REVIEW

Center for Drug Information and Pharmacy Practice[1], ABDA – Federal Union of German Associations of Pharmacists, Berlin, and Institute of Legal Medicine[2], University of Hamburg, Germany

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

M. Schulz[1], A. Schmoldt[2]

Received April 22, 2003, accepted May 5, 2003

Dr. Martin Schulz, Zentrum für Arzneimittelinformation und Pharmazeutische Praxis (ZAPP), ABDA, Jaegerstrasse 49/50, 10117 Berlin, Germany
M.Schulz@abda.aponet.de

Pharmazie 58, 447–474 (2003)

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 – presumingly – 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)			$t_{½}$ (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-Acetylacebutolol[1]	1–2.5		90–150	9–14	[466]
Acecainide	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]
Allobarbital	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)			$t_{½}$ (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]
Bepridil	0.6–2.5			33–42	[178]
Beryllium	–0.0003				[133]

Table (continued)

Substance	Blood-plasma/serum concentration (μg/ml)			$t_{½}$ (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]
Brallobarbital (Brallobarbitone)	4–8	8–10	15	20–40	
Bretylium	0.8–2.4			6–11	[155]
Brodifacoum		0.02	0.03–0.17; acute: 3.9[8]	20–60[6]	[391a, 528]
Bromadiolon		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)			$t_{½}$ (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-Carotine	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)			$t_{½}$ (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]
Clopenthixol	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)			$t_{½}$ (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]
Dipyrone	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)			$t_{½}$ (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)			$t_{½}$ (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-hydroxybutyricacid (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)			$t_{½}$ (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)			$t_{½}$ (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]
Lofepramine	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-phenoxyacetic acid				
MCPP	see 2-Methyl–4-chloro-phenoxypropionic 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)			$t_{½}$ (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 (MCPP)	–	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)			$t_{½}$ (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]
Oxatomide	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 Pentoxyfylline				
Oxprenolol	0.05–0.3 (–1.0)	2–3	10	1–4	[466]

Table (continued)

Substance	Blood-plasma/serum concentration (µg/ml)			$t_{½}$ (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]
Phenytoin	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)			$t_{½}$ (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	
Prajmalium[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]
Procainamide[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)			$t_{½}$ (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)			$t_{½}$ (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]; 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 from Nitroprusside	1–12[144] 5–30	35–50 50–100	200	3–4[6]	[3, 155, 446, 528]
Thiopental[57]	1–5		10–15[58]	3–8	
Thioproperazine	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]
Tiapride	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)			$t_{½}$ (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	
Tranylcypromine	–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)			$t_{½}$ (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.
$t_{½}$: 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 ($t_{½}$: 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 carbromal(um) + carbromide ($t_{1/2}$: 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] benzodiazepineantagonist
[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/ml[8]
[26] in some cases up to 80 h
[27] active metabolite levomepromazine sulfoxide ($t_{½}$: 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 desacetylmetipranolol
[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 ($t_{½}$: 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 desmethylastemizole
[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, $t_{1/2}$: 1.31.4 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-desmethyltramadol: 0.03–0.04 μg/ml (median: 0.036 μg/ml)
[88] 10–36 h
[89] 11–26 h
[90] stereoselective metabolism (therapeutic concentration after oral application higher than after intravenous administration)
[91] $t_{1/2}$ for ß-phase: 0.5–1 h
[92] as albendazole sulfoxide (active metabolite)
[93] $t_{½}$ in slow (poor) metabolizers appr. 40 h
[94] through plasma concentration at steady state during 2 g twice daily p.o. appr. 9 μg/ml; C_{max} 0.8 h after 1 g orally: appr. 45 μg/ml
[95] as active metabolite methimazole
[96] mean 80 min
[97] 15–85 h
[98] plasma concentrations does not correspond with pharmacological effects
[99] plasma concentrations of the less potent major metabolite 6-β-naltrexol ($t_{1/2}$: 11–13 h) are usually 1.5–10 times higher
[100] appr. 25–30 h for the metabolites
[101] sum rifampicin plus metabolites
[102] sum sulindac plus metabolites (sulindac sulfide, $t_{1/2}$: 15–18 h; $t_{1/2}$ sulfone: 17–20 h)
[103] abuse
[104] sum carisoprodol plus meprobamate
[105] 12–15 days for the metabolites
[106] $t_{1/2}$ for total platinum plasma concentrations: 20–40 h (up to 6–7 days)
[107] 2–20 μmol/l
[108] carboxylic acid metabolite ($t_{1/2}$: appr. 20 days): 1.5–5.5 μg/ml
[109] during concomitant therapy with carbamazepine or phenytoin 8–33 h (mean: 15 h), during concomitant therapy with valproic acid 31–89 h (mean: 60 h)
[110] in infants and after intoxications in some cases dramatically increased
[111] during steady state 3–4 h after oral doses of 100–400 mg; prophylaxis of candidiasis: >0.2 μg/ml and of aspergillosis: >1.0 μg/ml in patients with acute myeloid leukemia (AML)
[112] plasma concentrations of the major metabolite 13-cis-acitretin are usually higher
[113] higher and increased, respectively, in patients with impaired hepatic function; for tinnitus aurium: therapeutic plasma concentration appr. 1–2 μg/ml
[114] biologically active/major metabolite cycloguanil ($t_{1/2}$: 8–17 h): plasma concentration level after daily oral doses of 100–200 mg proguanil appr. 0.02–0.06 μg/ml
[115] active metabolite norpethidine ($t_{1/2}$: 14–24 (–48) h): toxic from appr. 0.5 μg/ml
[116] tremor, hypokalemia
[117] as cytostatic drug: >200 μg/ml
[118] neurotoxic
[119] in terminal renal insufficiency appr. 0.5–2 μg/ml, cumulation of the inactive metabolite N-acetyl-5-aminosalicylic acid (Ac-5-ASA) up to 20 μg/ml without adverse effects
[120] $t_{1/2}$ of the inactive major metabolite N-acetyl-5-aminosalicylic acid (Ac-5-ASA) appr. 6–9 h
[121] tocolytic (4.5–6.25 mval(mEq)/l, 2.25–3.125 mmol/l). Approximate normal range: 18–25 μg Mg^{2+}/ml (0.74–1.03 mmol/l); conversion factor: mg/dl × 0.4113 = mmol/l
[122] C_{max} appr. 2–8 μmol/l (i.e. 1.7–6.8 μg/ml, after 170–275 mg/m^2 intravenously for 6 h); much lower after intraperitoneal injection
[123] as transdermal system (patch); plasma concentrations of the major metabolite cotinine ($t_{1/2}$: mean 16–20 h) appr. 10 times higher
[124] mean 2 h; after application of the transdermal system possibly longer
[125] active metabolites desipramine (see Table), 2-hydroxyimipramine ($t_{1/2}$: 6–18 h), and 2-hydroxydesipramine[69]
[126] 3–7 min after retrobulbar blockade: 0.5–1.1 μg/ml
[127] for myasthenia gravis
[128] EC_{50} analgesia; EC_{50} respiratory depression: 0.035 ± 0.022 μg/ml
[129] appr. 14 h after oral ingestion of 1.5 g
[130] $t_{1/2}$ of the active metabolite norfluoxetine: 7–9 days (mean)
[131] active metabolites 2-oxoquazepam ($t_{1/2}$: 39 (28–43) h) and N-desalkyl-2-oxoquazepam (N-desalkylflurazepam, $t_{1/2}$: 74 ± 24 h)
[132] peak plasma concentration during steady state (C^{ss}_{max})
[133] range of plasma concentrations after therapeutically effective doses of thioridazine for the active metabolites mesoridazine (thioridazine-2-sulfoxide): 0.2–1.6 μg/ml ($t_{1/2}$: 10–14 h) and sulforidazine (thioridazine-2-sulfone): up to 0.6 μg/ml ($t_{1/2}$: 10–16 h) and for the inactive metabolite thioridazine-5(ring)-sulfoxide: 0.06–4 μg/ml; probably, the best correlation exists between the plasma concentration of mesoridazine and the clinical response
[134] usually sleep occurred with ≥0.1 μg/ml; in infants and children (<13 years): in some cases during mechanical ventilation up to 3 μg/ml; α-hydroxymidazolam-glucuronide likely contributes in case of impaired renal function to prolonged sedation
[135] plasma concentration range of the primary metabolite 1,5-dimethyl-3,3-diphenyl-2-ethylidene-pyrrolidine during steady state: 0.005–0.055 μg/ml (daily oral methadone dose: 10–225 mg, mean 60 mg)
[136] ratio clozapine/active metabolite N-desmethylclozapine (norclozapine, $t_{1/2}$: 19.2 ± 10.2 h) usually 1.0 to 2.5
[137] maximum antiemetic effect at >0.01 μg/ml
[138] active metabolite descarboethoxyloratadine ($t_{1/2}$: 17–24 h): appr. 0.005–0.02 μg/ml
[139] 0.15 ± 0.05‰ per h
[140] during chronic administration appr. 10–20 h (induction of own metabolism)
[141] caution is warranted in case of concomitant use or intoxication with serotonin reuptake inhibitors (SSRI) as citalopram, clomipramine (fluoxetine, paroxetine): possible serotonin syndrome
[142] trough concentration; peak concentration: <40 μg/ml
[143] distribution half-life: 0.3–0.5 (–1) h
[144] non-smoker: 1–4 μg/ml (17–69 μmol/l);
smoker: 3–12 μg/ml (52–206 μmol/l)
[145] major active metabolite 1-m-chlorophenylpiperazine; plasma concentration appr. 1/10 compared to trazodone
[146] plasma concentration for maximal cellular accumulation of the active form gemcitabine-5′-triphosphate
[147] after topical nasal or ocular administration
[148] Torsade de pointes, usually due to cytochrome P450 3A4 inhibition (e.g., ketoconazole, erythromycin) and/or impaired hepatic function
[149] after oral administration; after topical application: plasma concentration < 0.03 μg/ml and $t_{1/2}$ appr. 22 h
[150] for each added 1 mg/day dose of clonazepam, there is appr. an increase of 12 ng/ml in the plasma (patients with panic disorder)
[151] sum amoxapine and major metabolite 8-hydroxyamoxapine ($t_{1/2}$: appr. 30 h; $t_{1/2}$ 7-hydroxyamoxapine: 4–6.5 h)
[152] sum bupropion (amfebutamone) and morpholinole metabolite ($t_{1/2}$: 19–22 h)
[153] after i.m.-application as decanoate appr. 3 weeks
[154] C_{min} <1–2 μg/ml at best (especially in patients with renal dysfunction)
[155] appr. 0.02 μg/ml in organophosphorous ester poisoning depending on the clinical symptoms
[156] in case of organophosphorous ester (e.g. parathione) intoxication; 250 mg intravenously as bolus followed by an infusion of 750 mg/24 h
[157] if used as an antiarrhythmic appr. 0.1–0.4 μg/ml
[158] using daily oral doses of ≤25 mg 0.00046 μg risperidone/ml per mg dose and 0.0064 μg/ml per mg dose for risperidone plus 9-hydroxyrisperidone (the clinical effects likely results from the combined concentrations)
[159] extensive metabolizers; $t_{½}$ for risperidone plus 9-hydroxyrisperidone: 22–24 h
[160] 6 case reports: post-mortem 5.2–49 μg citalopram/g blood and 0.3–1.4 μg desmethylcitalopram/g blood
[161] concentration/dose-values for extensive metabolizers: 0.025–0.55 (median 0.098) nmol/l per mg oral perphenazine, and 0.096–0.75 (median 0.195) nmol/l per mg oral perphenazine (mol wt 506.07) for poor metabolizers, respectively
[162] two cases after ingestion of appr. 4 g moclobemide in combination with clomipramine (plasma concentration: 0.3–0.5 μg/ml, i.e. toxic)
[163] as R-enantiomer, mean: 9 μg/ml
[164] dosage: 50–55 mg/kg per day
[165] appr. 2.5 h after ingestion of 50–100 mg amlodipine besylate with alcohol (263 mmol ethanol/l)
[166] 101 ng/ml 4 h after ingestion of 70 mg and 185 ng/ml at 10.5 h, complicated by oxazepam ingestion
[167] data for d,l-sotalol
[168] after i.v.-application; $t_{1/2}$: 4–7 h following epidural administration (appr. 4–5 h following intercostal block and appr. 8 h following brachial plexus blockade, respectively)
[169] mean 19 h; $t_{1/2}$ of oral cyclosporine microemulsion is appr. 8 h
[170] a longer $t_{1/2}$ has been reported in elderly patients, up to 3.8 days
[171] target range of activated partial thromboplastin time (aPTT) is prolongation of 50–70 sec, aPTT prolongation of more than 100 sec has been associated with an increased risk of hemorrhagic events

