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Therapeutic and toxic blood concentrations of more than 800 drugs and other xenobiotics

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In order to assess the significance of drug levels measured in clinical and forensic toxicology as well as for Therapeutic Drug Monitoring (TDM) it is essential that good collections of data are readily available. For more than 800 substances, therapeutic ('normal') and, if data was available, toxic, and fatal plasma concentrations as well as elimination half-lives were compiled in a table. The compilation includes data for hypnotics, benzodiazepines, neuroleptics, antidepressants, sedatives, analgesics, anti-inflammatory agents (e.g., NSAIDs), antihistamines, antiepileptics, betaadrenergic antagonists, antibiotics (penicillins, cephalosporins, aminoglycosides, gyrase inhibitors), diuretics, calcium-channel blockers, cardiac glycosides, antiarrhythmics, antiasthmatics, ACE-inhibitors, opiate agonists, and local anesthetics, among others. In addition, toxicologically relevant xenobiotics were listed. Data have been abstracted from published information, both compilations and primary sources and have been completed with data collected in our own forensic and clinical toxicology laboratories. Wherever possible, ranges for therapeutic plasma concentrations are expressed as trough concentration at steady state. The half-life values given for each drug are chosen to represent the terminal log-linear phase at most. It is the purpose to rapidly assess the significance of drug levels for the therapeutic monitoring of patients, and to facilitate the diagnostic and clinical assessment in case of intoxications.

1. Introduction

It has been common for several years that plasma concentrations of drugs having a narrow therapeutic range have to be measured. This accounts, among others, for antiepileptics, cardiac glycosides, aminoglycosides, antiarrhythmics, theophylline, immunosuppressants, and few cytostatics. It is indicated to draw blood samples for the following reasons: if doses are high and borderline, if signs of overdosage occur although the dose is within normal range (e.g. genetic polymorphism), if there is no effect although the dose is correct or if non-compliance can be expected. In general, plasma concentrations at steady state are retrievable from dosage and pharmacokinetic data. However, sufficient pharmacokinetic data are often not available. Therefore, it makes sense to offer a compilation of therapeutic and toxic plasma concentration ranges for quick information. A list [469] published in 1997 has been completely revised and updated. In particular, data for drugs recently introduced to the market have been added. Reviews, compilations of other authors [e.g., 28, 99, 100, 109, 111, 112, 114, 155, 268, 269, 340, 354, 395, 423, 426–429, 495, 528, 534] and publications concerning individual drugs/xenobiotics and case reports have been used to set up the database. Experience

gained over several years from working in the clinical and forensic toxicological field also contributed to the following list.

2. Selection and criteria for evaluation

The substances have been selected by clinical and toxicological aspects, by frequency of prescribing and other matters in the area of internal intensive care medicine as well as clinical and forensic toxicology. There is an increase in determining antibiotic concentrations using analytical and chemical methods and there are special cases which are closely monitored although therapeutic concentrations depend on the susceptibility of the microorganisms and tissue concentrations are often more reliable.

Screening the data in daily practice, it became obvious that for many well known drugs there is only insufficient pharmacokinetic data available. However, for current substances little documented data is published about intoxications and their plasma/blood concentrations.

In general, therapeutic plasma concentration ranges or concentrations found after therapeutic dosing refer to trough levels at steady state. Inter-individual deviation is high. Therefore, any data listed can only be taken as orientation.

Often, it is not possible to find the threshold between the therapeutic and toxic concentration for the specific patient. This is the case if tolerance develops and if drug interactions or additional diseases are involved. In order to keep the overall context clear, we preferred not to go into further details.

Data about fatal plasma concentrations consciously orient on life threatening or lethal intoxications who occurred at low plasma concentrations so that actual and potential dangers in clinical cases are not being underestimated. Many intoxicated patients survived even with significantly higher concentrations. It is also difficult to relate the concentrations to the clinical picture because the interval between intake of the drug and drawing a blood sample is

generally unknown. In any case, it is more relevant to have the correct concentration measured rather than how much drug has been – presumably – taken. Statements about case histories are often not reliable. And often, it is not known how much drug has been absorbed after intake of charcoal, due to vomiting and/or irrigation of the stomach. Elimination half-lives are statistically more reliable than data gathered in case of intoxications. Yet even with this data, substantial deviation can be expected. In addition, most pharmacokinetic parameters are retrieved from healthy subjects after application of relatively low doses. The data indicated generally deals with the terminal elimination half-life which most of the time is higher than the half-life of the intended biological effect (see annotations).

Table: Therapeutic ('normal'), toxic, and comatose-fatal blood-plasma/serum concentrations (µg/mL) in man

| Substance | Blood-plasma/serum concentration (µg/ml) | | | t _{1/2} (h) | Ref. |
|--|--|----------------------------|-----------------------|-----------------------|-------------------------------------|
| | Therapeutic ('normal') | toxic (from) | comatose-fatal (from) | | |
| Acamprosate | appr. 0.37–0.65 ²³¹ | | | 13–20 ²³² | [155, 444] |
| Acebutolol | 0.2–2 (0.5–1.255) | | 15–20 | 3–11 | [440, 466] |
| N-Acetylacetolol ¹ | 1–2.5 | | 90–150 | 9–14 | [466] |
| Acecaidine | see (N-Acetyl-) Procainamide | | | | |
| Acecarbromal(um) | 10–20 (sum) | 25–30 | | ? | |
| Acemetacin | see Indomet(h)acin | | | | |
| Acenocoumarol | 0.03–0.1 ¹⁹⁷ | 0.1–0.15 | | 3–11 | [155, 340, 527, 528] |
| Acetaldehyde | 0–30 | 100–125 | | | [527, 528] |
| Acetaminophen | see Paracetamol | | | | |
| Acetazolamide | (4–)10–20 ²⁶⁷ | 25–30 | | 2–6 | [155, 468, 469, 528] |
| Acetohexamide | 20–70 | 500 | | 1.3 | [423] |
| Acetone | (2–)5–20 | 100–400; 2000 ⁸ | 550 | (6–)8–31 | [528, 545, 573] |
| Acetonitrile | | | 0.77 | | [528] |
| Acetyldigoxin ³ | 0.0005–0.0008 | 0.0025–0.003 | 0.005 | 40–70 | [420, 516] |
| Acetylsalicylic acid (ASS, ASA) ² | 20–200 | 300–350 | (400–)500 | 3–20 ³⁷ | [77, 207, 234, 329, 334, 409, 548] |
| Acitretin | appr. 0.01–0.05 ¹¹² | | | 2–4 ⁶ | [291, 488] |
| Acyclovir | (0.4–0.63) 0.5–1.5 ²⁰³ | | | 2–5 ⁸³ | [148, 155, 358, 476, 527] |
| Adipiodone-Meglumine | 850–1200 | | | 0.5 | [489] |
| Äthanol | see Ethanol | | | — ¹³⁹ | |
| Ajmaline | (0.1–) 0.53–2.21 (?) | | 5.5 ⁸ | 1.3–1.6, 5–6 | [155, 426] |
| Albendazole | 0.5–1.5 ⁹² | | | 8–9 ⁹² | [104, 333, 348, 572] |
| Albuterol | see Salbutamol | | | | |
| Alcuronium | 0.3–3 | | | 3.3±1.3 | |
| Aldrin | –0.0015 | 0.0035 | | | [528] |
| Alendronate | <0.005 | | | — ⁶ | [411] |
| Alfentanil | 0.03–0.6 ⁴ | | | 0.6–2.3 ⁹⁶ | [299, 327, 462, 541] |
| Alfuzosine | 0.003–0.06 | | | 3–9 | [423] |
| Alimemazine (Trimeprazine) | 0.05–0.4 | 0.5 | 1–3.2 | 8 | [114, 428] |
| Alizapride | 0.1–2 | | | 2–3 | [423] |
| Allobarbitol | 2–5 | 10 | 20 | 40–48 | |
| Allopurinol | 2–19 | | | 0.5–3 | [133, 528] |
| Alphaprodine | 0.87–1 | | | 1.6–2.6 | [528] |
| Alprazolam | 0.005–0.05 (–0.08) ⁶⁵ | 0.1–0.4 | 252 | 6–20 | [114, 155, 272, 286, 293, 301, 341] |
| Alprenolol ⁴⁸ | 0.025–0.14 | 1–2 | 40–48 | 2–7 | [466] |
| Aluminium | <0.005 ²³⁴ | 0.05–0.15 | 4.4 ⁸ | appr. 0.5 | [133, 371, 429, 528] |
| Amantadine | 0.2–0.6 (–1) | 1; 2.4 ⁸ | 21 ⁸ | 9–15 | |
| Amfebutamone | see Bupropion | | | | |
| Amikacin ⁷⁶ | 10–25 | 30 | | 2–3 | [71] |
| Aminobenzoic acid | 300–600 | 600 | | | [429] |
| Aminoglutethimide | 0.5–25 | | | 13.3 ± 2.65 | [133, 155, 528] |

Table (continued)

| Substance | Blood-plasma/serum concentration (µg/ml) | | | t _{1/2} (h) | Ref. |
|-------------------------------------|--|-------------------------|---------------------------|-------------------------------|--|
| | Therapeutic ('normal') | toxic (from) | comatose-fatal (from) | | |
| Aminophenazone | 10–20 | | | appr. 2–4 | [423] |
| 4-Aminopyridine (Fampridine) | 0.025–0.075 | 0.14 ⁸ ; 0.2 | | 3–3.5 | [503, 527, 528] |
| 5-Aminosalicylic acid (5-AS, 5-ASA) | see Mesalazine | | | | |
| Amiodarone ²⁶¹ | (0.5–) 1–2 (–2.5) | 2.5–3 | | 30–120 ⁶ | [54, 133, 155, 449] |
| Amisulpride | –0.4 | | | 12–18 | [423] |
| Amitriptyline ^{7, 48} | 0.05–0.3 | 0.5–0.6 | 1.5–2 | 30–50 | [45, 57, 114, 121, 151, 181, 304, 305, 345, 415] |
| Amlodipine | 0.005–0.015 (0.003–0.011) | 0.088 ^{8, 165} | 0.1–0.2 ^{8, 166} | 34–50 | [268, 275, 492] |
| Ammonia | 0.5–1.7 | | | | [528] |
| Amobarbital | 1–5 | 5–6 | 10 | 15–30 | |
| Amodiaquine | –0.05 ²⁷⁰ | | | — ²⁷⁰ | [133, 510] |
| Amoxapine | 0.18–0.6 ¹⁵¹ | 3 | 5 | 8 | [340] |
| Amoxicillin | 0.5–1 (5–15) | | | 1–2 | [423] |
| Amphetamine | 0.02–0.1 | 0.2 | 0.5–1 | 4–8 | [201, 429] |
| Amphotericin B | (0.1–) 0.2–3 | (3–) 5–10 | | 24–48 ¹¹⁰ | [79, 192, 310] |
| Ampicillin | 0.02–2 (2–20) | | | 1 | [71] |
| Amrinone | 1–2(–4) | | | 3–12 | [155, 200, 269] |
| Amsacrine | 0.1–0.5 (0.15–5.5) | | | 5–7 | |
| Anileridine | <0.5 | | 0.9 ⁸ | ? | [528] |
| Aniline | appr. –1 (urine) | | 6 | | [133, 528] |
| Antimony | –0.01 | 0.2 | | | [133] |
| Antipyrine | see Phenazone | | | | |
| Apomorphine | 0.002–0.02 ²⁰⁴ | | | appr. 0.75 | [155, 527] |
| Aprindine ⁴⁸ | 1–2 | 2–3 | | 13–50 | |
| Aprobarbital | 4–20 | 30–40 | 50 | 14–34 | |
| Arsenic | 0.002–0.07 | 0.05–0.25 | 9–15 | | [133, 528] |
| Articaine | <1.5–2 (?) | | | 0.3 (–1) | [379] |
| Ascorbic acid (Vitamin C) | 4–15 | ? | | – ⁶ | [39, 155, 241, 321, 546] |
| Astemizole | 0.002–0.05 ⁴³ | 14 ⁸ | | appr. 20 ^{6, 42, 43} | [28, 155, 487a] |
| Atenolol | 0.1–1 (–2) ⁷⁷ | 2–3 | 27 ⁸ | 4–14 ⁹ | [155, 426, 466, 504] |
| Atovaquone | 13.9 ± 6.9 (>15) | | | 2–3 ⁶ | [490] |
| Atracurium(besylate) | 0.1–0.5 (–5) | | | appr. 0.5 | |
| Atropine | 0.002–0.025 ¹⁵⁵ | 0.03–0.1 | 0.2 | 2–6.5, 13–38 | [429, 524, 528] |
| Azapropazone (Apazone) | 40–80 | | | 8–24 | |
| Azathioprine ¹⁰ | –2 | | | 1–4 ¹¹ | |
| Azelastine | 0.002–0.003(–0.01) | | | 22–25 | [423] |
| Azithromycin | appr. 0.04–1 | | | 50–60 (2–4 ⁶) | [17, 312, 402, 436, 470] |
| Aztreonam | 1–10 (50–250) | | | 1.5–2 | [528] |
| Baclofen | 0.08–0.4(–0.6) | 1.1–3.5 | 6–9.6 | 6.8 ± 0.7 | [28, 340, 528] |
| Bambuterol | see Terbutaline | | | 10 | |
| Barbital | 2–20 | 20–50 | 50 | 57–120 | |
| Barium | –0.001 | | | | [133] |
| Bendrofluazide | 0.05–0.1 | | | appr. 3 | [426] |
| Benoxaprofen | –50 | | | 19–39 | [133, 155] |
| Benperidol | appr. –0.002 | | | 4–8 | [423] |
| Benzbromarone | 2–10 | | | 2–4 | |
| Benzene | –0.0002 ²⁷¹ | | 0.95 | | [528] |
| Benzphetamine | 0.025–0.5 | 0.5 | 14 ⁸ | ? | [28, 528] |
| Benztropine | 0.01–0.18 | 0.05 | 0.2–0.7 | ? | [423, 528] |
| Benzyl alcohol | ? | 18 ^{8, 194} | | — ¹⁹⁵ | [155, 210, 314] |
| Benzylpenicillin | 1.2–12 | | | 1 | [71, 489] |
| Bepidil | 0.6–2.5 | | | 33–42 | [178] |
| Beryllium | –0.0003 | | | | [133] |

