or, taken together, NZ₃Z₄ forms a heterocyclic amine.
22. The compound of claim 15, wherein X is -CH₂-, A is -SO₂- and B is -NZ₁Z₂; wherein Z₁ and Z₂ are independently hydrogen, -C₁-C₅ alkyl unsubstituted or substituted with halo, hydroxy or -NZ₃Z₄; wherein Z₃ and Z₄ are independently hydrogen, -C₁-C₅ alkyl, unsubstituted or substituted with halo, hydroxy or -NH₂; or wherein Z₁ and Z₂, taken together, form a heterocyclic amine.
23. The compound of claim 22, wherein Z₁ and Z₂ are -(CH₂)_nD, wherein n is an integer ranging from 1-5, and D is hydrogen, hydroxy, a heterocyclic amine or -NZ₃Z₄; wherein Z₃ and Z₄ are independently hydrogen, methyl or ethyl.

24. The compound of claim 18, wherein B is a heterocycle, unsubstituted or substituted with methyl, ethyl or -alkanol.
25. The compound of claim 18, wherein Z_1 is hydrogen and Z_2 is $-(CH_2)_n NZ_3Z_4$, wherein n is 2 or 3, and Z_3 and Z_4 are independently methyl or ethyl, or, taken together, NZ_3Z_4 form a heterocyclic amine.
26. The compound of claim 1 wherein X is $-C(O)-$, $-CH(OH)-$, $-CH(Br)-$, $-CH_2-$ or $-CH(NR_{11}R_{12})-$ wherein R_{11} and R_{12} are hydrogen, $-C_1-C_9$ alkyl, or $NR_{11}R_{12}$, taken together, form a heterocycle.
27. The compound of claim 6 wherein X is $-C(O)-$, $-CH(OH)-$, $-CH(Br)-$, $-CH_2-$ or $-CH(NR_{11}R_{12})-$ wherein R_{11} and R_{12} are hydrogen, $-C_1-C_9$ alkyl, or $NR_{11}R_{12}$, taken together, form a heterocycle.
28. The compound of claim 8 wherein X is $-C(O)-$, $-CH(OH)-$, $-CH(Br)-$, $-CH_2-$ or $-CH(NR_{11}R_{12})-$ wherein R_{11} and R_{12} are hydrogen, $-C_1-C_9$ alkyl, or $NR_{11}R_{12}$, taken together, form a heterocycle.
29. The compound of claim 9 wherein X is $-C(O)-$, $-CH(OH)-$, $-CH(Br)-$, $-CH_2-$ or $-CH(NR_{11}R_{12})-$ wherein R_{11} and R_{12} are hydrogen, $-C_1-C_9$ alkyl, or $NR_{11}R_{12}$, taken together, form a heterocycle.
30. The compound of claim 10 wherein X is $-C(O)-$, $-CH(OH)-$, $-CH(Br)-$, $-CH_2-$ or $-CH(NR_{11}R_{12})-$ wherein R_{11} and R_{12} are hydrogen, $-C_1-C_9$ alkyl, or $NR_{11}R_{12}$, taken together, form a heterocycle.
31. The compound of claim 6 wherein X is $-C(O)-$, $-CH(OH)-$, $-CH(Br)-$ or $-CH_2-$.
32. The compound of claim 6 wherein X is $-CH_2-$.
33. The compound of claim 8 wherein X is $-C(O)-$, $-CH(OH)-$, $-CH(Br)-$ or $-CH_2-$.

34. The compound of claim 8 wherein X is $-\text{CH}_2-$.
35. The compound of claim 9 wherein X is $-\text{C}(\text{O})-$, $-\text{CH}(\text{OH})-$, $-\text{CH}(\text{Br})-$ or $-\text{CH}_2-$.
36. The compound of claim 9 wherein X is $-\text{CH}_2-$.
37. The compound of claim 10 wherein X is $-\text{C}(\text{O})-$, $-\text{CH}(\text{OH})-$, $-\text{CH}(\text{Br})-$ or $-\text{CH}_2-$.
38. The compound of claim 10 wherein X is $-\text{CH}_2-$.
39. The compound of claim 13 wherein X is $-\text{C}(\text{O})-$, $-\text{CH}(\text{OH})-$, $-\text{CH}(\text{Br})-$ or $-\text{CH}_2-$.
40. The compound of claim 13 wherein X is $-\text{CH}_2-$.
41. The compound of claim 14 wherein X is $-\text{C}(\text{O})-$, $-\text{CH}(\text{OH})-$, $-\text{CH}(\text{Br})-$ or $-\text{CH}_2-$.
42. The compound of claim 14 wherein X is $-\text{CH}_2-$.
43. The compound of claim 18 wherein X is $-\text{C}(\text{O})-$, $-\text{CH}(\text{OH})-$, $-\text{CH}(\text{Br})-$ or $-\text{CH}_2-$.
44. The compound of claim 18 wherein X is $-\text{CH}_2-$.
45. The compound of claim 19 wherein X is $-\text{C}(\text{O})-$, $-\text{CH}(\text{OH})-$, $-\text{CH}(\text{Br})-$ or $-\text{CH}_2-$.
46. The compound of claim 19 wherein X is $-\text{CH}_2-$.
47. The compound of claim 20 wherein X is $-\text{C}(\text{O})-$, $-\text{CH}(\text{OH})-$, $-\text{CH}(\text{Br})-$ or $-\text{CH}_2-$.
48. The compound of claim 20 wherein X is $-\text{CH}_2-$.
49. The compound of claim 21 wherein X is $-\text{C}(\text{O})-$, $-\text{CH}(\text{OH})-$, $-\text{CH}(\text{Br})-$ or $-\text{CH}_2-$.
50. The compound of claim 21 wherein X is $-\text{CH}_2-$.