[172] 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 μmol/l
[173] mild CNS symptoms (limited data)
[174] pharmacologically inactive metabolites 5′ and 6′-hydroxytenoxicam
[175] effective plasma concentrations for the 2 active metabolites: O-desmethylencainide (0.05–0.3; toxic from 0.3 μg/ml, $t_{1/2}$: 11 h) and 3-methoxy-o-desmethylencainide (0.06–0.28 μg/ml; $t_{1/2}$: >24 h) during long-term therapy
[176] in poor metabolizers 9–11 h
[177] "normal": 0.001–0.006; smoker: 0.005–0.012 (−0.15) μg/ml; μmol/l × 0.026 = μg/ml
[178] reference value; 0.001 μg/g creatinine or 0.0014 μg/ml urine; <30 μg/24 h urine ("normal"); "toxic" from appr. 0.05–0.3 μg/ml urine
[179] >0.04 μg/ml urine
[180] up to years in chronically exposed workers
[181] combination with 2,4-D and chlorpyrifos
[182] in case of intoxication/overdose: 70–90 h
[183] overdose
[184] one case of toxicokinetic estimation in acute KCN poisoning
[185] tentative target range; C^{ss}_{max} appr. 4.6 μg/ml (300 mg tid) and appr. 8.4 μg/ml (600 mg tid)
[186] prolonged in case of impaired renal function to 16–43 h; >100 h in dialysis dependent patients
[187] dependent of urine pH, if alkaline appr. 8–10 h
[188] 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
[189] 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 μg/ml; corresponding levels of the major active metabolite O-desmethylvenlafaxine ($t_{1/2}$: 10–11 h) were 0.148, 0.397, and 0.686 μg/ml
[190] 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
[191] a mean steady state peak plasma concentration of 0.286 μg/ml was observed in healthy volunteers after 60 mg (oral solution) every 12 hours for 10 doses
[192] the metabolite 2′,2′-difluorodeoxyuridine (dFdU) has minimal antitumor activity but may contribute to the toxicity of gemcitabine
[193] C_{max} after 200 mg tid
[194] serum concentration of benzoic acid following high dose diazepam i.v.-infusion and severe metabolic acidosis (5-year-old girl; urine concentration: 1200 μg/ml)
[195] 1.5 h in dogs after i.v.-administration
[196] for erythropoietic protoporphyria (EPP)
[197] trough; peak: 0.1–0.5 μg/ml
[198] +0.4 μg of its metabolite 3-deacetylpancuronium/ml
[199] "normal": ≤2–3% of total Hb; from 15–20%: cyanosis, headache, dizziness
[200] "normal": ≤5% (elderly: −15%); smoker: 8–10%
[201] 2 h after ingestion
[202] 3 h after ingestion of 400 mg with no severe symptoms
[203] mean steady state trough concentration; peak: 5–15 μg/ml
[204] for Parkinson's disease (appr. 15–50 pmol/ml)
[205] peak: 0.5–3 μg/ml
[206] 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 μg/ml 3–6 h after single oral doses of 250, 500, and 1000 mg
[207] active metabolite 6-O-desmethyldonepezil
[208] coma in a patient overdosing zonisamide, carbamazepine, and clonazepam
[209] 25–30 h in patients co-medicated with enzyme-inducing anticonvulsants
[210] 2–4 h in patients co-medicated with enzyme-inducing anticonvulsants
[211] long-term (2–3 years) treated renal-transplant patients had significantly lower trough plasma concentrations of mycophenolic acid (1.94 ± 0.24 μg/ml), the active metabolite, compared with patients taking mycophenolate mofetil (1 g twice daily) short-term (2–10 months; 3.53 ± 0.45 μg/ml). Proposed mycophenolic acid pre-dose target concentration: 1–3.5 μg/ml
[212] as mycophenolic acid
[213] ten men with multiple sclerosis, 10–20 mg p.o. every 6 h 30 min before the next dose; peak levels <0.1 μg/ml 30 min after a dose
[214] nine patients, maximum tolerated oral dose 50–100 mg
[215] $t_{1/2}$ metabolite 3-O-methyldopa: 15 h
[216] appr. 2.5 μmol/l (1 μg/ml) 24 h after single doses of 100–800 mg and during daily treatment with 200 mg
[217] active metabolite 14-hydroxyclarithomycin ($t_{1/2}$: 5–7 h)
[218] C_{max} following oral administration of 200, 400, 800, and 1200 mg, respectively: 3.7, 8, 18, and 29 μg/ml
[219] at a daily dosage of 60, 120, and 240 mg the mean ± SD concentration in patients with symptomatic ventricular tachyarrhythmias (n = 9–18) was 75 ± 46, 144 ± 105, and 324 ± 180 nmol/l, respectively
[220] nonlinear kinetics
[221] appr. 5 h after ingestion of 3 g, not associated with severe toxicity to a 27-year-old woman
[222] 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 triazoledione ($t_{1/2}$: 10–12 h)
[223] each as N-desmethylsuximide; appr. methsuximide ($t_{1/2}$: 1–2 h) steady state concentration: 0.04–0.08 μg/ml
[224] 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 μg/ml ($t_{1/2}$: 29 ± 40 h), and for the 4-oxo metabolite ($t_{1/2}$: 22 ± 10 h): 0.16–0.68 μg/ml
[225] for depression; higher in case of schizophrenia (2–3 μg/ml?)
[226] suggested threshold for the sum of clomipramine (0.05–0.06 μg/ml) and N-desmethylclomipramine (0.16–0.18 μg/ml): 0.2–0.24 μg/ml
[227] 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 μg/ml
[228] as ramiprilat ($t_{½}$: 13–17 (50–110) h)
[229] IC_{50} level for analgesic effect after oral surgery
[230] the inhibitory concentration to reduce the level of extracellular hepatitis B DNA by 50% varied from 2.3 ng/ml to 1.3 μg/ml
[231] C_{max} at steady state (666 mg tid p.o.)
[232] after oral administration of the enteric-coated tablet
[233] trough <2 plus peak 6–10 (5–12) μg/ml
[234] reference value; <0.015 μg/ml urine
[235] active metabolite 4′-hydroxynimesulide ($t_{½}$: 3–9 h)
[236] C_{max} 126.5 and 226.3 ng/ml (at 2 h) after 75 and 125 mg p.o.
[237] in patients >60 years prolonged up to 10 h
[238] adjuvant in methadone maintenance therapy
[239] means of the 'average' steady state plasma concentration for the relatively high dose of 250 mg q8 h appr. 0.4–0.6 μg/ml
[240] combination of distribution and elimination processes
[241] as active metabolite fenofibric acid
[242] appr. 37.5 mmol/l (mval/l, mEq/l)
[243] steady state concentration 21.6 ± 14.2 μg/ml (mean ± 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
[244] target trough concentration if cyclosporine (CsA) is being used at trough concentrations of 0.075–0.15 μg/ml; without CsA: appr. 0.03 μg/ml (LC/UV assay)
[245] 4 hours after ingestion of 30–40 tiagabine HCl 8 mg tablets (coma)
[246] bupropion plus 10-hydroxybupropion
[247] calculated steady state concentration in children (4 months to 16 years) receiving 0.3 mg/kg b.w. i.v.
[248] femoral blood concentration of the metabolite desmethylalimemazine after fatal intoxication: 0.2–1.3 μg/g
[249] 40–50 min after 0.15 mg/kg i.v.
[250] femoral blood concentration of the metabolite desmethylpromethazine after fatal intoxication (n = 3): 0.3–1.8 μg/g
[251] femoral blood concentration of the metabolite desmethyltrimipramine after fatal intoxication (n = 10): 0.3–2.5 μg/g
[252] fatal overdose with tramadol, alprazolam (0.21 μg/ml), and alcohol (1.29 g/kg) in a 30-year-old woman
[253] enterohepatic circulation; prolonged in elderly subjects to 33.4 hours (range: 20.0–53.4 h)
[254] C_{min}/D [(ng/ml)/mg], i.e. dose-normalised trough plasma drug concentration, dosage interval 8 h
[255] all data refer to the active metabolite A771726
[256] steady state concentrations at 5, 10, and 25 mg/d, respectively
[257] steady state trough concentrations after 400 mg/d orally; two major metabolites modafinil acid (appr. 0.5–0.8 μg/ml, $t_{½}$: 7.3 ± 1.1 h) and modafinil sulfone (appr. 4.5–5.3 μg/ml), but neither appears to contribute to the wake-promoting properties of modafinil
[258] mean plasma trough concentration at steady state obtained from 400 mg imatinib/day in 83 adult patients with chronic phase CML; peak: 2.3 μg/ml
[259] in a 5-year-old girl
[260] at this time (March 2003), there is insufficient evidence to recommend a general therapeutic range
[261] active metabolite N-desethylamiodarone ($t_{1/2}$: 57–64 days), which achieves plasma concentrations similar to the parent compound
[262] inactive metabolites deshydroxyethyl opipramol ($t_{1/2}$: 97 ± 24 h) and opipramol N-oxide ($t_{1/2}$: 10.7 ± 3.2 h)
[263] as 25-hydroxyvitamin D for adults >49 years
[264] 6 h after reportedly ingestion of 30 g in a 38-year-old woman
[265] metabolite perindoprilat, 3 to 10 hours, with a prolonged terminal half-life between 25 to 120 h
[266] sum venlafaxine and O-desmethylvenlafaxine
[267] for glaucoma 4–5 μg/ml
[268] doxapram + keto-doxapram
[269] 24 h after ingestion of appr. 20 ml
[270] active metabolite desethylamodiaquine ($t_{1/2}$: 1–10 days)
[271] smokers: −0.0006 μg/ml