Table (continued)

| Substance | Blood-plasma/serum concentration (µg/ml) | | | t _{1/2} (h) | Ref. |
|----------------------------------|--|-------------------------------------|---------------------------------------|-----------------------------|---|
| | Therapeutic ('normal') | toxic (from) | comatose-fatal (from) | | |
| Betacarotene | 4–6 ¹⁹⁶ | ? | | | [155, 168] |
| Betaxolol | 0.005–0.05 | | 36 ⁸ | 14–22 | [28, 34a, 466] |
| Bethanidine | 0.02–0.5 | | | 9–10 | [155, 528] |
| Bevantolol | 0.2–2 | | | 2 | [423] |
| Bezafibrate | –15 | | | 2 | [133, 155] |
| Bicalutamide | 1.5–17.5 (–25) ¹⁶³ | | | (3–) 7–10 ⁶ | [325] |
| Biperiden | 0.05–0.1 | | 0.25 ⁸ | 18–24 | [114] |
| Bismut(h) | <0.05 (–0.1) | 0.05–0.1 | | – ⁶ | |
| Bisoprolol | 0.01–0.1 | | | 10–12 | [466] |
| Bopindolol | 0.001–0.015 ⁵⁴ | | | 4–8 ⁵⁴ | [466] |
| Borate | 0–7 | 20 | 200 | | [429] |
| Boron | 0.8–6 | 20–50 | 50–150 | | [528] |
| Brallobarbitol (Brallobarbitone) | 4–8 | 8–10 | 15 | 20–40 | |
| Bretylum | 0.8–2.4 | | | 6–11 | [155] |
| Brodifacoum | | 0.02 | 0.03–0.17; acute: 3.9 ⁸ | 20–60 ⁶ | [391a, 528] |
| Bromadiolol | | 0.02 | | | [528] |
| Bromazepam | (0.05–) 0.08–0.2 | 0.3–0.4 | (1–) 2 | 8–22 | [272] |
| Bromide | 10–50 | 500–1500; 3000 ^{8, 242} | 2000 | 12–13 ⁶ | [186, 213, 497, 528] |
| Bromisoval | 10–20 | 30–40 | | appr. 4 ^{28, 105} | |
| Bromoxynil | | 20 | | | [133] |
| Bromperidol | 0.001–0.02 | | | 20–36 | |
| Brompheniramine | 0.005–0.015 | 0.2 ⁸ | | 2–10 (–20) | [423] |
| Brotizolam | 0.001–0.02 | | 10 ⁸ | 4–10 | [28, 443a] |
| Budipine | appr. 0.1–0.3 | | | 30 | [423] |
| Buflomedil | appr. 0.2–0.5 (–1.0) | 15–25 | 25–50; 275 ⁸ | 2–4 | [426, 528] |
| Bunitrolol | 0.001–0.015 | | | 2–6 | [466] |
| Bupivacaine | (0.25–) 0.5–1.5 (–2) | 2–4 | | 0.5–3 | [155, 202, 260, 300] |
| Bupranolol | – ⁴⁴ | | | 2–4 | [466] |
| Buprenorphine | 0.0005–0.005 (–0.01) | 0.2 (?) | 1.1 ⁸ ; 4–13 | 3–5 | [28, 133, 155, 520a, 544] |
| Bupropion (Amfebutamone) | 0.01–0.02; 0.05–0.1 ¹⁵² | 1.2 ²⁴⁶ | 7.3 | 10–20 | [28, 132, 148a, 214, 222, 287, 305, 412, 509] |
| Buspirone | 0.001–0.004 (–0.01) | | | 2–3 | [528] |
| Butabarbital | see Secbutabarbital | | | | |
| Butalbital | 1–5 | 10–15 | 15–30 | 30–40 | |
| Butanone | –10 | 500 | | | [133] |
| Butaperazine | 0.02–0.3(–0.7) | | | 12 | [423] |
| Butorphanol | 0.0006–0.002 | | | 4–9 | [423] |
| Butriptyline | 0.07–0.15 | 0.4–0.5 | | ? | [423] |
| Cadmium | –0.0065 | 0.015–0.05 | | | [133, 528] |
| Caffeine (Coffein) | (2–) 4–10 | 15–20 | 180 | 2–10 | [28, 82, 155, 350, 433] |
| Calcifediol | 0.01–0.05 | | | | [429] |
| Camazepam | 0.1–0.6 | 2 | | 20–24 | [272] |
| Camphor | | 0.3–0.4 | 1.7 | ? | [423] |
| Candesartan | 0.08–0.18 | | | 5–7 | [423] |
| Canrenone | see Spironolactone | | | | |
| Captopril | 0.05–0.5 (–1) | 5–6 | 60 | 1–2 | [4, 268, 426] |
| Carazolol ²³ | –0.015 | | | 9 | [466] |
| Carbamazepine ¹² | 2–8 (4–12) | 10 | 20 | 12–60 (7–35) ¹⁴⁰ | [60, 81, 114, 124, 145, 258, 311] |
| Carbaryl | | 5 | 6 | | [28, 114a] |
| Carbenoxolone | appr. 5–30 | | | 8–20 | [429] |
| Carbimazole ⁹⁵ | 0.5–3.4 ⁹⁵ | | | 3–5 ⁹⁵ | |
| Carbinoxamine | appr. 0.02–0.04 | | | appr. 10–15 | [502] |

Table (continued)

| Substance | Blood-plasma/serum concentration (µg/ml) | | | t _{1/2} (h) | Ref. |
|--------------------------------|--|--------------------------------|-----------------------------------|-----------------------------|---------------------------|
| | Therapeutic ('normal') | toxic (from) | comatose-fatal (from) | | |
| Carboc(h)romene | 0.8–2.4 | | | 0.2–1.5 | |
| Carbon monoxide | — ²⁰⁰ | 25–30% | 50–60% | | [155, 527, 528] |
| Carbon tetrachloride | –0.07 | 7.1 ⁸ , 269 ; 20–50 | 100–200 | | [458, 528] |
| Carboplatin | max. 10–25 | | | 2.5–6 ¹⁰⁶ | |
| Carbromal(um) ¹³ | 2–10 | 15–20 | 40 | 7–15 | |
| Carisoprodol | 10–30 | 40 | 50 ⁸ , 104 | 8 | [114, 528] |
| β-Carotene | see Betacarotene | | | | |
| Carteolol | 0.01–0.1 | | | 3–7 | [466] |
| Carvedilol | appr. 0.02–0.15 (–0.3) | | | 6–10 | [155, 269] |
| Cefaclor | 13–35 (i.v. –900) | | | 0.5–1 | [155, 528] |
| Cefalexin | –65 | | | 1–1.5 | [489] |
| Cefaloridine | 20–80 | | | 1.5 | [489] |
| Cefamandole | 1–5 (10–40–150) | | | 0.5–1.2 | [489, 528] |
| Cefazolin | –150 | | | 1.5–2 | [71, 489] |
| Cefoperazone | –250 | | | 1–2 (–5) | [88] |
| Cefotaxime | 0.5–2 (10–50, i.v. –225) | | | 1–1.5 | [71] |
| Cefotetan | 65–90 | | | 3.5 | [489] |
| Cefotiam | –150 ⁷¹ | | | 0.7–1.5 (–2) | [464, 489] |
| Cefoxitin | –150 | | | 0.7–1 | [489] |
| Cefsulodin | 20–100 | | | 1.6–1.9 | [155, 528] |
| Ceftazidime | 20–40 (50–200) | | | 1.6–2 | [155, 528] |
| Ceftibuten | appr. 3–20 | | | 2–4 | |
| Ceftizoxime | 40–160 | | | 6–9 | [489] |
| Ceftriaxone | 15–75 | | | 6.5–8.5 | [71] |
| Cefuroxime | 0.5–1 (–180) ; 7–59 ²⁴³ | | | 1.1–1.3 | [155, 315, 392, 527, 528] |
| Celiprolol | 0.05–0.5 | | | 3–6 | |
| Cephalothin (Cefalotin) | –30 | | | 0.5–0.6 | [155, 489] |
| Cerivastatin | 0.002–0.04 | | | 1.5–3 | [423] |
| Cetirizine | appr. 0.02–0.3 | 2–5 | | 7–9 | [28, 423] |
| Chinidine | see Quinidine | | | | |
| Chinine | see Quinine | | | | |
| Chloralhydrate ¹⁴ | 1.5–15 | 40–50 | 60–100 | 8–30 | |
| Chlorambucil | 0.15–0.3 (–1.0) | | | 1.5–3 | [423] |
| Chloramphenicol | 5–10 (–15) ⁵⁹ | 25 | | 2–6 | [277, 528] |
| Chlordane | –0.001 | 0.0025 | 1–7 | | [133, 528] |
| Chlordecone | | 0.5 | | | [133] |
| Chlordiazepoxide ¹⁵ | 0.4–3 | 3.5–10 | 20 | 6–24 | [18, 28, 114, 528] |
| Chlormethiazole | see Clomethiazole | | | | |
| Chlormezanone | (3–) 5–9 (–14) | appr. 20 | 18 ⁸ ; 53 ⁸ | 20–30 | [104, 114, 279] |
| Chlorobutanol | ? | 75 | | | [429] |
| Chloroform | 20–50 | 70–250 | 390 | | [528] |
| Chlorophacinone | | 0.1 | | | [133] |
| Chloroquine | 0.02–0.5 | 1 | 3 | dose-dependent ⁶ | [83, 114, 234] |
| Chlorothiazide | appr. 6 | | | 0.5–2 | [155, 528] |
| Chlorphen(ir)amine | 0.003–0.017 | | 1.1 ⁸ | 15–25 | [28, 133, 155, 528] |
| Chlorpromazine ⁶⁶ | 0.03–0.1 (–0.5) | 1–2 | 3–4 | 10–30 | [114, 155, 245, 346] |
| Chlorpropamide | 30–150 | 200–750 | | 25–60 | [429, 528] |
| Chlorprothixene | 0.02–0.2 | 0.4 | 0.8 | 10–30 | |
| Chlorpyrifos | | 0.2 | | 27 | [28, 133] |
| Chlortalidone | 0.15–0.3 (–1.4) | appr. 2 | | 44–48 (35–70) | |
| Chlortetracycline | 1–5 (–10) | 30 | | 5–6 | [340, 468, 469] |
| Chromium | –0.00035 | | 32 ⁸ | | [28, 133] |
| Cibenzoline | 0.2–0.4 (–0.9) | (0.5–) 1 | | 7–8 ⁸³ | [155, 537] |
| Cicletanine | appr. 1–2 | | | 5–23 | [155, 423] |
| Ciclosporine | see Cyclosporine | | | | |
| Cidofovir | appr. 7–43 | | | 2.5 | [155, 423] |

Table (continued)

| Substance | Blood-plasma/serum concentration (µg/ml) | | | t _{1/2} (h) | Ref. |
|---------------------------------|--|----------------------------------|--|--------------------------|---|
| | Therapeutic ('normal') | toxic (from) | comatose-fatal (from) | | |
| Cilazapril(–)at | 0.003–0.09 | | | 30–50 | [423] |
| Cimetidine | 0.25–3 (0.75–4) | 30–50 | 110 ⁸ | 1.5–4 | [172, 477] |
| Cinoxacin | appr. 15 | | | 1.5–4 | |
| Ciprofloxacin | 2.5–4 | 11.5 ⁸ | | 3–6 | [80, 93, 454, 494] |
| Cisaprid | 0.04–0.08 | | | 6–12 | [423] |
| Citalopram | appr. 0.01–0.2 (– 0.1?) | | 5–6 ¹⁶⁰ | appr. 33 ¹⁷⁰ | [173, 188, 242, 380, 386–388, 423] |
| Cladribine | appr. 0.006 | | | 0.1–0.2 (6.4–19.7) | [36, 248, 261] |
| Clarithromycin | appr. 0.2–2 | | | 3–7 ²¹⁷ | [17, 53, 423, 436, 437, 463] |
| Clemastine | appr. 0.001–0.002 (?) | | | appr. 8 | [56, 423] |
| Clenbuterol | 0.0003–0.0006 | 0.003 ⁸ | | 34–35 | [28] |
| Clindamycin | appr. 0.5 | | | 2–3 | |
| Clobazam ¹⁷ | 0.1–0.4 | | | 10–32 | [272, 274] |
| Clobutinol | appr. 0.05–0.2 | | | 23–34 | [155, 423] |
| Clofibrate | 50–250 | | | 10–18 | |
| Clomethiazole (Chlormethiazole) | 0.7–2 | (2.8–) 4–15 | 50 | 3–7 | [155, 273, 340, 468, 532] |
| Clomipramine ^{48, 85} | (0.02–) 0.09–0.25 (–0.4) ²²⁶ | 0.4–0.6 | 1–2 | 20–26 ⁸⁶ | [20, 87, 131, 151, 156, 285, 305] |
| Clonazepam | (0.004–) 0.01–0.08 ¹⁵⁰ | 0.1 | | 20–60 | [60, 286, 431] |
| Clonidine | 0.001–0.002 (–0.004) | 0.025–0.05 (0.009 ⁸) | 0.23 ⁸ | 8–25 | [28, 127, 367, 417] |
| Clopendixol | 0.002–0.015 | 0.05–0.1 | | 15–25 | [423, 528] |
| Clorazepate ¹⁵ | see Nordazepam | | | 1–2 | [145] |
| Clotiazepam | 0.1–0.7 | | | 3–15 | |
| Cloxacillin | 5–30 (–85) | | | 0.5–1 (0.3–2) | |
| Clozapine ¹³⁶ | (0.1–) 0.3–0.6 (>0.35 ?) | 0.6–1 (9.5 ⁸) | 1.2 ⁸ ; 2 ⁸ ; 5.2 ⁸ | 6–14 | [85, 134, 174, 326, 571] |
| Cobalt | 0.0001–0.0022 | | | | [133, 528] |
| Cocaine | 0.05–0.3 | 0.5–1 | 4 | 0.5–1 ¹⁸ | [28, 65, 133, 397, 468, 469, 528] |
| Codeine ⁴⁸ | 0.03–0.25 | 0.5–1 | 1.8 | 3–4 | [155, 484] |
| Coffein(e) | see Caffeine | | | | |
| Colchicine | 0.0003–0.0025 | 0.005 | 0.024 ⁸ | 11–32 ¹⁴³ | [29, 435, 527] |
| Colistin | 1–5 | | | 2–5 | |
| Copper | 0.6–1.5 | 2 | 5 | | [133, 429] |
| Cotrimoxazole | see Sulfamethoxazole and Trimethoprim | | | | |
| Cresol (Methylphenols) | | appr. 50 | 120 | | [133, 528] |
| Cromolyn (Cromoglycate) | appr. –0.01 | | | 1–1.5 | [133, 155] |
| Cyanide | – ¹⁷⁷ | 0.5 | 1–3 | appr. 19 ¹⁸⁴ | [30, 155, 179, 220, 434, 446, 497, 505] |
| Cyclizine | 0.1–0.25 | 0.75–1 | 15 | 24 | [133, 528] |
| Cyclobarbital | 2–6 | 10 | 20 | 8–17 | |
| Cyclobenzaprine | appr. 0.003–0.04 | 0.4 | | 18 (9–40) ²⁵³ | [133, 528, 565] |
| Cyclohexane | –0.4 | | | | [133] |
| Cyclophosphamide | 10–25 | | | 4–8 (1.3–16) | [155, 423] |
| Cyclopropane | 80–180 | | | | [133, 528] |
| Cyclosporine A (CsA) | <0.1–0.15–0.25 | 0.3–0.4 ¹⁶ | | 10–27 ¹⁶⁹ | [116, 219, 306, 307, 377, 520] |
| Cyproheptadine | appr. –0.05 | | 0.47 ⁸ | appr. 16 | [28, 133, 155] |
| Cyproterone acetate | ? | | | 30–40 | [325] |
| Cytarabine | 0.05–0.5 | | | 0.1–0.2 (1.9–2.5) | [248, 340] |
| 2,4-D | see 2,4-Dichloro-phenoxyacetic acid | | | | |
| Danazol | appr. –0.2 | | | 4.5 | [133, 155] |
| Dantrolene | (0.1–) 0.4–1.5 (–3) | | | 4–12 | [155, 340, 534] |