51. A compound of the formula



(III)

or a pharmaceutically acceptable hydrate or salt thereof,

wherein:

X is -CH₂- or -O-;

R₂ and R₃ are independently -hydrogen, -halo, -alkylhalo, -hydroxy, -O-(C₁-C₅ alkyl), -C₁-C₃ alkyl, -NO₂, -NH₂, -CONH₂, -C(O)OH, -OC(O)-C₁-C₅ alkyl or -C(O)O-C₁-C₅ alkyl;

R₈ and R₉ are independently -hydrogen and -A-B;

A is -SO₂-, -SO₂NH- or -NHCO-; and

B is -C₁-C₃ alkyl, -NZ₁Z₂, -heterocycle or -alkylamino, each unsubstituted or substituted with one or more of -alkanol, -alkylamino, -aminoalkyl, -aminodialkyl or -heterocycle, each unsubstituted or substituted with -C₁-C₁₀ alkyl or -alkanol; and

Z₁ and Z₂ are independently -hydrogen or -C₁-C₈ alkyl, which is unsubstituted or substituted with one or more of -hydroxy or -NZ₃Z₄, where Z₃ and Z₄ are independently -H or -C₁-C₃ alkyl, which is unsubstituted or substituted with one or more of -hydroxy or -NH₂, or N, Z₃ and Z₄ are taken together to a heterocyclic amine, or N, Z₁ and Z₂ are taken together to form a heterocyclic amine.

52. The compound of claim 51, wherein A is -SO₂- and B is -NZ₁Z₂.

53. The compound of claim 52, wherein Z₁ and Z₂ are independently hydrogen, or -C₁-C₅ alkyl, unsubstituted or substituted with hydroxy or -NZ₃Z₄, or, taken together, -NZ₁Z₂ form a heterocyclic amine.

54. The compound of claim 53, wherein Z_3 and Z_4 are independently hydrogen, or $-C_1-C_3$ alkyl, unsubstituted or substituted with hydroxy or $-NH_2$, or, taken together, NZ_3Z_4 form a heterocyclic amine.
55. The compound of claim 54, wherein the heterocyclic amine is selected from the group consisting of an unsubstituted piperidine, piperazine or morpholine group, or a piperazine, pyrrolidine or imidazole group which may be unsubstituted or substituted with $-N-(C_1-C_5 \text{ alkyl})$ or $-N-C(O)(C_1-C_5 \text{ alkyl})$.
56. The compound of claim 53, wherein either NZ_1Z_2 or NZ_3Z_4 is a heterocycle, unsubstituted or substituted with $-C_1-C_5$ alkyl, -alkanol or -alkylamino.
57. A method for inhibiting poly(ADP)-ribose synthase activity in a cell, the method comprising contacting said cell with the compound or pharmaceutically acceptable hydrate or salt of a compound of any one of claims 1, 2, 3 or 51 in an amount sufficient to inhibit poly (ADP)-ribose-synthase in said cell.
58. The method of claim 57 wherein the cell is an *in vivo* cell.
59. A method for treating or preventing an inflammatory disease in a subject, the method comprising administering to a subject in need thereof the compound or a pharmaceutically acceptable hydrate or salt of a compound of any one of claims 1, 2, 3 or 51 in an amount sufficient to treat or prevent the inflammatory disease.
60. The method of claim 59, wherein said subject is a human.
61. The method of claim 59, wherein said inflammatory disease is an inflammatory disease of a joint, a chronic inflammatory disease of the gum, an inflammatory bowel disease, an inflammatory lung disease, an inflammatory disease of the central nervous system, or an inflammatory disease of the eye.

62. The method of claim 59, wherein said inflammatory disease is gram-positive shock, gram negative shock, hemorrhagic shock, anaphylactic shock, traumatic shock and chemotherapeutic shock.

63. A method for treating or preventing a reperfusion disease in a subject, the method comprising administering to a subject in need thereof the compound or pharmaceutically acceptable hydrate or salt of a compound of any one of claims 1, 2, 3 or 51 in an amount sufficient to treat or prevent the reperfusion disease.

64. The method of claim 63, wherein the reperfusion disease is myocardial infarction.

65. The method of claim 63, wherein the reperfusion disease is stroke.

66. The method of claim 63, wherein the subject is a human.

67. A method for treating or preventing diabetes or a diabetic complication in a subject, the method comprising administering to a subject in need thereof the compound or pharmaceutically acceptable hydrate or salt of a compound of any one of claims 1, 2, 3 or 51 in an amount sufficient to treat or prevent diabetes or the diabetic complication.

68. A method for treating or preventing reoxygenation injury resulting from organ transplantation, the method comprising administering to a subject in need thereof the compound or pharmaceutically acceptable hydrate or salt of a compound of any one of claims 1, 2, 3 or 51 in an amount sufficient to treat or prevent the reoxygenation injury.

69. A composition comprising a compound or pharmaceutically acceptable salt or hydrate of the compound of claim 1 and a pharmaceutically acceptable carrier.

70. A composition comprising a compound or pharmaceutically acceptable salt or hydrate of the compound of claim 2 and a pharmaceutically acceptable carrier.

71. A composition comprising a compound or pharmaceutically acceptable salt or hydrate of the compound of claim 3 and a pharmaceutically acceptable carrier.
72. A composition comprising a compound or pharmaceutically acceptable salt or hydrate of the compound of claim 51 and a pharmaceutically acceptable carrier.
73. The compound or pharmaceutically acceptable salt or hydrate of claim 51, wherein either R^8 is hydrogen and R^9 is -A-B, or R^8 is -A-B and R^9 is hydrogen.