We thank Margit Schmidt and Susanne Roth, both at the Center for Drug Information and Pharmacy Practice at ABDA, for her most valuable help in preparing and updating the manuscript.

References

1 Aderjan, R.; Schmitt, G.; Hofmann, S.: Toxichem. Krimtech. **61**, 24 (1994)
2 Adkins, J. C.; Noble, S.: Drugs **55**, 437 (1998)
3 Ahearn, D. J.; Grim, C. E.: Arch. Intern. Med. **133**, 187 (1974)
4 Alderman, C. P.: Ann. Pharmacother. **30**, 55 (1996)
5 Alderman, C. P.; Lindsay, K. S. W.: Ann. Pharmacother. **30**, 1411 (1996)
6 Anderson, G. D.; Pak, C.; Doane, K. W.; Griffy, K. G.; Temkin, N. R.; Wilensky, A. J.; Winn, H. R.: Ann. Pharmacother. **31**, 279 (1997)
7 Anderson, J. L.; Reddy, C. P.; Myerburg, R. J.: Am. J. Cardiol. **71**, 686 (1993)
8 Apple, F. S.: J. Anal. Toxicol. **13**, 197 (1989)
9 Aquilonius, S.-M.; Hartvig, P.: Clin. Pharmacokinet. **11**, 236 (1986)
10 Armstrong, P. J.; Bersten, A.: Anesth. Analg. **65**, 536 (1986)
11 Arndt, G. A.; Reiss, W. G.; Bathke, K. A.; Springman, S. R.; Kenny, G.: Clin. Pharmacol. Ther. **53**, 224 (1993)
12 Arvanitis, L. A.; Miller, B. G.: Biol. Psychiatry **42**, 233 (1997)
13 ASHP: AHFS Drug information 2002. ASHP, Bethesda 2002
14 Asthana, S.; Greig, N. H.; Hegedus, L.; Holloway, H. H.; Raffele, K. C.; Schapiro, M. B.; Sincrant, T. T.: Clin. Pharmacol. Ther. **58**, 299 (1995)
15 Baas, H.; Harder, S.; Burklin, F.; Demisch, L.; Fischer, P. A.: Clin. Neuropharmacol. **21**, 86 (1998)
16 Backman, J. T.; Olkkola, K. T.; Neuvonen, P. J.: Clin. Pharmacol. Ther. **59**, 7 (1996)
17 Bahal, N.; Nahata, M. C.: Ann. Pharmacother. **26**, 46 (1992)
18 Bailey, D. N.: Clin. Toxicol. **22**, 433 (1984)
19 Bailey, J. M.; Schwieger, I. M.; Hug jr., C. C.: Anesth. Analg. **76**, 247 (1993)
20 Balant-Gorgia, A. E.; Gex-Fabry, M.; Balant, L. P.: Clin. Pharmacokinet. **20**, 447 (1991)
21 Ballerini, R.; Casini, A.; Chinol, M.; Mannucci, C.; Giaccai, L.; Salvi, M.: Int. J. Clin. Pharm. Res. **VI**, 69 (1986)
22 Barbé, F.; Hansen, C.; Badonnel, Y.; Legagneur, H.; Vert, P.; Boutroy, M. J.: Ther. Drug. Monit. **21**, 547 (1999)
23 Barbhaiya, R. H.; Shkla, U. A.; Chaikin, P.; Greene, D. S.; Marathe, P. H.: Eur. J. Clin. Pharmacol. **50**, 101 (1996)
23a Barnfield, C.; Kemmenoe, A. V.: Human Toxicol. **5**, 337 (1986)
24 Barone, J. A.: Ann. Pharmacother. **33**, 429 (1999)
25 Barone, J. A.; Moskovitz, B. L.; Guarnirei, J.; Hassell, A. E.; Coalizzi, J. L.; Bierman, R. H.; Jessen, L.: Pharmacotherapy **18**, 295 (1998)
26 Barthel, W.; Hüller, G.; Böhm, C.; Haustein, K.-O.: Pharm. Ztg. **141**, 4686 (1996)
27 Barrueto, F. Jr.; Williams, K.; Howland, M. A.; Hoffman, R. S.; Nelson, L. S.: J. Toxicol. Clin. Toxicol. **40**, 881 (2002)
28 Baselt, R. C.: Disposition of toxic drugs and chemicals in man. 6th ed., Biomedical Publishing, Davis 2002
29 Baud, F. J.; Sabouraud, A.; Vicaut, E.; Taboulet, P.; Lang, J.; Bismuth, C.; Rouzioux, J. M.; Scherrmann, J.-M.: N. Engl. J. Med. **332**, 642 (1995)
30 Baud, F. J.; Borron, S. W.; Bavoux, E.; Astier, A.; Hoffman, J. R.: Br. Med. J. **312**, 26 (1996)
31 Baumann, T. J.; Smythe, M. A.; Marikis, B.; Bivins, B. A.: DICP Ann. Pharmacother. **25**, 724 (1991)
32 Beaman, J. M.; Hackett, L. P.; Luxton, G.; Illett, K. F.: Ann. Pharmacother. **36**, 75 (2002)
33 Behrend, M.: BioDrugs **15**, 37 (2001)
34 Bernareggi, A.: Clin. Pharmacokinet. **35**, 247 (1998)
34a Berthault, F.; Kintz, P.; Tracqui, A.; Mangin, P.: J. Anal. Toxicol. **21**, 228 (1997)
35 Besson, J.-M.; Vickers, M. D.: Drugs **47** (Suppl. 1), 1 (1994)
36 Beutler, E.: Lancet **340**, 952 (1992)
37 Bever Jr., C. T.; Leslie, J.; Camenga, D. L.; Panitch, H. S.; Johnson, K. P.: Ann. Neurol. **27**, 421 (1990)
38 Bickel, U.; Thomsen, T.; Weber, W.; Fischer, J. P.; Bachus, R.; Nitz, M.; Kewitz, H.: Clin. Pharmacol. Ther. **50**, 420 (1991)
39 Biesalski, H. K.: Dt. Ärztebl. **92**, A-1316 (1995)
40 Bircher, J.: Ther. Umsch. **34**, 830 (1977)
41 Bircher, J.; Sommer, W.: Klinisch-pharmakologische Datensammlung. 2. Auflage. WVG, Stuttgart 1999
42 Blumer, J. L.: Clin. Pharmacokinet. **35**, 37 (1998)
43 Blychert, E.; Edgar, B.; Elmfeldt, D.; Hedner, T.: Clin. Pharmacol. Ther. **52**, 80 (1992)
44 Bockbrader, H. N.: Drugs Today **31**, 597 (1995)
45 Boehnert, M. T.; Lovejoy, F. H.: N. Engl. J. Med. **313**, 474 (1985)
46 de Boer, D.; Egberts, T.; Maes, R. A.: Pharm. World. Sci. **21**, 47 (1999)
47 Bolla, S.; Boinpally, R. R.; Poondru, S.; Devaraj, R.; Jasti, B. R.: J. Clin. Pharmacol. **42**, 327 (2002)
48 Bolten, W.; Salzmann, G.; Goldmann, R.; Miehlke, K.: Z. Rheumatol. **48**, 317 (1989)
49 Bond, A.; Seijas, D.; Dawling, S.; Lader, M.: Addiction **89**, 821 (1994)
50 Bond, G. R.; Krenzelok, E. P.; Normann, S. A.; Tendler, J. D.; Morris-Kukoski, C. L.; McCoy, D. J.; Thompson, M. W.; McCarthy, T., Roblez, J.; Taylor, C.; Dolan, M. A.; Requa, R. K.; Curry, S. C.: Clin. Toxicol. **32**, 513 (1994)
50a Bondesson, U.; Hartvig, P.; Danielsson, B.: Drug Metab. Dispos. **9**, 376 (1981)
51 Boni, J.; Korth-Bradley, J.; McGoldrick, K.; Appel, A.; Cooper, S.: J. Clin. Pharmacol. **39**, 729 (1999)
52 Borenstein, M.; Shupak, R. C.; Barnette, R. E.; Cooney, G. F.; Tzeng, T.-B.: Clin. Pharmacol. Ther. **55**, 129 (1994)
53 Boruchoff, S. E.; Sturgill, M. G.; Grasing, K. W.; Seibold, J R.; McCrea, J.; Winchell, G. A.; Kusma, S. E.; Deutsch, P. J.: Clin. Pharmacol. Ther. **67**, 351 (2000)
54 Bouillon, T.; Bartmus, D.; Schiffmann, H.; Gundert-Remy, U.: Arzneimittelther. **12**, 151 (1994)
55 Brandolese, R.; Scordo, M. G.; Spina, E.; Gusella, M.; Padrini, R.: Clin. Pharmacol. Ther. **70**, 391 (2001)
56 Breccia, A.; Ferri, E.; Girotti, S.; Bignamini, A. A.; Budini, R. A.: Curr. Ther. Res. **49**, 622 (1991)
57 Breyer-Pfaff, U.; Gaertner, H. J.: Antidepressiva. Pharmakologie, therapeutischer Einsatz und Klinik der Depression. WVG, Stuttgart 1987
58 Brier, M. E.; Zurada, J. M.; Aronoff, G. R.: Pharm. Res. **12**, 406 (1995)
59 Brodersen, H.-P.; Korsten, S.; Larbig, D.: Dtsch. Med. Wochenschr. **120**, 1301 (1995)
60 Brodie, M. J.; Dichter, M. A.: N. Engl. J. Med. **334**, 168 (1996)
61 Brook, I.: Clin. Pharmacokinet. 34, 303 (1998)
62 Brooks, D. E.; Wallace, K. L.: J. Toxicol. Clin. Toxicol. **40**, 513 (2002)
63 Brosen, K.: Ther. Drug Monit. **18**, 393 (1996)
64 Btaiche, I. F.; Woster, P. S.: Am. J. Health-Syst. Pharm. **52**, 61 (1996)
65 Buechler, K. F.; Moi, S.; Noar, B.; McGrath, D.; Villela, J.; Clancy, M.; Shenhav, A.; Colleymore, A.; Balkirs, G.; Lee, T.; Bruni, J. F.; Walsh, M.; Hoffman, R.; Ahmuty, F.; Nowakowski, M.; Buechler, J.; Mitchell, M.; Boyd, D.; Sitso, N.; Anderson, R.: Clin. Chem. **38**, 1678 (1992)
66 Burger, D. M.; Meenhorst, P. L.; Beijnen, J. H.: Pharm. World Sci. **17**, 25 (1995)
67 Burger, D. M.; Meenhorst, P. L.; ten Napel, C. H. H.; Mulder, J. W.; Henrichs, J. H.; Frissen, P. H. J.; Kroon, F. P.; Koks, C. H. W.; Bult, A.; Beijnen, J. H.: Eur. J. Pharm. Sci. **3**, 7 (1995)
68 Burgmann, H.; Winkler, S.; Uhl, F.; Feucht, M.; Hellgren, U.; Bergqvist, Y.; Feistauer, S.; Breyer, S.; Graninger, W.: Wien. Klin. Wochenschr. **105**, 61 (1993)
69 Burke, M. J.; Harvey, A. T.; Preskorn, S. H.; DeVane, C. L.: Am. J. Med. **100**, 119 (1996)
70 Burns, C. B.; Powers, J. R.; Currie, B. J.: Clin. Toxicol. **32**, 527 (1994)
71 Butler, D. R.; Kuhn, R. J.; Chandler, M. H. H.: Clin. Pharmacokinet. **26**, 374 (1994)
72 Caccia, S.; Garattini, S.: Clin. Pharmacokinet. **18**, 434 (1990)
73 Callaghan, J. T.; Bergstrom, R. F.; Ptak, L. R.; Beasley, C. M.: Clin. Pharmacokinet. **37**, 177 (1999)
74 Calvey, T. N.; Wareing, M.; Williams, N. E.; Chan, K.: Br. J. Clin. Pharmacol. **7**, 149 (1979)
75 Cami, J.; de la Torre, R.; Ortuno, J.; Farre, M.; Mas, M.; Roset, P. N.; Segura, J.: Eur J. Clin. Pharmacol. **52** (Suppl.), A168 (1997)
76 Challapalli, R.; Lefkovits, J.; Topol, E. J.: Coronary Artery Dis. **7**, 429 (1996)
77 Cham, B. E.; Johns, D.; Bochner, F.; Imhoff, D. M.; Rowland, M.: Clin. Chem. **25**, 1420 (1979)
78 Chellingsworth, M. D.; Willis, J. V.; Jack, D. B.; Kendall, M. J.: Am. J. Med. **84** (Suppl. 3B), 72 (1988)
79 Cleary, J. D.; Hayman, J.; Sherwood, J.; Perez Lasala, G.; Piazza-Hepp, T.: Ann. Pharmacother. **27**, 715 (1993)
80 Cohen, H.; Francisco, D. H.: Ann. Pharmacother. **28**, 805 (1994)
81 Collins, D. M.; Gidal, B. E.; Pitterle, M. E.: Ann. Pharmacother. **27**, 1180 (1993)
82 Cook, D. G.; Peacock, J. L.; Feyerabend, C.; Carey, I. M.; Jarvis, M. J.; Anderson, H. R.; Bland, J. M.: Br. Med. J. **313**, 1358 (1996)
83 Croes, K.; Augustijns, P.; Sabbe, M.; Desmet, K.; Verbeke, N.: Pharm. Weekbl. (Sci.) **14**, D9 (1992)
84 Dager, W. E.; Albertson, T. E.: Ann. Pharmacother. **26**, 1287 (1992)
85 Dahl, S. G.: Acta Psychiatr. Scand. **82** (Suppl. 358), 37 (1990)
86 Daldrup, T.; Pier, S.: Toxichem. Krimtech. **61**, 9 (1994)