Table (continued)

| Substance | Blood-plasma/serum concentration (µg/ml) | | | t _{1/2} (h) | Ref. |
|--|--|---------------------|--|-------------------------|---|
| | Therapeutic ('normal') | toxic (from) | comatose-fatal (from) | | |
| Dapsone ⁴⁸ | 0.5–2 | 10 | 18 ⁸ | 25–31 | [280, 406] |
| Deferoxamine (Desferrioxamine) | 3–15 | | | 4–6 | |
| Demoxepam | 0.5–0.74 | 1 | 2.7 | | [429] |
| Desipramine ^{48, 69} | 0.01–0.5 (0.12–0.25) | 0.5–1 | 3 | 15–25 ⁷⁰ | [57, 69, 304, 305, 356] |
| Desmethyldiazepam | see Nordazepam | | | 40–80 | [272] |
| Dexamethasone | appr. 0.05–0.265 ²⁴⁷ | | | 2.5–9.5 | [155, 432] |
| Dexfenfluramine | appr. 0.03–0.06 | 0.15–0.25 | | appr. 18 | [429, 528] |
| Dextromethorphan ⁴⁸ | 0.01–0.04 | 0.1 | 3 | 2–4 | [195, 427] |
| Dextromoramide | 0.075–0.15 | 0.2 | 0.9 | 0.1–1.5 (?) | [28, 266a, 423, 526, 528] |
| Dextropropoxyphene | 0.05–0.3 (–0.5) | 1 | 1–2 | 10–30 | [234] |
| 3,4-Diaminopyridin (DAP) | <0.04 ²¹³ | 0.1 (?) | | 0.3–2 ²¹⁴ | [37] |
| Diazepam ¹⁹ | 0.2–2 (–2.5) | 3–5 | | 24–48 | [65, 107, 155, 272, 431, 468, 469, 521] |
| Diazinon | | 0.05–0.1 (–0.5) | | | [133, 528] |
| Diazoxide | 10–20 (–50) | 50 (–100) | | 20–36 (–48) | [155, 268, 426, 527, 528] |
| Dibenzepine | 0.025–0.15 (0.1–0.5) | 3 | 18 | 3.5–5 | [133, 528] |
| Dichloromethane | | 200 | 280 | | [133] |
| 2,4-Dichlorophenoxyacetic acid (2,4-D) | – | appr. 100 | 200; 392 ⁸ ; 720 ⁸ | appr. 18 ¹⁸² | [155, 528] |
| Dichlorvos | | | 29 | 0.16 | [28] |
| Diclofenac | 0.5–3 | 50; 60 ⁸ | | 1–2 | [92, 133, 141, 142] |
| Dicoumarol | 8–30 | 50–70 | | 1–4 ⁶ | [133, 528] |
| Dicyclomine (Dicycloverin) | –0.1 | appr. 0.2 | 0.5 | 1.8–2 | [133, 423] |
| Didanosine | appr. 1–30 µmol/l | | | 1 | [66, 67, 155, 358] |
| Dieldrin | –0.0015 | 0.15–0.3 | | | [28, 133, 528] |
| Diethylcarbamazine | >0.8–1.0 | | | 4–15 | [47] |
| Diethylpentenamide (Valdetamide) | 2–10 | 20 | 45 | 6–7 | |
| Diethylpropion | 0.003–0.007 (–0.2) | 2 | 5.4 ⁸ | 4–8 ²³ | [133, 155, 423, 528] |
| Difenacoum | | 0.5 | | | [133] |
| Diflunisal | 40–100 (–200) | 300–500 | 600 | 5–12 ⁸³ | [133, 155, 340, 528, 556] |
| Digitoxin | 0.01–0.025 | 0.03 | 0.04 | 140–200 | [109, 171] |
| Digoxin | 0.0005–0.0008 (–0.002) | 0.0025–0.003 | 0.005 | 40–70 | [108, 120, 217, 251, 357, 420, 516, 529, 550] |
| Dihydralazine | see Hydralazine | | | | |
| Dihydrocodeine | 0.03–0.25 | 0.5–1 | 2 | 3–4 | [133, 469, 528] |
| Dihydroergotamine | 0.001–0.01 | | | 7–9 | [133, 155] |
| Diltiazem | 0.03–0.13 (–0.25) ¹⁵⁷ | 0.8–1 | 2–6; 7 ⁸ ; 8 ⁸ | 2–6 (4–9) | [133, 155, 268, 528] |
| Dimenhydrinate | see Diphenhydramine | | | | |
| Dimethadione | 700–1000 | 1000 | | ? | [133, 155, 528] |
| Dimethindene | 0.01–0.05 | | | appr. 6 | [155, 423] |
| N,N-Dimethyltryptamine | 0.001–0.1 | | | | [528] |
| 4,6-Dinitro–2-methylphenol | | 40 | | | [133] |
| Dinitro-o-cresol (DNOC) | 1–5 | 30–60 | 75 | | [528] |
| Diphenhydramine | 0.05–0.1 (–1) | 1–2 (–4) | 5–10 | 4–10, 20–60 | [86, 235, 524, 528] |
| Diphenoxylate | appr. 0.01 | | | 2–3 | |
| Dipipanone | appr. –0.05 | 0.2 | | ? | [133] |
| Diprophylline | see Dyphylline | | | | |
| Dipyridamole | 0.1–1.5 | 4 | | 11–13 | [340, 468, 469] |
| Dipyrrone | see Metamizole | | | | |
| Diquat | | 0.1–0.4 | | | [133, 528] |
| Disopyramide | 2–7 ⁷⁸ | 8 | | 5–8 | [133, 528] |
| Disulfiram | 0.05–0.4 | 5 | 8 | appr. 5–7 | |
| Dixyrazine | appr. 0.3 ²⁴⁹ | | 5.5 ⁸ ; 9.4 ⁸ | | [383] |

Table (continued)

| Substance | Blood-plasma/serum concentration (µg/ml) | | | t _{1/2} (h) | Ref. |
|---|--|-------------------|-----------------------|------------------------|----------------------------------|
| | Therapeutic ('normal') | toxic (from) | comatose-fatal (from) | | |
| Domperidone | appr. 0.01–0.1 | | | 12–16 | [24, 155, 208, 223, 343] |
| Donepezil ²⁰⁷ | appr. 0.03–0.075 | | | 70–100 | [230, 438] |
| Dothiepin (Dosulepin) ²⁰ | 0.02–0.1 | 0.8 | 1 | 11–40 | [265, 467] |
| Doxacurium | 0.01–0.3 | | | 1–2 ⁸³ | |
| Doxapram | (1.5–) 2–5 | 9 ²⁶⁸ | | 2.4–9.9 | [22, 133, 155, 528] |
| Doxazosin | 0.01–0.15 | | | 10–22 | [269] |
| Doxepin ²¹ | 0.01–0.2 (0.03–0.1) | 0.5–1 | 2–4 | 8–25 | [8, 45, 126, 181, 282, 305, 356] |
| Doxorubicin (Adriamycin) | 0.006–0.02 | | | 20–48 | [133, 155, 528] |
| Doxycycline | 1–5 (–10) | 30 | | 7–20 | |
| Doxylamine | 0.05–0.2 | 1–2 | 5 | 9–11 | |
| Dronabinol (Delta-9-tetra-hydrocannabinol, THC) | 0.005–0.01 (–0.05) ¹³⁷ | | | 50–100 | [65, 246, 382] |
| Droperidol | appr. –0.05 | | | 1.5–2.5 ²³⁷ | [133, 155, 450] |
| Dyphylline | 6.5–14 (–20) | 40 | | 2 | [133, 528] |
| Edrophonium | –0.15 | appr. 0.15 | | 1.3–2.4 | [9, 155, 528] |
| Emetine | appr. –0.1 | 0.5 | | ? | [133] |
| Enalapril ⁵² | 0.01–0.05 (–0.1) | | | 8–11 | [4, 268] |
| Encainide ⁴⁸ | – ¹⁷⁵ | | | 1.5–3.5 ¹⁷⁶ | [155] |
| Endrin | –0.003 | 0.01–0.03 | | | [133, 528] |
| Enoxacin | 1–4 | | | 3–6 | [93] |
| Enoximone | ≥0.2 | | | 4–7 | [155, 269] |
| Entacapone | 0.4–1.0 (–7.0) | | | 1.5–3.5 | [155, 423] |
| Ephedrine | 0.02–0.2 | 1 | 5 ⁸ | 3–11 | [133, 428, 528] |
| Epirubicin | 0.01–0.05 | | | 24–52 | |
| Eprosartan | 0.4–1.0 (–1.85) | | | 5–9 | [155, 423] |
| Erythromycin | 2–6 (–8) | 12–15 | | 1–3 | [133, 528] |
| Esmolol | 0.15–2 | | | 4–16 min | [466] |
| Estazolam | 0.055–0.2 | | | 10–24 | [133, 155, 528] |
| Et(h)amsylate | 15–20 | | | 2.5–4 | |
| Ethacrynic acid | 0.05–0.1 | | | 1–4 | [155, 340] |
| Ethambutol | 0.5–6 | 10 | | 2.5–3.5 | [236, 528] |
| Ethanol | | 1000–2000 | 3500–4000 | – ¹³⁹ | |
| Ethchlorvynol | 0.5–8 | 20 | 50 | 10–25 (–35) | [133, 155, 528] |
| Ethinamate | 1.5–10 | 50–100 | 200 ⁸ | appr. 2 | |
| Ethosuximide | 30–100 (40–60) | 150–200 | 250 | 30–60 | [60, 145] |
| Ethylene glycol | | 200–500 | 2000 | | [429] |
| Etidocaine | 0.5–1.5 | 1.6–2 | | 2–3 | [557] |
| Etilefrine | appr. 0.06 | | | 2–3.5 | |
| Etodolac | >14 ²²⁹ | | | 6–8 | [51, 155, 423] |
| Etomidate | 0.1–0.5 (–1) | | | 3.9 ± 1.1 (2–11) | [155, 340] |
| Etoposide | 1–6 | | | 4–11 | [133, 155, 528] |
| Ezetimibe | >0.015 | | | appr. 30 | [129, 130] |
| Famotidine | 0.02–0.2 | 0.42 ⁸ | | 2–4.5 | [13, 155, 570] |
| Fampridine | see 4-Aminopyridine | | | | |
| Felbamate | 50–110 ¹⁶⁴ | 200 (?) | | 20–24 | [167, 522, 542] |
| Felbinac | appr. 0.4–1 (topical) | | | 10–17 | [48, 155] |
| Felodipine | 0.001–0.012 | 0.01 | | 22–27 ⁸⁸ | [43, 268, 423] |
| Fenbufen | appr. –60 | | | 10–12 | [133, 155] |
| Fendiline | 0.02–0.15 | | | appr. 20 | |
| Fenfluramine | 0.04–0.3 | 0.5–0.7 | 6 | 1–2, 18–25 | |
| Fenitrothion | | | 1.1 | | [28] |
| Fenofibrate | 5–30 ²⁴¹ | | | 20–22 | [155, 313] |
| Fenoldopam | 0.003–0.06 | | | 0.1 | [423] |
| Fenoprofen | (25–) 30–60 | | | 2–3 | [206] |
| Fenoterol | (0.001–) 0.01–0.04 | | | appr. 7 | |

Table (continued)

| Substance | Blood-plasma/serum concentration (µg/ml) | | | t _{1/2} (h) | Ref. |
|--|--|---------------------|------------------------------------|--|---|
| | Therapeutic ('normal') | toxic (from) | comatose-fatal (from) | | |
| Fentanyl | 0.003–0.3 ⁴ | | 0.003–0.02 ^{8,103} | 1–3.5 (transdermal patch: appr. 17) | [13, 28, 226, 297, 299, 403, 462, 482, 486, 493, 569] |
| Fexofenadine | appr. –0.3 ¹⁹¹ | | | 14–18 | [423, 478] |
| Finasteride | 0.008–0.01 | | | 5–7 | [499] |
| Flecainide ⁴⁸ | (0.2–) 0.4–0.8 | 1–2 | 2.6 ⁸ ; 13 ⁸ | 10–20 | [128] |
| Fleroxacin | 1–4 | | | 8–13 | |
| Flucloxacillin | 3–30 | | | 0.7–1.5 | |
| Fluconazole | appr. 1–5 (–15) | 20; 95 ⁸ | | 22–31 ⁸³ | [98, 430, 461, 528] |
| Flucytosine | 35–70 (20–50) | 100 | | 3–5 | [192] |
| Flumazenil ²² | (0.01–) 0.02–0.1 | 0.5 | | 1–2 | |
| Flunarizine | 0.025–0.2 | 0.3 | | – ⁶ | [426] |
| Flunitrazepam ²³ | 0.005–0.015 | 0.05 | | 10–20 | [49, 114, 272] |
| Fluoride | 0.095–0.190 (–0.285) ³⁹ | 2 | 3 | short | [155, 391, 407, 497, 527, 528, 552] |
| 5-Fluorouracil | 0.05–0.3 | 0.4–0.6 | | <0.5 | [133, 155, 528] |
| Fluoxetine | appr. 0.16–0.5 | 1 | 6 ⁸ | 2–4 ^{6, 130} | [69, 121, 188, 204, 356, 425] |
| Flupentixol | 0.0005–0.002 | | | 19–39 | |
| Fluphenazine | 0.0002–0.004 | 0.05–0.1 | | 10–18 ⁴⁵ | |
| Flupirtine | 0.5–1.5 | appr. 3–4 | | 7–11 | [368] |
| Flurazepam ²⁴ | 0.02–0.1 | 0.2–0.5 | 0.8; 24 ⁸ | appr. 2 ²⁴ | |
| Flurbiprofen | 5–15 | | | 3–4 | [138] |
| Flutamide ⁶⁰ | 0.4–1.5 ⁶⁰ | | | 7–20 ⁶⁰ | [104, 465] |
| Fluvoxamine | appr. (0.05–) 0.15–0.25 | 0.65 | 2.8 ⁸ | 15–22 | [28, 170, 188] |
| Furosemide (Frusemide) | 1–6 | 25–30 | | 1–3 | [133, 155, 528] |
| Fusidinic acid | 30–200 | | | 4–6 | |
| Gabapentin | 5.9–21 ¹⁸⁵ | 85 ⁸ | | 5–8 ¹⁸⁶ | [28, 44, 64, 400, 483, 500, 519, 562] |
| Galant(h)amine | appr. 0.03–0.14 (?) | | | 6–8 | [38, 474] |
| Gallopamil | 0.02–0.1 | | 8 ⁸ | 3–8 | [146, 268] |
| Gamma-hydroxybutyric acid (gamma-hydroxybutyrate, gamma-butyrolactone, GHB, liquid ecstasy) | see 4-Hydroxybutyrate | | | | |
| Ganciclovir | (0.29–0.51) 0.5–5 ¹⁰⁷ | 3–5 | | 2–4 ⁸³ | [252, 358, 476] |
| Gemcitabine | 15–20 µmol/l ¹⁴⁶ | – ¹⁹² | | 0.05 (0.18–0.43) | [248] |
| Gemfibrozil | appr. –25 | | | 1.5 | [133, 155] |
| Gentamicin | (2–) 4–10 ²³³ | 12 | | 1.5–6 | [58, 71, 119, 120, 231, 278, 353, 547] |
| Glibenclamide (Glyburide) | 0.05–0.2 | 0.6 | | 10 | |
| Glipizide | 0.1–1.0 (–1.5) | 2 | | 3–7 | [429] |
| Glutethimide | 0.2–5 | 10–30 | 20–50 | 5–20 | [234] |
| Glyburide | see Glibenclamide | | | | |
| Glyceryl trinitrate | see Nitroglycerin | | | | |
| Gold | 3–8 | 10–15 | | | [528] |
| Granisetron | 0.009–0.017 (?) | | | 3–14 | [155, 423] |
| Griseofulvin | 0.3–1.3 | | | 22 | |
| Guaifenesin | appr. 0.3–1.4 | | | appr. 1 | [155, 423] |
| Guanethidine | 0.01 | | | 5–10 ⁶ | [133, 155, 528] |
| Halazepam ¹⁵ | see Nordazepam | | | 30–40 | |
| Haloperidol | 0.005–0.017 (0.001–0.02) | 0.05–0.5 | 0.5; 0.18 ^{8, 74} | 10–35 ¹⁵³ | [104, 288, 346, 413, 520, 530, 531, 571] |
| Hematin | 50–100 | | | ? | |
| Hemin | see Hematin | | | | |
| Heptabarb(ital) | 0.5–4 | 8–15 | 20 | 6–11 | |
| Heptaminol | appr. 0.2–1 (–1.5) | | | 2–3 | |
| Hexachlorophene | 0.003–0.65 (–1) | | 35 | 6–44 | [133, 528] |