87 Dale, O.; Hole, A.: Vet. Hum. Toxicol. **36**, 309 (1994)
88 Danziger, L. H.; Piscitelli, S. C.; Occhipinti, D. J.; Resnick, D. J.; Rodvold, K. A.: Ann. Pharmacother. **28**, 703 (1994)
89 Davies, N. M.: Clin. Pharmacokinet. **31**, 331 (1996)
90 Davies, N. M.; Anderson, K. E.: Clin. Pharmacokinet. **32**, 268 (1997)
91 Davies, N. M.; Watson, M. S.: Clin. Pharmacokinet. **32**, 437 (1997)
92 Davies, N. M.; Anderson, K. E.: Clin. Pharmacokinet. **33**, 184 (1997)
93 Davis, J. D.; Aarons, L.; Houston, J. B.: Pharm. Res. **11**, 1224 (1994)
94 Davis, R.; Whittington, R.; Bryson, H. M.: Drugs **53**, 608 (1997)
95 Dawling, S.; Flanagan, R. J.; Widdop, B.: Hum. Toxicol. **8**, 389 (1989)
96 Debailleul, G.; Abi Khalil, F.; Lheureux, P.: J. Anal. Toxicol. **15**, 35 (1991)
97 Debruyne, D.; Ryckelynck, J.-P.: Clin. Pharmacokinet. **24**, 10 (1993)
98 Debruyne, D.: Clin. Pharmacokinet. **33**, 52 (1997)
99 Deom, A.: Ther. Umschau **43**, 259 (1986)
100 Deom, A.: Ther. Umschau **43**, 261 (1986)
101 Desel, H.; Stedtler, U.; Behrens, A.; Neurath, H.: Toxichem. Krimtech. **67**, 4 (2000)
102 DeVane, C. L.; Nemeroff, C. B.: Clin. Pharmacokinet. **40**, 509 (2001)
103 Dettloff, R. W.; Touchette, M. A.; Zarowitz, B. J.: Ann. Pharmacother. **27**, 781 (1993)
104 Dinnendahl, V.; Fricke, U. (Eds.): Arzneistoff-Profile. Basisinformation über arzneiliche Wirkstoffe. Fortsetzungswerk. Govi, Eschborn
105 Dinovo, E. C.; Gottschalk, L. A.; McGuire, F. L.; Birch, H.; Heiser, J. F.: Clin. Chem. **22**, 847 (1976)
106 Dionne, R. A.; Gordon, S. M.; Tahara, M.; Rowan, J.; Troullos, E.: J. Clin. Pharmacol. **39**, 131 (1999)
107 Divoll, M.; Greenblatt, D. J.; Lacasse, Y.; Shader, R. I.: Psychopharmacology **73**, 381 (1981)
108 Dobbs, R. J.; O'Neill, C. J. A.; Deshmukh, A. A.; Nicholson, P. W.; Dobbs, S. M.: Clin. Pharmacokinet. **20**, 175 (1991)
109 Dollery, C.: Therapeutic drugs. Churchill Livingstone, Edinburgh 1991
110 Douglas, J. G.; McLeod, M.-J.: Clin. Pharmacokinet. **37**, 127 (1999)
111 Drayer, D. E.: Clin. Pharmacokinet. **1**, 426 (1976)
112 Drayer, D. E.: Ther. Drug Monit. **10**, 1 (1988)
113 Druker, B. J.; Talpaz, M.; Resta, D. J.; Peng, B.; Buchdunger, E.; Ford, J. M.; Lydon, N. B.; Kantarjian, H.; Capdeville, R.; Ohno-Jones, S.; Sawyers, C. L.: N. Engl. J. Med. **344**, 1031 (2001)
114 Druid, H.; Holmgren, P.: J. Forensic Sci. **42**, 79 (1997)
114a Duck, B. J.; Woolias, M.: J. Anal. Toxicol. **9**, 177 (1985)
115 von Düsterlho, J.: Dtsch. Med. Wochenschr. **120**, 542 (1995)
116 Dumont, R. J.; Ensom, M. H. H.: Clin. Pharmacokinet. **38**, 427 (2000)
117 Edstein, M. D.; Veenendaal, J. R.; Scott, H. V.; Rieckmann, K. H.: Chemotherapy **34**, 385 (1988)
118 Edvardsson, N.; Varnauskas, E.: Pharmacokinetics **6**, 558 (1989)
119 Edwards, D. J.: J. Pharm. Pract. **IV**, 211 (1991)
120 El Desoky, E.; Meinshausen, J.; Bühl, K.; Engel, G.; Harings-Kaim, A.; Drewelow, B.; Klotz, U.: Ther. Drug Monit. **15**, 281 (1993)
121 El-Yazigi, A.; Chaleby, K.; Gad, A.; Raines, D. A.: J. Clin. Pharmacol. **35**, 17 (1995)
121a Elian, A. A.: Forensic Sci. Int. **91**, 231 (1998)
122 Elias-Jones, A. C.; Larcher, V. F.; Shaw, P. N.: Pharm. Pharmacol. Lett. **2**, 115 (1992)
123 Elliott, S. P.: J. Anal. Toxicol. **24**, 85 (2000)
124 Elmquist, W. F.; Riad, L. E.; Leppik, I. E.; Sawchuk, R. J.: Pharm. Res. **8**, 282 (1991)
125 Emanuelsson, B.-M.; Norsten-Höög, C.; Sandberg, R.; Sjövall, J.: Eur. J. Pharm. Sci. **5**, 171 (1997)
126 Ereshefsky, L.; Tran-Johnson, T.; Davis, C. M.; LeRoy, A.: Clin. Chem. **34**, 863 (1988)
127 Erickson, S. J.; Duncan, A.: J. Paediatr. Child Health **34**, 280 (1998)
128 Evers, J.; Eichelbaum, M.; Kroemer, H. K.: Ther. Drug Monit. **16**, 349 (1994)
129 Ezzet, F.; Krishna, G.; Wexler, D.; Statkevich, P.; Kosoglou, T.; Batra, V.: Clin. Ther. **23**, 871 (2001)
130 Ezzet, F.; Wexler, D.; Statkevich, P.; Kosoglou, T.; Patrick, J.; Lipka, L.; Mellars, L.; Veltri, E.; Batra, V.: Clin. Pharmacol. Ther. **41**, 943 (2001)
131 Faravelli, C.; Ballerini, A.; Ambonetti, A.; Broadhurst, A. D.; Das, M.: J. Affect. Disord. **6**, 95 (1984)
132 Findlay, J. W. A.; Van Wyck Fleet, J.; Smith, P. G.; Butz, R. F.; Hinton, M. L.; Blum, M. R.; Schroeder, D. H.: Eur. J. Clin. Pharmacol. **21**, 127 (1981)
133 Flanagan, R. J.: Ann. Clin. Biochem. **35**, 261 (1998) (www.gtfch.org 'or' www.leeds.ac.uk/acb/annals)
134 Fleischhaker, C.; Schulz, E.; Clement, H.-W.; Krieg, C.; Remschmidt, H.: Psychopharmakother. **6**, 102 (1999)