Table (continued)

| Substance | Blood-plasma/serum concentration (µg/ml) | | | t _{1/2} (h) | Ref. |
|-------------------------------|---|-----------------------|------------------------|-----------------------------|---------------------------------------|
| | Therapeutic ('normal') | toxic (from) | comatose-fatal (from) | | |
| n-Hexane | –0.01 | | | | [133] |
| Hexapropymate | 2–5 | 10–20 | | ? | [528] |
| Hexobarbital | 1–5 | 10–20 | 50 | 4–6 | |
| Hirudin-rec | — ¹⁷¹ | — ¹⁷¹ | | (1–) 2.5–3 | [76, 104, 155] |
| Hydralazine ⁵ | 0.05–0.5 (–1.5) | | | 2–6 | [268] |
| Hydrochlorothiazide | appr. 0.04–2 | | | 10–12 | [155, 426] |
| Hydrocodone | 0.01–0.05 | 0.1 | 0.2 | appr. 4 | [423] |
| Hydromorphone | appr. 0.005–0.015 | 0.1 | 0.2 | 2–3 | [176, 340, 423, 427] |
| 4-Hydroxybutyrate (GHB) | appr. 50–120 ⁴ | 80 (abuse) | 250–280 (abuse) | 0.3–0.5 (–1) | [28, 133, 155, 335a, 423] |
| Hydroxychloroquine | –0.1 (–0.4) | 0.5–0.8 | 4 | dose-dependent ⁶ | [133, 155, 284, 468, 469] |
| Hydroxyzine | 0.05–0.1 | 0.1 | 39 ⁸ | 7–20 | [114, 528] |
| Ibuprofen | 15–30 | 200 | | 2–3 | [28, 140, 206, 556] |
| Idebenone | 0.05–0.2 | | | 16–22 | [155, 405] |
| Iloprost | appr. 0.0001 | | | appr. 0.5 | |
| Imatinib | 0.72 ²⁵⁸ | | | appr. 18 | [113, 320] |
| Imipenem | 0.5–5 (20–75) | | | 1 | [513] |
| Imipramine ^{48, 125} | 0.05–0.35 | 0.5–1 | 1.5–2 | 6–20 ²⁶ | [8, 57, 126, 151, 181, 249, 304, 305] |
| Indinavir | — ²⁶⁰ | 0.5 | | 1.5–2 | [53, 155, 421] |
| Indomet(h)acin | 0.3–1 (–3) | 4–5 | | 3–11 | [157] |
| Indoramin | appr. 0.025–0.1 | | | 12 (3.5–15) | [269] |
| Iproniazid | appr. –5 (?) | | | ? | [133] |
| Iridium | –0.02 | | | | [133] |
| Iron | 0.5–2 | 6 | 17 | | [133, 426, 528] |
| Isoniazid (INH) | 5–10 | 20 | (30–) 100 | 1–3 | [155, 236, 423] |
| Isopropanol | | 200–400 | 1000 | | [28, 528] |
| Isosorbid mononitrate (ISMN) | 0.1–1 | | | 2–5 | [269] |
| Isotretinoin | appr. 0.001–0.002 (topical) ²²⁴ | | | 10–20 | [155, 349, 375] |
| Isoxicam | 5–15 | | | 20–50 | |
| Isradipine | 0.0005–0.002 (–0.01) | 0.01 | 0.26 ^{8, 259} | 5–10 | [78, 155, 268, 439, 523] |
| Itraconazole | appr. 0.4–2 ¹¹¹ | | | 24–36 | [25, 309, 366, 485] |
| Ivermectin | appr. 0.05 ⁵¹ | | | 16–28 | [155, 384] |
| Kanamycin | 1–4 (10–25) | 25–30 | | 0.5–3 | |
| Ketamine | 1–6 | 7 (abuse) | 7 (abuse) | 1–3 | [28, 50a, 114, 191, 499a] |
| Ketanserin | 0.05–0.5 | | | 10–22 | |
| Ketazolam ¹⁵ | 0.001–0.02 | | | 1–3 | [272] |
| Ketobemidone | appr. 0.3 | | 0.6 | 2–2.5 | [28, 50a, 155, 499a] |
| Ketoconazole | 1–3 (–6) | | | 6–10 | [423] |
| Ketoprofen | 1–6 (–20) | | 1100 ⁸ | 1.5–2 (–4) | [21, 28, 106, 206, 237, 302, 364] |
| Ketorolac | 0.5–3 | 5 | | 4–10 | [155, 423] |
| Ketotifen | 0.001–0.004 | 0.02 | 1.2 ⁸ | 21 | [428] |
| Labetalol | 0.03–0.18 (–0.65) ⁵⁰ | 1 | | 3–10 | [155, 269, 466] |
| Lacidipine | 0.003–0.006 | | | 12–19 | [423] |
| Lamivudine | — ²³⁰ | | | (3–) 5–7 | [155, 247] |
| Lamotrigine | (1–5) 3–14 | 15–30 | 50 ⁸ | 24–36 ¹⁰⁹ | [28, 64, 419, 453, 519] |
| Lead | –0.16 (–0.3) | 0.4–0.6 | 3 | — ^{6, 180} | [28, 133, 155, 452, 456] |
| Leflunomide ²⁵⁵ | 8.8 ± 2.9, 18 ± 9.6, 63 ± 36 ²⁵⁶ | | | 11 (4–28) ⁶ | [32, 155, 163, 316] |
| Levetiracetam | 10–37 | 400 ^{8, 264} | | 5–8 | [27] |
| Levocabastine | <0.001–0.01 ¹⁴⁷ | | | 33–40 | [209] |

Table (continued)

| Substance | Blood-plasma/serum concentration (µg/ml) | | | t _{1/2} (h) | Ref. |
|--|--|--------------------|--|------------------------|---------------------------|
| | Therapeutic ('normal') | toxic (from) | comatose-fatal (from) | | |
| Levodopa (L-Dopa) | 0.3–1.6 | | 650 ⁸ | 1–3 ²¹⁵ | [15, 182–184, 507] |
| Levomepromazine ²⁷ | 0.005–0.025 (–0.2) | 0.4 | 0.5 | 15–30 ²⁸ | |
| Levomethadone | 0.04–0.3 | 1 | 0.2 | 10–40 | [155, 451] |
| Levorphanol | 0.007–0.02 | 0.1 | 2.7 ⁸ | 11–30 | [423] |
| Levothyroxine | 0.045–0.14 ⁴⁷ | | | 6–8 ⁶ | [143] |
| Lidocaine (Lignocaine) | (1–) 1.5–5 ¹¹³ | 6–7 | 10 | 1–4 ¹¹³ | [95, 189, 231, 557, 567] |
| Lisinopril | (0.005–) 0.02–0.07 | 0.5 | | 12 | [268] |
| Lithium | 4–8 ⁷⁹ | 13 | 14 | 8–50 ²⁸ | [5, 161, 305, 356, 361] |
| Lofepamine | 0.003–0.01 | | | 10–20 | |
| Loperamide | — ⁸⁴ | | | 7–15 | |
| Loprazolam | 0.003–0.01 | | | 11–20 | [272] |
| Loratadine | 0.001–0.02 ¹³⁸ | | | 8–14 | [418, 575] |
| Lorazepam | (0.02–) 0.08–0.25 | 0.3–0.5 | | 10–40 | [203, 272, 424, 431] |
| Lorcainide | (0.04–) 0.1–0.4 (–0.9) | | | 5–10 | |
| Lormetazepam | 0.005–0.025 (–0.1) | | | 10–15 | [272] |
| Losartan | <0.2 ²²⁷ | | | 1.5–2 | [155] |
| Loxapine | 0.01–0.03 (–0.1) | 1 | 7.7 | 4 (1–14) | [133, 528] |
| Lysergide (lysergic acid diethyl amide, LSD) | 0.0005–0.005 | 0.001 | 0.002–0.005 | appr. 2–5 | [317, 423, 528] |
| Magnesium | 55–75 ¹²¹ | 120–140 | 150–180 | | [155, 558] |
| Malathione | | 0.5 | 175 ⁸ | | [28, 133] |
| Manganese | 0.0005–0.0015 | | | | [133] |
| Maprotiline | 0.1–0.6 (0.1–0.25) | 0.5–1 | 1–5 | 20–60 | |
| MCPA | see 2-Methyl–4-chloro-phenoxycetic acid | | | | |
| MCPP | see 2-Methyl–4-chloro-phenoxypionic acid | | | | |
| Mebendazole | ≥0.1 ⁶⁷ | appr. 0.6 | | 2.8–9 | [104] |
| Medazepam ³⁰ | 0.1–0.5 (–1) | | | 2–5 | |
| Mefenamic acid | 2–10 (–20) | 25 | | 2–4 | [340, 468, 469] |
| Mefloquine | 0.4–1 ¹⁰⁸ | 1.5–2 ⁸ | | appr. 21 ⁶ | [68, 199] |
| Melitracen | 0.01–0.1 | | | 12–23 | |
| Meloxicam | 0.4–2 | | | 17–22 | [373, 423] |
| Melperone | <0.2 ²¹⁹ | | 17.1 ⁸ | 4–8 | [228, 423, 496a] |
| Melphalan | –1.5 | | | 1.5–2 | |
| Meperidine | see Pethidine | | | | |
| Mephenesin | 3–10 (?) | | | appr. 2–4 | [423] |
| Mepindolol | 0.007–0.07 | | | 3–6 | [466] |
| Mepivacaine | appr. 0.4 (–4) | 5–6 (–10) | 50 | 1–3 | [423] |
| Meprobamate | 5–10 | 10–25 | 30 | 6–17 | [114] |
| Meptazinol | 0.025–0.25 | | | 2–3 | |
| Mercury | appr. 0.0015–0.002 (<0.005) ¹⁷⁸ | 0.05–0.2 | 0.5 | appr. 3 ⁶ | [133, 155, 372, 429, 481] |
| Mesalazine (Mesalamine) | –appr. 1 ¹¹⁹ | | | 0.5–2.4 ¹²⁰ | [271] |
| Mesoridazine | 0.15–1 | 3–5 | 3 ⁸ ; 4 ⁸ ; 16 ⁸ | 20 | [423] |
| Mesuximide | see Methsuximide | | | 1–2 | [155] |
| Metaclazepam | 0.05–0.2 | | | 7–23 | [272] |
| Metamizole (Dipyrone) ⁵ | 10 ³² | 20 ³² | | 6–8 | [423] |
| Metformin | 0.1–1 (0.6–1.3) | 5–10 | 64 ⁸ ; 85 ⁸ ; 91 ⁸ ; 166 ⁸ | 2–4 (–10) | [101, 422] |
| Methadone ¹³⁵ | (0.05–) 0.1–0.5 (–0.75) | 0.2 | 0.4 | 23–25 (13–55) | [218, 232, 233, 457, 525] |
| Methamphetamine | 0.01–0.05 | 0.2–1 | 10–40 | 6–9 | [423] |
| Methanol | appr. –2 | 200 | 900 | | [133, 423, 528] |
| Methapyrilene | appr. 0.1 | 4 | | | [133] |
| Methaqualone | 1–3 | 3–5 | 5–10 | 10–40 | |

Table (continued)

| Substance | Blood-plasma/serum concentration (µg/ml) | | | t _{1/2} (h) | Ref. |
|--|--|-------------------------------------|--|----------------------|--------------------------------|
| | Therapeutic ('normal') | toxic (from) | comatose-fatal (from) | | |
| Methemoglobin | — ¹⁹⁹ | 25–30% | 60–70% | | [155, 527, 528] |
| Methimazole | 0.5–2 | | | 2–28 | [317, 423] |
| Methocarbamol | 25–40 (–50) | 250 | | 0.9–2 | [133, 155, 528] |
| Methohexital | (0.5–) 1–6 ⁵⁵ | | | 1–3 | |
| Methomyl | | | 28 (8–57) | | [28] |
| Methotrexate | 0.04–? | 0.4 | | 2–10 | |
| Methotrimeprazine | see Levomepromazine | | | | |
| Methoxsalen (8-Methoxypsoralene) | 0.025–0.1 (–0.2) | 1 | | | [155, 527] |
| Methsuximide (Mesuximide) ²²³ | 10–40 | 40–50 | | 20–40 | [155, 496, 528] |
| D-Methylamphetamine | –0.1 | 1 | | | [133] |
| 2-Methyl–4-chlorophenoxy- acetic acid (MCPA) | — | appr. 100 | appr. 180 | — ¹⁸⁷ | [155, 459] |
| 2-Methyl–4-chlorophenoxy- propionic acid (MCPA) | — | appr. 100 | 669 ⁸ ; 715 ^{8, 181} | 17 ¹⁸³ | [155] |
| Methyldopa | 1–5 | 9 ⁸ | | 1.5–3 | [340, 468, 469] |
| Methylenedioxyamphetamine (MDA) | –0.4 | 1.5 | 2 | | [317, 423, 528] |
| Methylenedioxyethyl- amphetamine (MDEA) | 0.2 | | 1 | | [28] |
| 3,4-Methylenedioxymethyl- amphetamine (XTC, MDMA) | 0.1–0.35 ²³⁶ | 0.35–0.5 | 0.4 | 9–10 | [75, 317, 423, 528] |
| Methylphenidate | 0.01–0.06 | 0.5; 1 ⁸ | 2.3 | 2–7 | [427] |
| 4-Methylthioamphetamine (4-MTA, p-MTA) | | | 2 ⁸ ; 4.2 ⁸ ; 7.4 ⁸ | | [46, 123, 410, 512, 549] |
| Methyprylon(e) | <10–20 | 12–75 | 50 (–100) | 3–6, 9–11 | |
| Metiamide | 0.01–0.06 | | | ? | [528] |
| Metildigoxin ³ | 0.0005–0.0008 | 0.0025–0.003 | 0.005 | 40–70 | [420, 516] |
| Metipranolol ³³ | 0.02–0.08 | | | 2–3.5 | |
| Metoclopramide | 0.05–0.15 | 0.2 | 4.4 ⁸ | 3–6 | [429] |
| Metocurine | appr. –0.4 | | | ? | [133] |
| Metoprolol ⁴⁸ | 0.035–0.5 | 0.65 ⁸ ; 12–18 | 4.7 ⁸ ; 12 ⁸ ; 63 ⁸ | 3–6 | [28, 155, 466] |
| Metrifonate | appr. 1.4–3.6 | | | 2–5 | [423] |
| Metronidazole | 3–10 (–20) | 200 ⁸ | | 6–10 (–14) | [423] |
| Mexiletine | (0.5–) 0.7–2 | 2.5 | 35 ⁸ | 5–26 | [338] |
| Mianserin | 0.01–0.15 | 0.5–5 | | 8–19 | [114] |
| Miconazole | appr. 1 | | | 24 | |
| Midazolam | 0.04–0.1 (–0.25) ¹³⁴ | 1–1.5 | | 1.5–3 ⁴⁶ | [16, 42, 227, 293, 431] |
| Mifepristone | — ²¹⁶ | | | 24–48 (20–54) | [196] |
| Milrinone | 0.15–0.25 | 0.3 | | 1–2 | [155, 269, 426] |
| Minaprine | appr. –0.1 | | | ? | [133] |
| Minoxidil ¹⁴⁹ | appr. 0.02–0.25 | 1.4 ⁸ ; 3.1 ⁸ | 2.7 ⁸ | 2.8–4.2 | [28, 155, 268] |
| Mirtazapine | –0.3 | 1–2 | | 20–40 ¹⁸⁸ | [155, 501] |
| Mizolastine | appr. 0.2–0.8 | | | 8–17 | [155, 423] |
| Moclobemide ¹⁴¹ | appr. 0.5–1.5 (–3) | 11 ¹⁶² ; 25–60 | | 1–3 | [150, 175, 239, 336, 363, 365] |
| Modafinil | appr. 2–3 ²⁵⁷ | | | 12–15 | [201, 352] |
| Molindone | appr. –0.5 | | | ? | [133] |
| Molsidomine | 0.002–0.01 | | | 1–2.5 | [269] |
| Molybdenum | –0.005 | | | | [133] |
| Montelukast | appr. 0.05–0.3 | | | 3–6 | [155, 423, 574] |
| Moricicine | appr. 0.12–1.27 | | | 6–13 | [317, 423] |
| Morphine | 0.01–0.1 | 0.1 | 0.1–4 | 1–4 | [1, 65, 159, 253] |
| Moxonidine | 0.001–0.002 (–0.004) | | | 2–3 | [155, 269] |
| Muromonab-CD3 (OKT 3) | appr. 0.7–1.3 | | | appr. 18 | |
| Mycophenolate mofetil | — ²¹¹ | | | 16–18 ²¹² | [33, 149, 225, 448] |
| Nabumetone | — ²⁰⁶ | | | — ²⁰⁶ | [155, 560] |

Table (continued)

| Substance | Blood-plasma/serum concentration (µg/ml) | | | t _{1/2} (h) | Ref. |
|-------------------------------------|--|-----------------------------------|-----------------------------------|----------------------|-----------------------------------|
| | Therapeutic ('normal') | toxic (from) | comatose-fatal (from) | | |
| Nadolol | 0.01–0.25 | | 1.3 ⁸ | 14–24 | |
| Naftidrofuryl (Nafronyl) | <0.5 | | | 1–2 | [133] |
| Nalbuphine | 0.02–0.2 | | | 2.5–7 | |
| Nalidixic acid | 10–30 | 40–50 | | 1 (–7) | [155, 340, 423] |
| Nalmefene | –0.1 | | | 8.5–11 | [133, 155] |
| Naloxone | 0.01–0.03 | | | 1–2 | |
| Naltrexone | –0.05 ⁹⁹ | | | 4–10 | |
| Naproxen | 20–50 (–100) | 200–400; 414 ⁸ | | 10–20 | [90, 206, 335, 556] |
| Naratriptan | appr. 0.01–0.05 | | | 5–6 | [155, 423] |
| Nebivolol | <0.02 (–0.2) | 0.48 ⁸ | | 10 (8–27) | [155, 197, 211, 337] |
| Nedocromil | <0.025 | | | 1.5–3.3 | [133, 155] |
| Nefazodone | appr. 0.01–0.3 (?) ²²⁰ | 5.5 ⁸ , ²²¹ | | 2–7 ²²² | [23, 94, 153, 155, 169, 262, 445] |
| Nefopam | 0.01–0.1 | 4 ⁸ | 12 ⁸ | 3–8 | |
| Neostigmine | appr. 0.001–0.01 ¹²⁷ | | | 0.4–1.3 | [9, 74] |
| Netilmicin | 1–12 | | | 2–3 ⁸⁰ | |
| Nicardipine | 0.07–0.1 | | | 7–12 | [268] |
| Nickel | –0.003 | 0.005 | | | [133, 528] |
| Nicotine ¹²³ | 0.005–0.02 (–0.03) | 0.4 (–1) | 5; 13.6 ⁸ | 1–4 ¹²⁴ | [155, 255, 426] |
| Nicotinic acid | 4–18 | | | 0.3–1 | |
| Nifedipine | 0.025–0.1 | appr. 0.15–0.2 | 5.4 ⁸ | 2–5 | [28, 268] |
| Niflumic acid | 2–35 | | | 2–3 | [423] |
| Nilvadipine | <0.01 | | | 11–20 | [268] |
| Nimesulide | appr. 1–3 ²³⁵ | | | 2–7 | [34, 155, 423] |
| Nimodipine | 0.01–0.05 | | | 1–2 (8–9) | [268] |
| Nimustine | 0.0002–0.0005 | | | ? | [528] |
| Nisoldipine | 0.0003–0.001 | | | 7–12 | [155, 268] |
| Nitrazepam | 0.03–0.1 | 0.2–3 | 5 (?) | 20–30 | |
| Nitrendipine | 0.01–0.05 | | | 8–12 | [268] |
| Nitrofurantoin | 1–3 | 3–4 | | 1 ± 0.3 | |
| Nitroglycerin (Glyceryl trinitrate) | appr. –0.015 | | | 20–30 min | [355] |
| Nitroprusside | see Thiocyanate | see also Cyanide | | | |
| Nizatidine | 0.05–0.5 (–1.0) | | | 0.7–2.1 | |
| Nomifensine | 0.01–0.1 | 8–10 | | 2–5 | |
| Nordazepam | 0.02–0.2 (–0.8) | 1.5–2 | | 40–80 | |
| Norephedrine | see Phenylpropanol-amine | | | | |
| Norfenefrine | –0.4 | | | 2–3 | |
| Norfloxacin | 0.5–5 | | | 3–4 | [155, 528] |
| Normesuximide ³¹ | 10–30 | 40 | | 38 | |
| Nortriptyline ⁴⁸ | 0.02–0.2 (0.05–0.15) | 0.5 | 1–3 | 18–56 ⁶⁸ | [151, 305, 345, 415] |
| Obidoxime | 1–10 (appr. 10–15 µmol/l) | | | | [133, 518, 528] |
| Ofloxacin | appr. 2.5–5.5 | (30–) 40 ⁸ | | (3–) 5–8 | [155, 289] |
| OKT 3 | see Muromonab-CD3 | | | | |
| Olanzapine | appr. 0.02–0.03 (–0.05) | 0.2 | 1 ⁸ ; 4.9 ⁸ | 33 (21–54) | [28, 73, 121a, 423, 477a, 528] |
| Omeprazole ⁴⁸ | — ⁹⁸ | | | 0.5–1 (–1.5) | |
| Ondansetron | 0.03–0.3 | | | 3–5.5 | [429] |
| Opipramol | 0.1–0.5 | 2–3 | 7–10 | 6–12 ²⁶² | [104, 264] |
| Orphenadrine | 0.1–0.2 (–0.6) | 1.7 | 3.6 ⁸ ; 5–7 | 14–18 | [86, 114, 340] |
| Oxatamide | 0.02–0.1 | | | 14–30 | [133, 155] |
| Oxazepam | 0.2–1.5 | 2 | 3–5 | 6–20 | [107, 155, 272, 468] |
| Oxazolam ¹⁵ | see Nordazepam | | | 1–2 | |
| Oxcarbazepine | 12–24 ¹⁷² | | | 1–2.5 ¹⁷² | [155, 517, 519] |
| Oxpentifylline | see Pentoxifylline | | | | |
| Oxprenolol | 0.05–0.3 (–1.0) | 2–3 | 10 | 1–4 | [466] |

Table (continued)

| Substance | Blood-plasma/serum concentration (µg/ml) | | | t _{1/2} (h) | Ref. |
|------------------------------------|--|-------------------------|-----------------------|------------------------|---|
| | Therapeutic ('normal') | toxic (from) | comatose-fatal (from) | | |
| Oxycodone | (0.005–) 0.02–0.05 | 0.2 | 0.6; 5 ⁸ | 2–5 ⁵³ | [340, 426, 528] |
| Oxyfedrine | appr. 0.06 | | | 4.2 | [269] |
| Oxypurinol ⁶¹ | 5–15 | 20 | | 18–30 | [528] |
| Oxytocin | appr. –0.0002 | | | 3–5 min | [133, 155] |
| Paclitaxel | 0.085–1 (?) ¹²² | | | 4–8 (–13) | |
| Pamidronate | appr. 0.5–1 | | | appr. 2.5 | |
| Pancuronium | 0.1–0.6 | 0.4 ⁸ ; 198 | 1.6 | 1.5–2.5 | [536] |
| Pantoprazole | appr. –4.6 | | | 1–2 | [155, 423] |
| Papaverine | (0.2–) 0.6–1 (–2) | | | 1–2, 6–7 | [428] |
| Paracetamol | (5–)10–25 | 100–150 | 200–300 | 2–4 | [50, 166, 260, 331, 369, 442, 455, 484, 487, 535] |
| Paraldehyde | 10–100 | 200 | 400–500 | 4–10 | |
| Paraoxon | – | 0.005 | | | [528] |
| Paraquat | – | 0.05 | 1–2 ²⁰¹ | | [155, 187, 528] |
| Parathion | – | 0.01–0.05 | 0.05–0.08 | | [155, 527, 528] |
| Paroxetine ⁴⁸ | <0.01–0.05 (–0.1) | 0.35–0.4 | | 16–24 ⁹³ | [69, 170, 188, 283, 479, 480] |
| Pefloxacin | 1–10 (3–6) | 25 | | 8–15 | |
| Pemoline | appr. 1–7 | | | 7–13 | |
| Penbutolol | 0.01–0.3 (–1.0) | | | 20–26 | [466] |
| Penfluridol | 0.004–0.025 | | | 70 | [155, 528] |
| (D–)Penicillamine | 1.7–5.6 (–11) | | | 1–3 | |
| Pentachlorophenol | –0.2 | 30 | 45 | | [133, 528] |
| Pentamidine | appr. 0.3–0.5 | | | 6–9 | [155, 423] |
| Pentazocine | 0.01–0.2 | 1–2 | 3 | 2–5 | |
| Pentobarbital | 1–10 | 10–19 | 15–25 | 20–40 | |
| Pentoxifylline ⁷² | appr. 0.5–2 | | | 0.5–2 (4–6) | |
| Perazine | 0.02–0.35 | 0.5 (6.1 ⁸) | | 8–16 (–35) | [164, 423] |
| Perici(y)azine | 0.005–0.03 | 0.1 | | ? | [340] |
| Perindopril | 0.08–0.15 | | | 0.8–1.5 ²⁶⁵ | [155, 423] |
| Perphenazine | 0.001–0.02 (0.0008–0.0024) ¹⁶¹ | 0.05 | | 8–12 (–21) | [308] |
| Pethidine ¹¹⁵ | 0.1–0.8 | 1–2 | 2 (–3) | 3–6 (–10) | [10, 31, 177, 215, 257] |
| Phenacetin ⁶² | 5–10 (–20) | 50 | | appr. 1 | [340, 468] |
| Phenazone (Antipyrine) | 5–25 | 50–100 | | 10–12 | |
| Phencyclidine (PCP) | | 0.007–0.24 | 1–5 | 1–12 | [317, 423, 528] |
| Phendimetrazine | 0.02–0.24 (–0.3) | | | 2–4 | [133] |
| Phenelzine | 0.001–0.002 (–0.04) | 0.5 | 1.5 | 6–8 | [155, 528] |
| Phenformin | 0.03–0.1 | 0.6 | 3 | 4–13 | [155, 423] |
| Pheniramine | 0.01–0.27 | | 2 (?) | 16–19 | [155, 423] |
| Phenmetrazine | 0.02–0.25 | 0.5 | 4 | ca. 8 | |
| Phenobarbital | 10–30 (15–40) | 30–40 | 50–60 | 60–130 | [60, 145, 157] |
| Phenol | | 50 | 90 | | [133, 528] |
| Phenprocoumon | 0.16–3.6 (1–5) | appr. 5 | | 100–160 ³⁵ | [528] |
| Phensuximide | 4–10 (–20) | 80 | | 4–12 | [423, 528] |
| Phentermine | 0.03–0.1 | 0.9 | 1 | appr. 20 | [423, 528] |
| Phenylbutazone ³⁶ | 50–100 | 120–200 | 400 | 30–175 ³⁷ | [340, 468] |
| Phenylephrine | 0.04–0.1 | | | 2–3 | [423] |
| Phenylpropanolamine (Norephedrine) | 0.1–0.5 | 2 | 48 | 3–7 | [155, 340] |
| Phenytion | 5–15 (10–20) ⁸¹ | 20–25 | 43 ⁸ ; 50 | 10–60 ³⁷ | [6, 55, 145, 147, 193, 221, 351, 362, 416] |
| Pholcodine | appr. –0.2 | | | ? | [133] |
| Physostigmine | <0.001–0.005 | | | 0.4–1 | [9, 14, 230] |
| Pimozide | appr. 0.004–0.01 (–0.02) | | | 24–55 | |

Table (continued)

| Substance | Blood-plasma/serum concentration (µg/ml) | | | t _{1/2} (h) | Ref. |
|------------------------------------|--|------------------------------|--|--------------------------|--------------------------|
| | Therapeutic ('normal') | toxic (from) | comatose-fatal (from) | | |
| Pinazepam ¹⁵ | 0.01–0.05 | | | 16 | [272] |
| Pindolol | 0.02–0.15 | 0.7–1.5 | | 2–5 | [466] |
| Pipamperone | 0.1–0.4 | 0.5–0.6 | | <4 | |
| Piperacilline | 1–5 (20–70) | | | 1–2 | [423, 528] |
| Piperazine | 0.02–0.1 | 0.5 | | | [426, 429, 528] |
| Pipotiazine | 0.001–0.06 | 0.1 | | 8–11 | [155, 340, 423, 528] |
| Piracetam | appr. 20–50 | | | 4.5–7 | |
| Pirenzepine | 0.03–0.45 | | | 8–20 | |
| Piritramide | 0.0088 ± 0.0053 ¹²⁸ | | | 4–10 | [266] |
| Pirmenol | 1–4 | | | 6–18 | [155, 528] |
| Piroxicam | 2–6 | 14 ⁸ | | 30–70 | |
| Pizotifen | 0.007–0.009 | | | 26 | |
| Prajalium ⁴⁸ | 0.06–0.44 | | | 5–7 | |
| Pramipexole | appr. 0.0002–0.007 | | | 8–14 | [317, 423] |
| Pranlukast | appr. 0.2–1.2 | | | appr. 2–9 | [155, 423] |
| Prazepam ¹⁵ | 0.2–0.7 | 1 | | 1–3 | |
| Praziquantel | appr. 0.2 | | | 1–2.5 | |
| Prazosin | 0.001–0.02 | 0.9 | | 2.9 ± 0.8 | [269, 426] |
| Prednisolone | 0.5–1 | | | 2–6 | |
| Prilocaine | 0.5–1.5 (–2) ¹²⁶ | 5–6 | appr. 20 | 1–2 | [162, 557] |
| Primaquine | appr. 0.1–0.2 | | | 4–7 | [423] |
| Primidone ⁶³ | 4–12 (8–15) | 20–50 | 65 | 4–12, 9–22 | [60, 145] |
| Probenecid | 100–200 (20–150) | | | 3–17 ³⁷ | |
| Procaine | 0.2–2.5 (–10) | 15–20 | 20 | –0.5 | [423, 528] |
| Procinamide ⁵ | 4–10 (3–9) | 10–15 | 20 | 2–5 | |
| N-Acetylprocainamide ³⁸ | 5–30 (10–35, 15–40) | | | 3–7 | |
| Prochlorperazine | 0.01–0.05 | 0.2–0.3 | 5 | 7–9 (–18) | [155, 340, 528] |
| Procyclidine | 0.08–0.63 | 1–2 | 7.8 ⁸ | 7–16 | [423, 528] |
| Proguanil ⁴⁸ | appr. 0.04–0.15 ¹¹⁴ | | | 13–24 ¹¹⁴ | [117] |
| Promazine | 0.01–0.05 (–0.4) | 1 | 5 | 5–41 (8 ± 7) | |
| Promethazine | 0.05–0.2 (–0.4) | 1–2 | 2.4 ⁸ ; 1.8–5.4 ²⁵⁰ | 8–15 (–20) | [114, 506] |
| Propafenone ⁴⁸ | 0.4–3 (0.06–1) | 2–3 | 7.7 ⁸ | 5–8, 2–32 ⁴⁸ | [244, 426] |
| Propallylonal | 0.3–10 | >10 | | appr. 3 | |
| 2-Propanol | see Isopropanol | | | | |
| Propantheline | appr. –0.02 | | | 1–3 | [133, 155] |
| Propiomazine | <0.3 (?) | | | 8–10 | [114, 190] |
| Propofol | appr. 2–8 | | | 3–8 ⁹¹ | [11, 299] |
| Propoxyphene | see Dextropropoxyphen | | | | |
| Propranolol | 0.02–0.3 | (0.5–) 1–3 | 4–10 | 2–6 | [466, 504] |
| Propylene glycol | 0.05–0.5 | 1000–2000; 4700 ⁸ | | | [62, 528] |
| Propylhexedrine | 0.01 | 0.5 | 2–3 | ? | [133, 528] |
| Propyphenazone | 3–12 | | | 1–1.5 (–3) | [340, 468, 469] |
| Prothipendyl | appr. 0.05–0.2 | appr. 0.5 (–1) | | 2–3 | |
| Protriptyline | 0.05–0.3 | 0.5 | 1 | 50–200 | |
| Pseudoephedrine | 0.5–0.8 | | 19–20 | 9–16 | [423, 528] |
| Pyrazinamide | 30–75 | | | 9–10 (–25) | [110, 155, 340] |
| Pyridostigmine | <0.05–0.2 | | | 1–2.5 | [9, 554, 559] |
| Pyridoxine | 0.003–0.018 | | | 3–6 | [429] |
| Pyrimethamine | appr. –1.5 | | | 80–96 | [133, 155] |
| Pyrithyldione | 1–10 | | | 11–20 | [340, 468, 469] |
| Quazepam ¹³¹ | 0.01–0.05 (–0.15) | | | 39 (25–41) | [272, 423, 528] |
| Quetiapine | <1 ²³⁹ | 1.8 ⁸ | 12.7 ⁸ | appr. 5–7 ²⁴⁰ | [12, 102, 185, 374, 408] |
| Quinidine ⁴⁸ | 1–5 | 6–10 | 10–15 | 4–12 | [357] |
| Quinine | 1–7 | 10 | | 4–15 | [115, 390] |