135 Fleishaker, J. C.: Clin. Pharmacokinet. **39**, 413 (2000)
136 Fletcher, C. V.; Balfour jr., H. H.: Pharmacotherapy **16**, 1154 (1996)
137 Fletcher, C. V.; Acosta, E. P.; Henry, K.; Page, L. M.; Gross, C. R.; Kawle, S. P.; Remmel, R. P.; Erice, A.; Balfour jr., H. H.: Clin. Pharmacol. Ther. **64**, 331 (1998)
138 Forland, S. C.; Wechter, W. J.; Witchwoot, S.; Clifford, K. H.; Arnett, R. L.; Cutler, R. E.: J. Pharm. Pharmacol. **48**, 546 (1996)
139 Forrest, A. R. W.; Marsh, I.; Bradshaw, C.; Braich, S. K.: Lancet II, 226 (1986)
140 Forsyth, D. R.; Jayasinghe, K. S. A.; Roberts, C. J. C.: Eur. J. Clin. Pharmacol. **35**, 85 (1988)
141 Fowler, P. D.; Dawes, P. T.; John, V. A.; Shotton, P. A.: Eur. J. Clin. Pharmacol. **31**, 469 (1986)
142 Fowler, P. D.; Shadforth, M. F.; Crook, P. R.; John, V. A.: Eur. J. Clin. Pharmacol. **25**, 389 (1983)
143 Foy, J. L.; Eastman, R. C.; Nealon, R. C.; Bowen, P. M.; Pengelly, M. L.; Drass, J. A.; Dorworth, T. E.; Pucino, F.: Ann. Pharmacother. **26**, 675 (1992)
144 Freeman, C. D.; Quintiliani, R.; Nightingale, C. H.: Ann. Pharmacother. **27**, 594 (1993)
145 French, J.: Ann. Intern. Med. **120**, 411 (1994)
146 Frese, J. H.; Rohland, L.; Schulz, M.; Schmoldt, A.: Dtsch. Med. Wochenschr. **113**, 770 (1988)
147 Frey, O. R.; von Brenndorf, A. I.; Probst, W.: Ann. Pharmacother. **32**, 300 (1998)
148 Friedman, D.; Weller, S.; Dix, L.: 34. Int. Conf. AAC, Abstr. A72 (1994)
148a Friel, P. N.; Logan, B. K.; Fligner, C. L.: J. Anal. Toxicol. **17**, 436 (1993)
149 Fulton, B.; Markham, A.: Drugs **51**, 278 (1996)
150 Fulton, B.; Benfield, P.: Drugs **52**, 450 (1996)
151 Furlanut, M.; Benetello, P.; Spina, E.: Clin. Pharmacokinet. **24**, 301 (1993)
152 Furman, W. L.; Baker, S. D.; Pratt, C. B.: J. Clin. Oncol. **14**, 1504 (1996)
153 Gaffney, P. N.; Schuckman, H. A.; Beeson, M. S.: Ann. Pharmacother. **32**, 1249 (1998)
154 Garnier, R.; Guerault, E.; Muzard, D.; Azoyan, P.; Chaumet-Riffaud, A.; Efthymiou, M.: Clin. Toxicol. **32**, 391 (1994)
155 Gelman, C. R.; Rumack, B. H.; Hess, A. J. (Eds.): Drugdex System. Micromedex, Inc., Englewood, Colorado 01/2001-03/2003
156 Gex-Fabry, M.; Balant-Gorgia, A. E.; Balant, L. P.: Eur. J. Clin. Pharmacol. **54**, 895 (1999)
157 Gilman, J. T.; Gal, P.: Clin. Pharmacokinet. **23**, 1 (1992)
158 Gillet, P.; Gavriloff, C.; Hercelin, B.; Salles, M. F.; Nicolas, A.; Netter, P.: Fundam. Clin. Pharmacol. **9**, 205 (1995)
159 Glare, P. A.; Walsh, T. D.: Ther. Drug Monit. **13**, 1 (1991)
160 Gock, S. B.; Wong, S. H. Y.; Nuwayhid, N.; Venuti, S. E.; Kelley, P. D.; Teggatz, J. R.; Jentzen, J. M.: J. Anal. Toxicol. **23**, 559 (1999)
161 Goff, D. C.; Baldessarini, R. J.: J. Clin. Psychopharmacol. **13**, 57 (1993)
162 Goggin, M.; Crowley, K.; O'Malley, K.; Barry, P.; Kelly, G.; Blake, J.: Br. J. Anaesth. **64**, 107 (1990)
163 Goldenberg, M. M.: Clin. Ther. **21**, 1837 (1999)
164 Gosciniak, H.-T.: Psychopharmakother. **4**, 105 (1997)
165 Gottschalk, L. A.; Cravey, R. H.: Toxicological and pathological studies on psychoactive drug-involved deaths. Biomedical Publishing, Davis 1980
166 Graudins, A.; Aaron, C. K.; Linden, C. H.: N. Engl. J. Med. **333**, 196 (1995)
167 Graves, N. M.: Ann. Pharmacother. **27**, 1073 (1993)
168 Greenberg, E. R.; Baron, J. A.; Karagas, M. R.; Stukel, T. A.; Nierenberg, D. W.; Stevens, M. M.; Mandel, J. S.; Haile, R. W.: JAMA **275**, 699 (1996)
169 Greene, D. S.; Barbhaiya, R. H.: Clin. Pharmacokinet. **33**, 260 (1997)
170 Grimsley, S. R.; Jann, M. W.: Clin. Pharm. **11**, 930 (1992)
171 Gschwantler, M.; Gulz, W.; Brownstone, E.; Feichtenschlager, T., Pulgram, T.; Schrutka-Kölbl, C.; Weiss, W.: Wien. Klin. Wochenschr. **105**, 500 (1993)
172 Gugler, R.; Fuchs, G.; Dieckmann, M.; Somogyi, A. A.: Clin. Pharmacol. Ther. **29**, 744 (1981)
173 Gutierrez, M.; Abramowitz, W.: Pharmacotherapy **20**, 1441 (2000)
174 Guitton, C.; Kinowski, J.-M.; Abbar, M.; Chabrand, P.; Bressolle, F.: J. Clin. Pharmacol. **39**, 721 (1999)
175 Hackett, L. P.; Joyce, D. A.; Hall, R. W.; Dusci, L. J.; Ilett, K. F.: Drug Invest. **5**, 281 (1993)
176 Hagen, N.; Thirlwell, M. P.; Dhaliwal, H. S.; Babul, N.; Harsanyi, Z.; Darke, A. C.: J. Clin. Pharmacol. **35**, 37 (1995)
177 Hagmeyer, K. O.; Mauro, L. S.; Mauro, V. F.: Ann. Pharmacother. **27**, 29 (1993)
178 Hakamäki, T.; Apoil, E.; Arstila, M.; Timmer, C. J.; Lehtonen, A.: Curr. Ther. Res. **44**, 752 (1988)