Table (continued)

| Substance | Blood-plasma/serum concentration (µg/ml) | | | t _{1/2} (h) | Ref. |
|-----------------------------|--|-------------------------|-----------------------------------|----------------------|---------------------------------------|
| | Therapeutic ('normal') | toxic (from) | comatose-fatal (from) | | |
| Rabeprazole | appr. –0.6 | | | 1–2 | [423] |
| Ramipril | appr. 0.001–0.01 ²²⁸ | | | 1–5 | [155] |
| Ranitidine | 0.05–1 | | | 2–4 | [344] |
| Reboxetine | C _{max} < 0.3 | | | 12–14 | [135, 155] |
| Recainam | 1.3–5.7 | | | 5–7 | [7] |
| Remoxipride | 2.15 ± 0.59 ¹³² | | 41–150 | 5–10 | [114, 250, 290] |
| Retinol (Vitamin A) | 0.2–0.8 (0.7–2.8 µmol/l) | | | | [342, 429] |
| Ricin | | 0.0005 | | | [276a] |
| Rifabutin | 0.05–0.15 | | | 45 (?) | [155] |
| Rifampicin (Rifampin) | 0.1–10 ¹⁰¹ | | 55 ⁸ | 2.3–5 | [28, 110, 236, 407a] |
| Rifapentine | ? | | | 13.2 | [110] |
| Riluzole | appr. 0.05–0.5 (–1.5) | | | 9–15 | [317, 423] |
| Risperidone ⁴⁸ | appr. 0.006 ¹⁵⁸ | | 1.8 ⁸ | 2–4 ¹⁵⁹ | [28, 401] |
| Ritonavir | appr. 5–11 (–20) | | | 3–5 | [155, 224] |
| Rivastigmine | ? | | | 1–2 | [230, 423] |
| Rizatriptan | appr. –0.1 | | | 2–3 | [155, 423] |
| Ropinirole | 0.0004–0.006 ²⁵⁴ | | | 6 (2–10) | [263] |
| Ropivacaine | | (1–) 2 ¹⁷³ | | 2 ¹⁶⁸ | [125, 332, 473] |
| Roxatidine | 0.1–0.8 | | | 5–6 | |
| Roxithromycin | 4–12 | | | 12 | [17, 155] |
| Salbutamol (Albuterol) | <0.01–0.02 | 0.1–0.15 ¹¹⁶ | 0.16 | 3–6 | [303, 528] |
| Salicylamide | 5–40 | | | appr. 1 | |
| Salicylic acid | 20–200 | 300–350 | (400–) 500 | 3–20 | [77, 155, 207, 234, 329, 334, 409] |
| Scopolamine | 0.0001–0.0003 (–0.001) | | | appr. 3 | [423, 528] |
| Secbutabarbital | 5–10 (–15) | 20 | 30 | 34–42 | |
| Secobarbital | 1.5–5 | 7–10 | 10–15 | 15–30 | |
| Selegiline | see Amphetamine and Methamphetamine | | | 1.2 | [155] |
| Selenium | 0.045–0.13 | 0.4 | | | [133, 155, 359] |
| Sertraline | 0.05–0.25 (–0.5) | 0.29 ⁸ | 1.6 ⁸ ; 3 ⁸ | 24–28 | [28, 317, 345a, 423, 528] |
| Sildenafil | appr. 0.05–0.5 | | | 3–5 | [155, 423] |
| Silver | –0.005 | 0.06–0.6 | | | [528] |
| Sirolimus | 0.005–0.015 ²⁴⁴ | 0.015 (–0.06) | | 57–63 | [155, 256, 322, 324, 576] |
| Sodium nitroprusside | see Thiocyanate | | | 0.1 | |
| Sodium oxybate (GHB) | see 4-Hydroxybutyrate | | | | |
| Sodium valproate | see Valproic acid | | | | |
| Sotalol ¹⁶⁷ | 0.5–3 (–4) | 7.5–16 ⁸ | 40 ⁸ ; 43 ⁸ | 5–13 (–17) | [118, 466, 498] |
| Sparteine ⁴⁸ | 0.5–1 | | | 2.6 | |
| Spiramycin | appr. –3 | | | 5–8 | [61, 155] |
| Spironolactone | (0.05–) 0.1–0.25 (–0.5) ⁷³ | | | 13–24 ⁷³ | [423, 528] |
| Stiripentol | appr. 4–22 | 20 | | 13 | [133, 155] |
| Streptomycin | 1–5 (15–40) | 40–50 | | 2–4 | [317, 423, 528] |
| Strontium | –0.03 | | | | [133] |
| Strychnine | | 0.075–0.1 | 0.2–2 | appr. 10–15 | [423, 528] |
| Sufentanil | 0.0005–0.01 ⁴ | | 0.001–0.007 ⁸ | 2–5, 22 | [19, 28, 52, 194, 226, 403, 460, 462] |
| Sulbactam | –80 | | | 1–2 ⁷⁰ | [88, 155] |
| Sulfamethoxazole | 30–60 ⁵⁶ | 200–400 | | 9–12 | [155, 389] |
| Sulfasalazine ³⁴ | 5–30 (–70) | | | 4–10 | |
| Sulfinpyrazone | 6–17 | | | 3–5 | |
| Sulindac | 1–5 ¹⁰² | | | appr. 7 | [91] |

Table (continued)

| Substance | Blood-plasma/serum concentration (µg/ml) | | | t _{1/2} (h) | Ref. |
|-----------------------------|--|---|---|-----------------------------|--|
| | Therapeutic ('normal') | toxic (from) | comatose-fatal (from) | | |
| Sulpiride | 0.05–0.4 (–0.6) ²²⁵ | | 3.8 ⁸ ; 38 ⁸ | 4–7 | [28, 104, 155, 528] |
| Sultiam (Sulthiame) | 0.5–12.5 (6–10) | 12–15 | 20–25 | 3–30 | [496] |
| Sumatriptan | 0.018–0.06 | | | 2 | [423] |
| Suramin | >100 ¹¹⁷ | 300 ¹¹⁸ | | 44–54 | [281] |
| 2,4,5-T | see 2,4,5-Trichloro-phenoxyacetic acid | | | | |
| Tacrine | appr. 0.01 | | | 2–4 | [230] |
| Tacrolimus (FK–506) | 0.005–0.015 (–0.02) | (0.015–) 0.02–0.025 | | 9–16 | [216, 254, 306, 360, 511, 528, 533, 538–540, 543, 564] |
| Talinolol | 0.04–0.15 | | 5 ⁸ , 129 ⁹ ; 20 ⁸ | 10–14 | [466, 514, 515] |
| Talipexole | appr. 0.0001–0.001 | | | 5–9 | [423] |
| Tamoxifen | 0.05–0.5 | | | 5–7 ⁶ | [133, 155] |
| Taxol | see Paclitaxel | | | | |
| Teicoplanin | (10–) 15–20 (–40) | 200 | | 10–15; 83–168 ⁸³ | [243, 561] |
| Temazepam | 0.02–0.15 (–0.9) | 1 | 8.2 ⁸ ; 14 ⁸ | 6–25 | [139, 272, 423, 528] |
| Tenoxicam ¹⁷⁴ | appr. 5–10 | | | (50–) 70–90 | [198, 370] |
| Terazosin | appr. 0.02–0.08 | | | 8–12 | [423] |
| Terbinafine | 0.01–0.03 ²⁰⁵ | | | 22–26 | [155, 527, 528] |
| Terbutaline | 0.001–0.006 (–0.01) | | 0.04 | 16–20 ⁸⁹ | [423, 528] |
| Terfenadine | <0.01 | 0.06 ¹⁴⁸ | 0.4 ⁸ | 15–22 ⁶⁴ | [28, 155, 566] |
| Tetrachloroethylene | | | 4–5 | | [528] |
| Tetracycline | 1–5 (5–10) | 30 | | 6–10 | [155, 423, 528] |
| Tetrazepam ⁴⁰ | 0.05–0.6 (–1) | | | 10–26 | [272] |
| Thalidomide | 0.5–1.5 (–8) | | | 5–9 | [155, 423] |
| Thallium | | 0.1–0.5 ¹⁷⁹ ; 5.6 ⁸ | 0.5–11 | – ⁶ | [59, 155, 528] |
| Theobromine | 10–15 | 20 | | 6–10 | [528] |
| Theophylline | (5–) 8–15 (–20) ⁸² | 20 | 50 | 6–9 ⁴¹ | [84, 103, 120, 122, 157, 180, 217, 267, 404, 447, 475, 508, 553] |
| Thiamphenicol | 0.5–3–10 (–15) | 20 | | 2–7 | [423] |
| Thiazinamium | 0.05–0.15 | 0.3 | | | [317, 423, 528] |
| Thiocyanate | 1–12 ¹⁴⁴ | 35–50 | 200 | 3–4 ⁶ | [3, 155, 446, 528] |
| from Nitroprusside | 5–30 | 50–100 | | | |
| Thiopental ⁵⁷ | 1–5 | | 10–15 ⁵⁸ | 3–8 | |
| Thiopropazine | appr. 0.001–0.02 | 0.1 | | | [423] |
| Thioridazine ¹³³ | 0.1–2 (0.2–0.8–1.25) ¹³³ | 2.5–5 | 3–10 | 7–13 (–36) | [114] |
| Thiothixene | see Tiotixene | | | | |
| Thyroxine | see Levothyroxine | | | | |
| Tiagabine | 0.05–0.2 (?) | 0.5–0.6; 3.1 ⁸ , 245 | | 7–9 (4–13) | [2, 155, 294, 295, 318, 399, 423, 519] |
| Tiaprude | max. 1–2 | | | appr. 3–4 | [423] |
| Tiaprofenic acid | appr. 15–40 ¹⁹³ | | | 1.5–3 | [89, 155, 414] |
| Ticlopidine | <1–2 (?) | | | 0.8 ¹⁰⁰ | |
| Tilidine ²⁵ | 0.05–0.12 | | 1.7 ⁸ | appr. 3 | |
| Tiludronate | 0.2–1.5 | | | 65–78 (–150) | [472] |
| Timolol | 0.005–0.05 (–0.1) | | | 2–6 | |
| Tin | 0.03–0.14 | | | | [133, 528] |
| Tinidazol | max. –60 | | | 11–15 | [133, 155] |
| Tiopronin | appr. 2–5 | | | 23 ± 11 | [158] |
| Tiotixene | 0.001–0.03 (0.002–0.014) | 0.1 | | 34–36 | [346] |
| Tizanidine | appr. 0.015 | | | appr. 2.5 | [155] |
| Tobramycin | 4–10 ¹⁵⁴ | 12–15 | | 2–3 | [71, 155, 454, 489] |
| Tocainide | 4–12 (6–10) | 13–15; 20 ⁸ | 74 ⁸ ; 140 ⁸ | 8–25 | [23a, 28, 155, 292] |
| Tofenacine | 0.025–0.1 | 0.5–1 | | | [340, 528] |
| Tolbutamide | 50–100 | 400–500 | 640 ⁸ | 4–12 | [26, 528] |

Table (continued)

| Substance | Blood-plasma/serum concentration (µg/ml) | | | t _{1/2} (h) | Ref. |
|---|--|-----------------------|---|-----------------------|---|
| | Therapeutic ('normal') | toxic (from) | comatose-fatal (from) | | |
| Tolmetin | 10–80 | 60 (?) | | 2–4 | [528] |
| Toluene | | | 10 | | [528] |
| Topiramate | 3.4–5.2 (–10?) ²¹⁸ | | | 20–30 | [399, 423, 519] |
| Topotecan | appr. 0.001–0.01 ¹⁹⁰ | | | 2–3 | [152, 155, 205] |
| Tramadol ⁴⁸ | 0.1–1 (>0.3) ⁸⁷ | 1 | 2 ^{8, 49} ; 13 ⁸ ; 38.3 ^{8, 252} | 5–10 | [35, 298, 341, 528] |
| Tranexamic acid | 10–50 | | | 10 | |
| Tranlycypromine | –0.2 (?) | 0.5 ^{8, 202} | 0.7 ⁸ ; 5 ⁸ | 1.5–3.5 | [238] |
| Trapidil | (4–) 6–10 | | | 2–6, 12 | [155, 269, 339] |
| Trazodone ¹⁴⁵ | (0.5–) 0.8–1.6 | 4 | 12–15 ⁸ | 4–8 (6–13) | [104, 381] |
| Triamterene | 0.01–0.1 | | | 1.5–4 | [155, 426] |
| Triazolam | 0.002–0.02 | 0.04 | | 2–5 | [229, 272, 366] |
| 2,2,2-Tribromoethanol | | 50 | 90 | | [133, 528] |
| Trichloroethane | | | 100–1000 | | [528] |
| 2,2,2-Trichloroethanol | 5–15 | 40–70 | 60–100 | | [28, 133, 528] |
| 2,4,5-Trichlorophenoxyacetic acid (2,4,5-T) | – | appr. 100 | 200 | 23–33 | [155, 528] |
| Trifluoperazine | 0.001–0.01 (0.05) | 0.1–0.2 | | 7–18 | |
| Triflupromazine | 0.03–0.1 | 0.3–0.5 | | appr. 6 | |
| Trihexyphenidyl | — ⁷⁵ | 0.5 | | 3–5 | [340, 524] |
| Trimeprazine | see Alimemazine | | | | |
| Trimethadione | 20–40 | | | ? | [528] |
| Trimethobenzamide | 1–2 | | | ? | [133, 528] |
| Trimethoprim | 1.5–2.5 ⁵⁶ | 20 | | 8–11 | [155, 389] |
| Trimipramine | 0.01–0.25 | 0.5 | 1.7–8.2 ²⁵¹ | 10–20 (–40) | [114] |
| Tripelennamine | 0.02–0.06 | | 10 | 5–8 | [423, 428, 528] |
| Triprolidine | 0.004–0.045 | | | 2–5 | [428] |
| Tropisetron | appr. 0.02–0.05 | | | 5.6–8.6 | [429] |
| Tubocurarine | (0.6–) 1–3 (–6) | | | 2–4 | |
| Tungsten | –0.035 | | | | [133] |
| Urapidil | appr. 0.1–0.2 | | | 2.7–7 | [155, 269] |
| Valdetamide | see Diethylpentenamide | | | | |
| Valnoctamide | 5 | 40 | | ? | [528] |
| Valproic acid | 40–100 (50–150) | 150–200 | 720 ⁸ | 10–20 (7–17) | [28, 60, 145] |
| Vanadium | –0.05 | | | | [133] |
| Vancomycin | ≤5–10 (–12) ¹⁴² | 30 | | 4–11 ⁸³ | [28, 71, 119, 144, 296, 323, 330, 394, 551] |
| Vecuronium | appr. 0.2–0.37 (–0.5) | | | 1–1.5 | [133, 155, 340] |
| Venlafaxine | appr. 0.2–0.4 ¹⁸⁹ | 1–1.5 ²⁶⁶ | 6.6 ⁸ | 3–5 | [28, 270, 528] |
| Verapamil ⁹⁰ | (0.01–) 0.02–0.25 (–0.4) | 1 | 2.5; 3.9 ⁸ | 6–14 ⁴² | [114, 268, 292, 319, 471] |
| Vigabatrin | 2–9 (–15) ⁹⁴ | | | 5–8 | [28, 519] |
| Viloxazine | –6.0–8.0 (?) | | | 2–5 | [104, 155, 423] |
| Vincamine | <0.25 (?) | | | 1–2 (8–17) | |
| Vinylbital | 1–3 | 5 | 8 | 18–33 | |
| Viquidil | appr. 0.15–0.25 | | | 6–12 | |
| Vitamin A | see Retinol | | | | |
| Vitamin C | see Ascorbic acid | | | | |
| Vitamin D | >50 nmol/l ²⁶³ | | | appr. 30 ⁶ | [328] |
| Warfarin | 1–3 (–7) | 10–12 | 100 | 37–50 ⁹⁷ | [155, 426, 469, 555] |
| Wismut | see Bismut(h) | | | | |
| Xamoterol | appr. 0.02–0.04 (–0.1) | | | 7–8 | [133, 155] |
| Xipamide | –20 | | | 5–8 | [133, 155] |
| Xylene | | | 3–40 | | [528] |
| Yohimbine | appr. 0.05–0.3 | | | 1–3 | [133, 423] |
| Zafirlukast | 0.005–0.03 | | | 10 | [155, 423] |

Table (continued)

| Substance | Blood-plasma/serum concentration (µg/ml) | | | t _{1/2} (h) | Ref. |
|------------------------------|--|--------------|--------------------------------------|----------------------|--|
| | Therapeutic ('normal') | toxic (from) | comatose-fatal (from) | | |
| Zalcitabine | appr. 0.1 (0.5 µmol/l) | | | 1–3 ⁸³ | [66, 358] |
| Zanoterone | 0.1–0.5 | | | | [568] |
| Zidovudine ⁵¹ | 0.1–0.3 (–1) | 2–3 | | 1–1.5 | [66, 136, 137, 155, 212, 358] |
| Zinc | 0.6–1.3 | 2 | 42 ⁸ | | [429] |
| Zipeprol | 0.1–0.7 | | 5.8 ⁸ ; 10.6 ⁸ | ? | [133, 428] |
| Ziprasidone | 0.02–0.06 | | | 2–7 | [155, 423] |
| Zolmitriptan | appr. 0.007–0.01 | | | 2.5–3 | [423] |
| Zolpidem | 0.08–0.15 (–0.2) | 0.5 | 2–4 | 2–5 | [96, 114, 154, 155, 160, 282, 423, 528, 563] |
| Zonisamide | (15–) 20–30 (–40) | (30–) 40–70 | 100 ²⁰⁸ | 50–70 ²⁰⁹ | [276, 347, 399, 519] |
| Zopiclone | <0.1 | 0.15 | 0.6–1.8 | 3.5–8 | [114, 155, 423, 528] |
| Zotepine | 0.01–0.15 | 0.15–0.2 | | 14–16 | [155] |
| Zuclopenthixol ⁴⁸ | 0.005–0.1 | 0.15–0.3 | | appr. 20 | [423, 469] |

Clinical categories used for grouping analytical data:

Therapeutic: blood-plasma/serum concentrations (in general, trough at steady state) observed following therapeutically effective doses; no, or only minimal, side-effects (drugs); 'normal': concentrations associated with no, or only minimal, toxic effects (other xenobiotics).

Toxic: blood-plasma/serum concentrations which produce toxicity.

Comatose-fatal: blood-plasma/serum (comatose) concentrations and whole blood (fatal) concentrations reported to have caused coma and death, respectively.

t_{1/2}: in general, terminal elimination half-life.

Ref.: if not specifically referenced, data was taken from review articles [13, 28, 40, 41, 57, 63, 72, 99, 100, 104, 105, 109, 111, 112, 114, 133, 155, 165, 240, 272, 317, 340, 354, 376, 378, 393, 395, 423, 426–429, 441, 443, 466, 468, 469, 489, 491, 495, 510, 527, 528, 534] and/or supplemented with our clinical and forensic analytical results.

Annotations

- ¹ active metabolite of acebutolol
- ² as salicylic acid (for analgesic and antipyretic effect)
- ³ as digoxin
- ⁴ during mechanical ventilation
- ⁵ slow (poor) and rapid (extensive) acetylators (metabolizers)
- ⁶ days
- ⁷ active metabolites nortriptyline (see Table) and amitriptyline oxide (t_{1/2}: 1.5–3 h)
- ⁸ case report
- ⁹ in patients with impaired renal function in some cases up to 100 h
- ¹⁰ active metabolite 6-mercaptopurine (t_{1/2}: 1–1.5 h)
- ¹¹ appr. 0.2 h for azathioprine
- ¹² active metabolite carbamazepine-10,11-epoxide (t_{1/2}: 5–16 h; usual plasma concentration range 0.2–2 µg/ml) should be considered in case of intoxication
- ¹³ each sum carbomal(um) + carbamide (t_{1/2}: 12–15 days)
- ¹⁴ each as trichloroethanol
- ¹⁵ active metabolite desmethyldiazepam = nordazepam (see Table)
- ¹⁶ nephrotoxic
- ¹⁷ active metabolite desmethylclobazam
- ¹⁸ duration of pharmacological effects: 0.3–0.4 h; major metabolite: benzoylecgonine (t_{1/2}: 5–6 h)
- ¹⁹ active metabolites nordazepam and oxazepam (see Table)
- ²⁰ active metabolite nordothiepin (t_{1/2}: 20–60 h)
- ²¹ active metabolite desmethyldoxepin (nordoxepin, t_{1/2}: 33–80 h) should be considered in case of intoxication
- ²² benzodiazepine antagonist
- ²³ active metabolites
- ²⁴ active metabolite desalkylflurazepam (t_{1/2}: 74 ± 24 h)
- ²⁵ active metabolite nortilidine (t_{1/2}: 6 h), comatose-fatal plasma concentration: 4.4 µg/ml⁸
- ²⁶ in some cases up to 80 h
- ²⁷ active metabolite levomepromazine sulfoxide (t_{1/2}: 5–10 h)
- ²⁸ t_{1/2} for biological effects
- ²⁹ active metabolite desipramine (see Table)
- ³⁰ active metabolites diazepam, nordazepam plus oxazepam (see Table)
- ³¹ active metabolite of mesuximide
- ³² sum of active metabolites
- ³³ each as desacetylmepitranolol
- ³⁴ active metabolite 5-aminosalicylic acid (mesalazine, see Table); rapid/slow acetylators of the primary metabolite sulfapyridine
- ³⁵ in some cases longer
- ³⁶ active metabolite oxyphenbutazone (t_{1/2}: 27–64 h)
- ³⁷ dose dependent
- ³⁸ active metabolite of procainamide
- ³⁹ for the management of osteoporosis

- ⁴⁰ active metabolite nortetrazepam (t_{1/2}: 25–51 h)
- ⁴¹ smokers: 3–6 h
- ⁴² during steady state
- ⁴³ astemizole plus desmethyastemizole
- ⁴⁴ blood drug concentrations following therapeutically effective doses below detection limit
- ⁴⁵ as decanoate (t_{1/2}: 5–12 days)
- ⁴⁶ in intensive care patients in some cases 8–22 h
- ⁴⁷ physiologic
- ⁴⁸ rapid (extensive) and slow (poor) metabolizers (genetic polymorphism)
- ⁴⁹ 6 month-old-child, appr. 15 h after 100 mg rectally tramadol
- ⁵⁰ total labetalol: 0.7–5.0 µg/ml
- ⁵¹ C_{max} 0.038 ± 0.006 µg/ml after a single oral dose of 150 µg/kg in nine persons with onchocerciasis (t_{1/2}: 56 ± 7 h)
- ⁵² as enalaprilat
- ⁵³ duration of clinical effect: 3–5 h
- ⁵⁴ product after hydrolysis
- ⁵⁵ narcotic; analyzed during distribution phase
- ⁵⁶ for pneumocystis carinii pneumonia (PcP) treatment: sulfamethoxazole 100–200 µg/ml, trimethoprim 5–10 µg/ml
- ⁵⁷ metabolite: pentobarbital (see Table)
- ⁵⁸ "narcotic"
- ⁵⁹ higher with meningism (–25 µg/ml); decreased protein binding in neonates results in increased unbound drug
- ⁶⁰ each as 2-hydroxyflutamide (active and major metabolite)
- ⁶¹ active metabolite of allopurinol
- ⁶² active metabolite paracetamol (acetaminophen, see Table)
- ⁶³ active metabolite phenobarbital (see Table)
- ⁶⁴ as active carboxylic acid metabolite = fexofenadine (t_{1/2}: mean 15 h)
- ⁶⁵ 1 mg oral alprazolam/day equals appr. a plasma concentration of 10 ng alprazolam/ml during steady state. Usually higher doses/plasma concentrations are recommended for the treatment of phobias when compared to panic disorder/attacks
- ⁶⁶ highly inter- and intraindividual variable kinetics; for children (therapeutically): 0.04–0.1 µg/ml; active metabolite desmethylchlorpromazine
- ⁶⁷ ≥0.25 µmol/l desirable for echinococcosis
- ⁶⁸ mean: 27 h; for geriatric patients (>65 years) in some cases increased to more than 90 h
- ⁶⁹ active metabolite 2-hydroxydesipramine (t_{1/2}: mean 18 h; in patients with impaired renal function several fold increased)
- ⁷⁰ in patients with impaired renal function several fold increased
- ⁷¹ in colon tissue 0.8–1.8 h after 1 × 2 g i.v.: 94.0–7.4 µg/g
- ⁷² active metabolites 1-(5-hydroxyhexyl)-3,7-dimethylxanthine and 1-(3-carboxypropyl)-3,7-dimethylxanthine (t_{1/2}: 1–1.6 h), among others, with 5 and 8 times, respectively, higher plasma levels than pentoxifylline
- ⁷³ as canrenone (one of the active metabolites of spironolactone, t_{1/2}: 1.314 h)

- 74 appr. 8 h after ingestion of probably 210 mg haloperidol and 1400 mg
orphenadrine-HCl with life-threatening arrhythmias
- 75 data on effective plasma concentrations for Parkinson's disease not
available
- 76 peak: 20–30 µg/ml, trough: <7 µg/ml
- 77 for hypertension: 0.2–0.45 µg/ml; for angina/CHD, arrhythmias: 0.3–
0.8 µg/ml
- 78 therapeutic concentration of the unbound fraction: appr. 0.5–2 µg/ml
79 in mmol/l (mEq/l, mval/l): 0.4–1.2 (0.6–1.4), toxic from 1.5
- 80 terminal elimination $t_{1/2}$: 37 ± 6 h; increased in case of renal dysfunction
- 81 therapeutic concentration of the unbound fraction: 1–2.2 µg/ml
- 82 for (sleep) apnea: 5–10 µg/ml
- 83 increased in patients with impaired renal function
- 84 C_{max} 3–5 h after 4 mg oral loperamide hydrochloride: 1–3 ng/ml
- 85 active metabolite N-desmethylclomipramine ($t_{1/2}$: 21–65 h, mean: 40 h)
86 12–36 h
- 87 post-operative (on-demand; i.v.): 0.02–1–2 µg/ml (median: 0.29–
0.92 µg/ml) as minimal (analgesic) effective concentration; O-des-
88 methyltramadol: 0.03–0.04 µg/ml (median: 0.036 µg/ml)
- 89 10–36 h
- 90 11–26 h
- 91 stereoselective metabolism (therapeutic concentration after oral applica-
92 tion higher than after intravenous administration)
- 93 $t_{1/2}$ for β-phase: 0.5–1 h
- 94 as alendazole sulfoxide (active metabolite)
- 95 $t_{1/2}$ in slow (poor) metabolizers appr. 40 h
- 96 through plasma concentration at steady state during 2 g twice daily p.o.
97 appr. 9 µg/ml; C_{max} 0.8 h after 1 g orally: appr. 45 µg/ml
- 98 as active metabolite methimazole
- 99 mean 80 min
- 100 15–85 h
- 101 plasma concentrations does not correspond with pharmacological ef-
102 fects
- 103 plasma concentrations of the less potent major metabolite 6-β-naltrexol
104 ($t_{1/2}$: 11–13 h) are usually 1.5–10 times higher
- 105 appr. 25–30 h for the metabolites
- 106 sum rifampicin plus metabolites
- 107 sum sulindac plus metabolites (sulindac sulfide, $t_{1/2}$: 15–18 h; $t_{1/2}$ sul-
108 fone: 17–20 h)
- 109 abuse
- 110 sum carisoprodol plus meprobamate
- 111 12–15 days for the metabolites
- 112 $t_{1/2}$ for total platinum plasma concentrations: 20–40 h (up to 6–7 days)
113 2–20 µmol/l
- 114 carboxylic acid metabolite ($t_{1/2}$: appr. 20 days): 1.5–5.5 µg/ml
- 115 during concomitant therapy with carbamazepine or phenytoin 8–33 h
116 (mean: 15 h), during concomitant therapy with valproic acid 31–89 h
117 (mean: 60 h)
- 118 in infants and after intoxications in some cases dramatically increased
- 119 during steady state 3–4 h after oral doses of 100–400 mg; prophylaxis
120 of candidiasis: >0.2 µg/ml and of aspergillosis: >1.0 µg/ml in patients
121 with acute myeloid leukemia (AML)
- 122 plasma concentrations of the major metabolite 13-cis-acitretin are
123 usually higher
- 124 higher and increased, respectively, in patients with impaired hepatic
125 function; for tinnitus aurium: therapeutic plasma concentration appr.
126 1–2 µg/ml
- 127 biologically active/major metabolite cycloguanil ($t_{1/2}$: 8–17 h): plasma
128 concentration level after daily oral doses of 100–200 mg proguanil
129 appr. 0.02–0.06 µg/ml
- 130 active metabolite norethidine ($t_{1/2}$: 14–24 (–48) h): toxic from appr.
131 0.5 µg/ml
- 132 tremor, hypokalemia
- 133 as cytostatic drug: >200 µg/ml
- 134 neurotoxic
- 135 in terminal renal insufficiency appr. 0.5–2 µg/ml, cumulation of the
136 inactive metabolite N-acetyl-5-aminosalicylic acid (Ac-5-ASA) up to
137 20 µg/ml without adverse effects
- 138 $t_{1/2}$ of the inactive major metabolite N-acetyl-5-aminosalicylic acid
139 (Ac-5-ASA) appr. 6–9 h
- 140 tocolytic (4.5–6.25 mval(mEq)/l, 2.25–3.125 mmol/l). Approximate
141 normal range: 18–25 µg Mg²⁺/ml (0.74–1.03 mmol/l); conversion fac-
142 tor: mg/dl × 0.4113 = mmol/l
- 143 C_{max} appr. 2–8 µmol/l (i.e. 1.7–6.8 µg/ml, after 170–275 mg/m² intra-
144 venously for 6 h); much lower after intraperitoneal injection
- 145 as transdermal system (patch); plasma concentrations of the major me-
146 tabolite cotinine ($t_{1/2}$: mean 16–20 h) appr. 10 times higher
- 147 mean 2 h; after application of the transdermal system possibly longer
- 148 active metabolites desipramine (see Table), 2-hydroxyimipramine
149 ($t_{1/2}$: 6–18 h), and 2-hydroxydesipramine⁶⁹
- 150 3–7 min after retrobulbar blockade: 0.5–1.1 µg/ml
- 151 for myasthenia gravis
- 152 EC₅₀ analgesia; EC₅₀ respiratory depression: 0.035 ± 0.022 µg/ml
- 153 appr. 14 h after oral ingestion of 1.5 g
- 154 $t_{1/2}$ of the active metabolite norfluoxetine: 7–9 days (mean)
- 155 active metabolites 2-oxoquazepam ($t_{1/2}$: 39 (28–43) h) and N-desalkyl-
156 2-oxoquazepam (N-desalkylflurazepam, $t_{1/2}$: 74 ± 24 h)
- 157 peak plasma concentration during steady state (C_{max}^{ss})
- 158 range of plasma concentrations after therapeutically effective doses of
159 thioridazine for the active metabolites mesoridazine (thioridazine-2-
160 sulfoxide): 0.2–1.6 µg/ml ($t_{1/2}$: 10–14 h) and sulforidazine (thiorid-
161 azine-2-sulfone): up to 0.6 µg/ml ($t_{1/2}$: 10–16 h) and for the inactive
162 metabolite thioridazine-5(ring)-sulfoxide: 0.06–4 µg/ml; probably, the
163 best correlation exists between the plasma concentration of mesorida-
164 zine and the clinical response
- 165 usually sleep occurred with ≥0.1 µg/ml; in infants and children (<13
166 years): in some cases during mechanical ventilation up to 3 µg/ml;
167 α-hydroxymidazolam-glucuronide likely contributes in case of impaired
168 renal function to prolonged sedation
- 169 plasma concentration range of the primary metabolite 1,5-dimethyl-3,3-
170 diphenyl-2-ethylidene-pyrrolidine during steady state: 0.005–0.055 µg/
171 ml (daily oral methadone dose: 10–225 mg, mean 60 mg)
- 172 ratio clozapine/active metabolite N-desmethylclozapine (norclozapine,
173 $t_{1/2}$: 19.2 ± 10.2 h) usually 1.0 to 2.5
- 174 maximum antiemetic effect at >0.01 µg/ml
- 175 active metabolite descarboethoxyloratadine ($t_{1/2}$: 17–24 h): appr.
176 0.005–0.02 µg/ml
- 177 0.15 ± 0.05% per h
- 178 during chronic administration appr. 10–20 h (induction of own metabo-
179 lism)
- 180 caution is warranted in case of concomitant use or intoxication with
181 serotonin reuptake inhibitors (SSRI) as citalopram, clomipramine
182 (fluoxetine, paroxetine): possible serotonin syndrome
- 183 trough concentration; peak concentration: <40 µg/ml
- 184 distribution half-life: 0.3–0.5 (–1) h
- 185 non-smoker: 1–4 µg/ml (17–69 µmol/l);
- 186 smoker: 3–12 µg/ml (52–206 µmol/l)
- 187 major active metabolite 1-m-chlorophenylpiperazine; plasma concentra-
188 tion appr. 1/10 compared to trazodone
- 189 plasma concentration for maximal cellular accumulation of the active
190 form gemcitabine-5'-triphosphate
- 191 after topical nasal or ocular administration
- 192 Torsade de pointes, usually due to cytochrome P450 3A4 inhibition
193 (e.g., ketoconazole, erythromycin) and/or impaired hepatic function
194 after oral administration; after topical application: plasma concentration
195 < 0.03 µg/ml and $t_{1/2}$ appr. 22 h
- 196 for each added 1 mg/day dose of clonazepam, there is appr. an increase
197 of 12 ng/ml in the plasma (patients with panic disorder)
- 198 sum amoxapine and major metabolite 8-hydroxyamoxapine
199 ($t_{1/2}$: appr. 30 h; $t_{1/2}$ 7-hydroxyamoxapine: 4–6.5 h)
- 200 sum bupropion (amfebutamone) and morpholinole metabolite
201 ($t_{1/2}$: 19–22 h)
- 202 after i.m.-application as decanoate appr. 3 weeks
- 203 C_{min} <1–2 µg/ml at best (especially in patients with renal dysfunction)
- 204 appr. 0.02 µg/ml in organophosphorous ester poisoning depending on
205 the clinical symptoms
- 206 in case of organophosphorous ester (e.g. parathion) intoxication;
207 250 mg intravenously as bolus followed by an infusion of 750 mg/24 h
208 if used as an antiarrhythmic appr. 0.1–0.4 µg/ml
- 209 using daily oral doses of ≤25 mg 0.00046 µg risperidone/ml per mg
210 dose and 0.0064 µg/ml per mg dose for risperidone plus 9-hydroxyris-
211 peridone (the clinical effects likely results from the combined concen-
212 trations)
- 213 extensive metabolizers; $t_{1/2}$ for risperidone plus 9-hydroxyrisperidone:
214 22–24 h
- 215 6 case reports: post-mortem 5.2–49 µg citalopram/g blood and 0.3–
216 1.4 µg desmethylcitalopram/g blood
- 217 concentration/dose-values for extensive metabolizers: 0.025–0.55
218 (median 0.098) nmol/l per mg oral perphenazine, and 0.096–0.75
219 (median 0.195) nmol/l per mg oral perphenazine (mol wt 506.07) for
220 poor metabolizers, respectively
- 221 two cases after ingestion of appr. 4 g moclobemide in combination
222 with clomipramine (plasma concentration: 0.3–0.5 µg/ml, i.e. toxic)
- 223 as R-enantiomer, mean: 9 µg/ml
- 224 dosage: 50–55 mg/kg per day
- 225 appr. 2.5 h after ingestion of 50–100 mg amlodipine besylate with al-
226 cohol (263 mmol ethanol/l)
- 227 101 ng/ml 4 h after ingestion of 70 mg and 185 ng/ml at 10.5 h, com-
228 plicated by oxazepam ingestion
- 229 data for d,l-sotalol
- 230 after i.v.-application; $t_{1/2}$: 4–7 h following epidural administration
231 (appr. 4–5 h following intercostal block and appr. 8 h following bra-
232 chial plexus blockade, respectively)
- 233 mean 19 h; $t_{1/2}$ of oral cyclosporine microemulsion is appr. 8 h
- 234 a longer $t_{1/2}$ has been reported in elderly patients, up to 3.8 days
- 235 target range of activated partial thromboplastin time (aPTT) is prolon-
236 gation of 50–70 sec, aPTT prolongation of more than 100 sec has
237 been associated with an increased risk of hemorrhagic events