179 Hall, A. H.; Rumack, B. H.: Ann. Emerg. Med. **15**, 1067 (1986)
180 Hallas, J.; Davidsen, O.; Grodum, E.; Damsbo, N.; Gram, L. F.: Respiration **59**, 30 (1992)
181 Hanzlick, R. L.: Am. J. Forensic Med. Pathol. **5**, 11 (1984)
182 Harder, S.; Baas, H.; Rietbrock, S.: Clin. Pharmacokinet. **29**, 243 (1995)
183 Harder, S.; Baas, H.; Bergemann, N.; Demisch, L.; Rietbrock, S.: Br. J. Clin. Pharmacol. **39**, 39 (1995)
184 Harder, S.; Baas, H.: Clin. Pharmacol. Ther. **64**, 183 (1998)
185 Harmon, T. J.; Benitez, J. G.; Krenzelok, E. P.; Cortes-Belen, E.: J. Toxicol. Clin. Toxicol. **36**, 599 (1998)
186 Hardy, G. A.; Lafond, J.-L. V.; Mallaret, M. P.: Ann. Pharmacother. **35**, 386 (2001)
187 Hart, T. B.; Nevitt, A.; Whitehead, A.: Lancet II, 1222 (1984)
188 van Harten, J.: Clin. Pharmacokinet. **24**, 203 (1993)
189 den Hartigh, J.; Hilders, C. G. J. M.; Schoemaker, R. C.; Hulshof, J. H.; Cohen, A. F.; Vermeij, P.: Clin. Pharmacol. Ther. **54**, 415 (1993)
190 Hartvig, P.; Roos, B. E.; Ahs, U.; Ryde, M.: Curr. Ther. Res. **29**, 351 (1981)
191 Hartvig, P.; Valtysson, J.; Lindner, K.-J.; Kristensen, J.; Karlsten, R.; Gustafsson, L. L.; Persson, J.; Svensson, J. O.; Oye, I.; Antoni, G.; Westerberg, G.; Langström, B.: Clin. Pharmacol. Ther. **58**, 165 (1995)
192 Hay, R. H.: Q. J. Med. **64**, 631 (1987)
193 Hayes, G.; Kootsikas, M. E.: Ann. Pharmacother. **27**, 1389 (1993)
194 Haynes, G.; Brahen, N. H.; Hill, H. F.: Can. J. Anaesth. **40**, 286 (1993)
195 Härtter, S.; Baier, D.; Dingemanse, J.; Ziegler, G.; Hiemke, C.: Naunyn-Schmiedeberg's Arch. Pharmacol. **353** (Suppl.), R154 (1996)
196 Heikinheimo, O.: Clin. Pharmacokinet. **33**, 7 (1997)
197 Heinroth, K. M.; Kuhn, C.; Walper, R.; Busch, I.; Winkler, M.; Prondzinsky, R.: Dtsch. Med. Wochenschr. **124**, 1230 (1999)
198 Heintz, R. C.; Stebler, T.; Lunell, N. O.; Mueller, S.; Guentert, T. W.: J. Pharm. Med. **3**, 57 (1993)
199 Hellgren, U.; Jastrebova, J.; Jerling, M.; Krysen, B.; Bergqvist, Y.: Eur. J. Clin. Pharmacol. **51**, 171 (1996)
200 Hellinger, A.; Wolter, K.; Marggraf, G.; Pentz, R.; Fritschka, E.: Eur. J. Clin. Pharmacol. **48**, 57 (1995)
201 Hellriegel, E. T.; Arora, S.; Nelson, M.; Robertson Jr., P.: J. Clin. Pharmacol. **42**, 450 (2002)
202 Hempel, V.; Lenz, G.: Anästh. Intensivmed. **23**, 337 (1982)
203 Henry, D. W.; Burwinkle, J. W.; Klutman, N. E.: Clin. Pharm. **10**, 625 (1991)
204 Henry, J. A.: Int. Clin. Psychopharmacol. **6** (Suppl 6), 22 (1992)
205 Herben, V. M. M.; ten Bokkel Huinink, W. W.; Beijnen, J. H.: Clin. Pharmacokinet. **31**, 85 (1996)
206 Hercegova, A.; Polonsky, J.: Pharmazie **54**, 479 (1999)
207 Herren, T.; Como, F.; Krähenbühl, S.; Wyss, P. A.: Schweiz. Med. Wochenschr. **123**, 1775 (1993)
208 Heykants, J.; Hendriks, R.; Meuldermans, W.; Michiels, M.; Scheygrond, H.; Reyntjens, H.: Eur. J. Drug. Metab. Pharmacokinet. **6**, 61 (1981)
209 Heykants, J.; Van Peer, A.; Van de Velde, V.; Snoeck, E.; Meuldermans, W.; Woestenborghs, R.: Clin. Pharmacokinet. **29**, 221 (1995)
210 Hiller, J. L.; Benda, G. I.; Rahatzad, M.; Allen, J. R.; Culver, D. H.; Carlson, C. V.: Pediatrics **77**, 500 (1986)
211 Himmelmann, A.; Hedner, T.; Snoeck, E.; Lundgren, B.; Hedner, J.: Eur. J. Clin. Pharmacol. **51**, 259 (1996)
212 Hoetelmans, R. M. W.; Burger, D. M.; Meenhorst, P. L.; Beijnen, J. H.: Clin. Pharmacokinet. **30**, 314 (1996)
213 Hoizey, G.; Souchon, P. F.; Trenque, T.; Frances, C.; Lamiable, D.; Nicolas, A.; Grossenbacher, F., Sabouraud, P.; Bednarek, N.; Motte, J.; Millart, H.: J. Toxicol. Clin. Toxicol. **40**, 817 (2002)
214 Holm, K. J.; Spencer, C. M.: Drugs **59**, 1007 (2000)
215 Holmberg, L.; Odar-Cederlöf, I.; Boréus, L. O.; Heyner, L.; Ehrnebo, M.: Eur. J. Clin. Pharmacol. **22**, 175 (1982)
216 Hooks, M. A.: Ann. Pharmacother. **28**, 501 (1994)
217 Hoppe, M. M.; Iafrate, R. P.; Hendeles, L.; Neims, A.: Fl. J. Hosp. Pharm. **8**, 259 (1988)
218 Horns, W. H.; Rado, M.; Goldstein, A.: Clin. Pharmacol. Ther. **17**, 636 (1975)
219 Horton, R. C.; Bonser, R. S.: Br. Med. J. **311**, 422 (1995)
220 Houeto, P.; Hoffman, J. R.; Imbert, M.; Levillain, P.; Baud, F. J.: Lancet **346**, 605 (1995)
221 Howard, C. E.; Roberts, R. S.; Ely, D. S.; Moye, R. A.: Ann. Pharmacother. **28**, 201 (1994)
222 Hsyu, P. H.; Singh, A.; Giargiari, T. D.; Dunn, J. A.; Ascher, J. A.; Jonhston, J. A.: J. Clin. Pharmacol. **37**, 737 (1997)
223 Huang, Y.-C.; Colaizzi, J. L.; Bierman, R. H.; Westenborghs, R.; Heykants, J. J. P.: J. Clin. Pharmacol. **26**, 628 (1986)
224 Hsu, A.; Granneman, G. R.; Bertz, R. J.: Clin. Pharmacokinet. **35**, 275 (1999)