- as 10-hydroxycarbazepine for seizures; in patients with trigeminal neuralgia, therapeutic serum concentrations of the active metabolite 10-hydroxycarbazepine ($t_{1/2}$: 8–11 h): 50–110 $\mu\text{mol/l}$
- mild CNS symptoms (limited data)
- pharmacologically inactive metabolites 5' and 6'-hydroxytenoxicam
- effective plasma concentrations for the 2 active metabolites: O-desmethylencaimide (0.05–0.3; toxic from 0.3 $\mu\text{g/ml}$, $t_{1/2}$: 11 h) and 3-methoxy-o-desmethylencaimide (0.06–0.28 $\mu\text{g/ml}$; $t_{1/2}$: >24 h) during long-term therapy
- in poor metabolizers 9–11 h
- "normal": 0.001–0.006; smoker: 0.005–0.012 (–0.15) $\mu\text{g/ml}$; $\mu\text{mol/l}$ \times 0.026 = $\mu\text{g/ml}$
- reference value; 0.001 $\mu\text{g/g}$ creatinine or 0.0014 $\mu\text{g/ml}$ urine; <30 $\mu\text{g/24 h}$ urine ("normal"); "toxic" from appr. 0.05–0.3 $\mu\text{g/ml}$ urine
- >0.04 $\mu\text{g/ml}$ urine
- up to years in chronically exposed workers
- combination with 2,4-D and chlorpyrifos
- in case of intoxication/overdose: 70–90 h
- overdose
- one case of toxicokinetic estimation in acute KCN poisoning
- tentative target range; $C_{\text{max}}^{\text{ss}}$ appr. 4.6 $\mu\text{g/ml}$ (300 mg tid) and appr. 8.4 $\mu\text{g/ml}$ (600 mg tid)
- prolonged in case of impaired renal function to 16–43 h; >100 h in dialysis dependent patients
- dependent of urine pH, if alkaline appr. 8–10 h
- females showed significantly longer elimination half-lives (35.4 ± 13.7 h) than males (mean 21–26 h); the $t_{1/2}$ of the R(–)-enantiomer is twice that of the S(+)-enantiomer
- after doses of 25, 75, and 150 mg every 8 h for 3 days, mean peak serum levels were 0.053, 0.167, and 0.393 $\mu\text{g/ml}$; corresponding levels of the major active metabolite O-desmethylenlafaxine ($t_{1/2}$: 10–11 h) were 0.148, 0.397, and 0.686 $\mu\text{g/ml}$
- at least 10 nmol of the lactone (mol wt 421.46)/l (?); decreases in absolute neutrophil counts of 50–90% were observed with steady state plasma concentrations of total topotecan (lactone + hydroxy acid) of 20–60 nmol/l, respectively
- a mean steady state peak plasma concentration of 0.286 $\mu\text{g/ml}$ was observed in healthy volunteers after 60 mg (oral solution) every 12 hours for 10 doses
- the metabolite 2',2'-difluoro-deoxyuridine (dFdU) has minimal antitumor activity but may contribute to the toxicity of gemcitabine
- C_{max} after 200 mg tid
- serum concentration of benzoic acid following high dose diazepam i.v.-infusion and severe metabolic acidosis (5-year-old girl; urine concentration: 1200 $\mu\text{g/ml}$)
- 1.5 h in dogs after i.v.-administration
- for erythropoietic protoporphyria (EPP)
- trough; peak: 0.1–0.5 $\mu\text{g/ml}$
- +0.4 μg of its metabolite 3-deacetylpancuronium/ml
- "normal": ≤ 2 –3% of total Hb; from 15–20%: cyanosis, headache, dizziness
- "normal": $\leq 5\%$ (elderly: –15%); smoker: 8–10%
- 2 h after ingestion
- 3 h after ingestion of 400 mg with no severe symptoms
- mean steady state trough concentration; peak: 5–15 $\mu\text{g/ml}$
- for Parkinson's disease (appr. 15–50 pmol/ml)
- peak: 0.5–3 $\mu\text{g/ml}$
- plasma concentrations below detection limit; plasma concentrations of the active metabolite 6-methoxy-2-naphthylacetic acid ($t_{1/2}$: appr. 24 h), which appears to be responsible for the effects, were 10–37 $\mu\text{g/ml}$ 3–6 h after single oral doses of 250, 500, and 1000 mg
- active metabolite 6-O-desmethyldonepezil
- coma in a patient overdosing zonisamide, carbamazepine, and clonazepam
- 25–30 h in patients co-medicated with enzyme-inducing anticonvulsants
- 2–4 h in patients co-medicated with enzyme-inducing anticonvulsants
- long-term (2–3 years) treated renal-transplant patients had significantly lower trough plasma concentrations of mycophenolic acid (1.94 ± 0.24 $\mu\text{g/ml}$), the active metabolite, compared with patients taking mycophenolate mofetil (1 g twice daily) short-term (2–10 months; 3.53 ± 0.45 $\mu\text{g/ml}$). Proposed mycophenolic acid pre-dose target concentration: 1–3.5 $\mu\text{g/ml}$
- as mycophenolic acid
- ten men with multiple sclerosis, 10–20 mg p.o. every 6 h 30 min before the next dose; peak levels <0.1 $\mu\text{g/ml}$ 30 min after a dose
- nine patients, maximum tolerated oral dose 50–100 mg
- $t_{1/2}$ metabolite 3-O-methyldopa: 15 h
- appr. 2.5 $\mu\text{mol/l}$ (1 $\mu\text{g/ml}$) 24 h after single doses of 100–800 mg and during daily treatment with 200 mg
- active metabolite 14-hydroxycyclitromycin ($t_{1/2}$: 5–7 h)
- C_{max} following oral administration of 200, 400, 800, and 1200 mg, respectively: 3.7, 8, 18, and 29 $\mu\text{g/ml}$
- at a daily dosage of 60, 120, and 240 mg the mean \pm SD concentration in patients with symptomatic ventricular tachyarrhythmias ($n = 9$ –18) was 75 ± 46 , 144 ± 105 , and 324 ± 180 nmol/l, respectively
- nonlinear kinetics
- appr. 5 h after ingestion of 3 g, not associated with severe toxicity to a 27-year-old woman
- slightly increased (8–12 h) in patients with impaired hepatic function; active metabolites hydroxynefazodone ($t_{1/2}$: 2–5 h), m-chlorophenyl-piperazine ($t_{1/2}$: 4–10 h), and triazolidione ($t_{1/2}$: 10–12 h)
- each as N-desmethyloximide; appr. methsuximide ($t_{1/2}$: 1–2 h) steady state concentration: 0.04–0.08 $\mu\text{g/ml}$
- mean steady state trough concentration in 15 young adults receiving a daily dose of 0.47–1.71 mg isotretinoin/kg: 0.05–0.34 $\mu\text{g/ml}$ ($t_{1/2}$: 29 ± 40 h), and for the 4-oxo metabolite ($t_{1/2}$: 22 ± 10 h): 0.16–0.68 $\mu\text{g/ml}$
- for depression; higher in case of schizophrenia (2–3 $\mu\text{g/ml}$?)
- suggested threshold for the sum of clomipramine (0.05–0.06 $\mu\text{g/ml}$) and N-desmethylclomipramine (0.16–0.18 $\mu\text{g/ml}$): 0.2–0.24 $\mu\text{g/ml}$
- for the active metabolite E-3174 ($t_{1/2}$: 4–9 h); plasma concentration of losartan producing 50% of maximal blood pressure response to exogenous angiotensin-II: 0.032 $\mu\text{g/ml}$
- as ramiprilat ($t_{1/2}$: 13–17 (50–110) h)
- IC_{50} level for analgesic effect after oral surgery
- the inhibitory concentration to reduce the level of extracellular hepatitis B DNA by 50% varied from 2.3 ng/ml to 1.3 $\mu\text{g/ml}$
- C_{max} at steady state (666 mg tid p.o.)
- after oral administration of the enteric-coated tablet
- trough <2 plus peak 6–10 (5–12) $\mu\text{g/ml}$
- reference value; <0.015 $\mu\text{g/ml}$ urine
- active metabolite 4'-hydroxynimesulide ($t_{1/2}$: 3–9 h)
- C_{max} 126.5 and 226.3 ng/ml (at 2 h) after 75 and 125 mg p.o.
- in patients >60 years prolonged up to 10 h
- adjuvant in methadone maintenance therapy
- means of the 'average' steady state plasma concentration for the relatively high dose of 250 mg q8 h appr. 0.4–0.6 $\mu\text{g/ml}$
- combination of distribution and elimination processes
- as active metabolite fenofibric acid
- appr. 37.5 mmol/l (mval/l, mEq/l)
- steady state concentration 21.6 ± 14.2 $\mu\text{g/ml}$ (mean \pm SD) during continuous infusion of 3 g (1.1–2.2 mg/kg h) every 24 hours in 44 patients undergoing coronary artery bypass graft surgery
- target trough concentration if cyclosporine (CsA) is being used at trough concentrations of 0.075–0.15 $\mu\text{g/ml}$; without CsA: appr. 0.03 $\mu\text{g/ml}$ (LC/UV assay)
- 4 hours after ingestion of 30–40 tiagabine HCl 8 mg tablets (coma)
- bupropion plus 10-hydroxybupropion
- calculated steady state concentration in children (4 months to 16 years) receiving 0.3 mg/kg b.w. i.v.
- femoral blood concentration of the metabolite desmethylalimemazine after fatal intoxication: 0.2–1.3 $\mu\text{g/g}$
- 40–50 min after 0.15 mg/kg i.v.
- femoral blood concentration of the metabolite desmethylpromethazine after fatal intoxication ($n = 3$): 0.3–1.8 $\mu\text{g/g}$
- femoral blood concentration of the metabolite desmethyltrimipramine after fatal intoxication ($n = 10$): 0.3–2.5 $\mu\text{g/g}$
- fatal overdose with tramadol, alprazolam (0.21 $\mu\text{g/ml}$), and alcohol (1.29 g/kg) in a 30-year-old woman
- enterohepatic circulation; prolonged in elderly subjects to 33.4 hours (range: 20.0–53.4 h)
- C_{min}/D [(ng/ml)/mg], i.e. dose-normalised trough plasma drug concentration, dosage interval 8 h
- all data refer to the active metabolite A771726
- steady state concentrations at 5, 10, and 25 mg/d, respectively
- steady state trough concentrations after 400 mg/d orally; two major metabolites modafinil acid (appr. 0.5–0.8 $\mu\text{g/ml}$, $t_{1/2}$: 7.3 ± 1.1 h) and modafinil sulfone (appr. 4.5–5.3 $\mu\text{g/ml}$), but neither appears to contribute to the wake-promoting properties of modafinil
- mean plasma trough concentration at steady state obtained from 400 mg imatinib/day in 83 adult patients with chronic phase CML; peak: 2.3 $\mu\text{g/ml}$
- in a 5-year-old girl
- at this time (March 2003), there is insufficient evidence to recommend a general therapeutic range
- active metabolite N-desethylamiodarone ($t_{1/2}$: 57–64 days), which achieves plasma concentrations similar to the parent compound
- inactive metabolites deshydroxyethyl opipramol ($t_{1/2}$: 97 ± 24 h) and opipramol N-oxide ($t_{1/2}$: 10.7 ± 3.2 h)
- as 25-hydroxyvitamin D for adults >49 years
- 6 h after reportedly ingestion of 30 g in a 38-year-old woman
- metabolite perindoprilat, 3 to 10 hours, with a prolonged terminal half-life between 25 to 120 h
- sum venlafaxine and O-desmethylenlafaxine
- for glaucoma 4–5 $\mu\text{g/ml}$
- doxapram + keto-doxapram
- 24 h after ingestion of appr. 20 ml
- active metabolite desethylamodiaquine ($t_{1/2}$: 1–10 days)
- smokers: –0.0006 $\mu\text{g/ml}$

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