225 Hübner, G. I.; Eismann, R.; Sziegoleit, W.: Arzneim.-Forsch./Drug Res. **50 (II)**, 936 (2000)
226 Hug jr., C. C.: Anesthesiology **74**, 390 (1991)
227 Hughes, J.; Gill, A. M.; Mulhearn, H.; Powell, E.; Choonara, I.: Ann. Pharmacother. **30**, 27 (1996)
228 Hui, W. K. K.; Mitchell, L. B.; Kavanagh, K. M.; Gillis, A. M.; Wyse, D. G.; Manyari, D. E.; Duff, H. J.: J. Cardiovasc. Pharmacol. **15**, 144 (1990)
229 Hukkinen, S. K.; Varhe, A.; Olkkola, K. T.; Neuvonen, P. J.: Clin. Pharmacol. Ther. **58**, 127 (1995)
230 Imbimbo, B. P.: CNS Drugs **15**, 375 (2001)
231 Inciardi, J. F.; Willits, N. H.: Ann. Pharmacother. **26**, 1070 (1992)
232 Inturrisi, C. E.; Colburn, W. A.; Kaiko, R. F.; Houde, R. W.; Foley, K. M.: Clin. Pharmacol. Ther. **41**, 392 (1987)
233 Inturrisi, C. E.; Verebely, K.: Clin. Pharmacol. Ther. **13**, 633 (1972)
234 Irey, N. S.; Froede, R. C.: Am. J. Clin. Pathol. **61**, 778 (1974)
235 Isabelle, C.; Warner, A.: Am. J. Health-Syst. Pharm. **56**, 555 (1999)
236 Iseman, M. D.: N. Engl. J. Med. **329**, 784 (1993)
237 Ishizaki, T.; Sasaki, T.; Suganuma, T.; Horai, Y.; Chiba, K.; Wtanabe, M.; Asuke, W.; Hoshi, H.: Eur. J. Clin. Pharmacol. **18**, 407 (1980)
238 Iwersen, S.; Schmoldt, A.: J. Anal. Toxicol. **20**, 301 (1996)
239 Iwersen, S.; Schmoldt, A.: Clin. Toxicol. **34**, 223 (1996)
240 Jack, D. B.: Handbook of clinical pharmacokinetic data. Macmillan, Basingstoke 1992
241 Jacob, R. A.: J. Nutr. **120**, 1480 (1990)
242 Jaehde, U.; Sörgel, F.; Reiter, A.; Sigl, G.; Naber, K. G.; Schunack, W.: Clin. Pharmacol. Ther. **58**, 532 (1995)
243 Janknegt, R.: Pharm. Weekbl. (Sci.) **13**, 153 (1991)
244 Janousek, J.; Paul, T.; Reimer, A.; Kallfelz, H.-C.: Am. J. Cardiol. **72**, 294 (1993)
245 Javaid, J. I.: J. Clin. Pharmacol. **34**, 286 (1994)
246 Johansson, E.; Agurell, S.; Hollister, L. E.; Halldin, M. M.: J. Pharm. Pharmacol. **40**, 374 (1988)
247 Johnson, M. A.; Moore, K. H. P.; Yuen, G. J.; Bye, A.; Pakes, G. E.: Clin. Pharmacokinet. **36**, 41 (1999)
248 Johnson, S. A.: Clin. Pharmacokinet. **39**, 5 (2000)
249 Jorgensen, O. S.; Lober, M.; Christiansen, J.; Gram, L. F.: Clin. Pharmacokinet. **5**, 386 (1980)
250 Jostell, K.-G.; Lapierre, Y. D.; and the Canadian Remoxipride Study Group: Acta Psychiatr. Scand. **82** (Suppl. 358), 48 (1990)
251 Josune, I.; Victoria, C. M.; Mar, A. M.; Dominguez-Gil Hurlé, A.: Ann. Pharmacother. **27**, 791 (1993)
252 Jung, D.; Griffy, K.; Wong, R.; Colburn, W.; Hulse, J.: J. Clin. Pharmacol. **38**, 1021 (1998)
253 June, H. L.; Stitzer, M. L.; Cone, E.: Clin. Pharmacol. Ther. **57**, 270 (1995)
254 Jusko, W. J.; Thomson, A. W.; Fung, J.; McMaster, P.; Wong, S. H.; Zylber-Katz, E.; Christians, U.; Winkler, M.; Fitzsimmons, W. E.; Lieberman, R.; McBride, J.; Kobayashi, M.; Warty, V.; Soldin, S. J.: Ther. Drug Monit. **17**, 606 (1995)
255 Kadoya, C.; Domino, E. F.; Matsuoka, S.: Clin. Pharmacol. Ther. **55**, 370 (1994)
256 Kahan, B. D.; Napoli, K. L.: Transplant. Proc. **30**, 2189 (1998)
257 Kaiko, R. F.; Foley, K. M.; Grabinski, P. Y.; Heidrich, G.; Rogers, A. G.; Inturrisi, C. E.; Reidenberg, M. M.: Ann. Neurol. **13**, 180 (1983)
258 Kale, P. B.; Thomson, P. A.; Provenzano, R.; Higgins, M. J.: Ann. Pharmacother. **27**, 866 (1993)
259 Kamali, F.; Edwards, C.; Rawlins, M. D.: Br. J. Clin. Pharmacol. **33**, 309 (1992)
260 Kastrissios, H.; Triggs, E. J.; Sinclair, F.; Moran, P.; Smithers, M.: Eur. J. Clin. Pharmacol. **44**, 555 (1993)
261 Kath, R.; Knauf, W. U.; Mitrou, P. S.; Rummel, M.; Höffken, K.; Peters, H. D.: Onkologe **1**, 614 (1995)
262 Kaul, S.; Shukla, U. A.; Barbhaiya, R. H.: J. Clin. Pharmacol. **35**, 830 (1995)
263 Kaye, C. M.; Nicholls, B.: Clin. Pharmacokinet. **39**, 243 (2000)
264 Kees, F.; Jehkul, A.; Bucher, M.; Mair, G.; Kiermaier, J.; Grobecker, H.: Arzneim.-Forsch./Drug Res. **53**, 87 (2003)
265 Keller, T.; Schneider, A.; Tutsch-Bauer, E.: Forensic Sci. Int. **109**, 159 (2000)
266 Kietzmann, D.; Hamm, C.; Bouillon, T.; Kettler, D.; Gundert-Remy, U.: Naunyn-Schmiedeberg's Arch. Pharmacol. **349** (Suppl.), R139 (1994)
266a Kintz, P.; Tracqui, A; Mangin, P.; Lugnier, A. A.; Chaumont, A. J.: J. Anal. Toxicol. **13**, 238 (1989)
267 Kirk, J. K.; Dupuis, R. E.; Miles, M. V.; Gaddy, G. D.; Miranda-Massari, J. R.; Williams, D. M.: Ther. Drug Monit. **16**, 58 (1994)
268 Kirsten, R.; Nelson, K.; Kirsten, D.; Heintz, B.: Clin. Pharmacokinet. **34**, 457 (1998)
269 Kirsten, R.; Nelson, K.; Kirsten, D.; Heintz, B.: Clin. Pharmacokinet. **35**, 9 (1998)
270 Klamerus, K. J.; Maloney, K.; Rudolph, R. L.: J. Clin. Pharmacol. **32**, 716 (1992)

271 Klotz, U.; Stracciari, G. L.: Arzneim.-Forsch./Drug Res. **43**, 1357 (1993)
272 Klotz, U.; Laux, G.: Tranquillantien, WVG, Stuttgart 1996
273 Klug, E.; Schneider, V.: Z. Rechtsmed. **93**, 89 (1994)
274 Knapp, J.; Bokník, P.; Gumbinger, H.-G.; Linck, B.; Lüss, H.; Müller, F. U.; Schmitz, W.; Vahlensieck, U.; Neumann, J.: J. Chromatogr. Sci. **37**, 145 (1999)
275 Koch, A. R.; Vogelaers, D. P.; Decruyenaere, J. M.; Callens, B.; Verstraete, A.; Buylaert, W. A.: Clin. Toxicol. **33**, 253 (1995)
276 Kochak, G. M.; Page, J. G.; Buchanan, R. A.; Peters, R.; Padgett, C. S.: J. Clin. Pharmacol. **38**, 166 (1998)
276a Kopferschmitt, J.; Flesch, F.; Lugnier, A.; Sauder, P.; Jaeger, A.; Mantz, J. M.: Hum. Toxicol. **2**, 239 (1983)
277 Koren, G.: Clin. Chem. **43**, 222 (1997)
278 Kozyrskyj, A.; Masih, M.; Hahn, J.; Ho, C.; Wong, M.; Sirdevan, M.: Can. J. Hosp. Pharm. **47**, 262 (1994)
279 Köppel, C.; Kristinsson, J.; Wagemann, A.; Tenczer, J.; Martens, F.: Eur. J. Drug Metab. Pharmacokinet. **16**, 43 (1991)
280 Kraemer, T.; Paul, L. D.; Jochum, C.; Maurer, H. H.: Toxichem. Krimtech. **69**, 80 (2002)
281 Kragh Larsen, A.: Cancer Chemother. Pharmacol. **32**, 96 (1993)
282 Kretzschmar, M.: Z. ärztl. Fortbild. Qual.sich. **95**, 45 (2001)
283 Kuhs, H.; Rudolf, G. A. E.: Psychopharmacology **102**, 379 (1990)
284 Kunze, K.; Kauert, U.; Schmoldt, A.: Vet. Hum. Toxicol. **29** (Suppl. 2), 59 (1987)
285 Kuss, H. J.; Jungkunz, G.: Prog. Neuropsychopharmacol. Biol. Psychiatry **10**, 739 (1986)
286 Labbate, L. A.; Pollack, M. H.; Otto, M. W.; Tesar, G. M.; Rosenbaum, J. F.: J. Clin. Psychopharmacol. **14**, 274 (1994)
287 Lai, A. A.; Schroeder, D. H.: J. Clin. Psychiatry **44**, 82 (1983)
288 Lam, Y. W. F.; Jann, M. W.; Chang, W.-H.; Yu, H.-S.; Lin, S.-K.; Chen, H.; Davis, C. M.: J. Clin. Pharmacol. **35**, 128 (1995)
289 Lamp, K. C.; Bailey, E. M.; Rybak, M. J.: Clin. Pharmacokinet. **22**, 32 (1992)
290 Lappenberg-Pelzer, M.; Baudisch, H.: Toxichem. Krimtech. **61**, 10 (1994)
291 Larsen, F. G.; Jakobsen, P.; Knudsen, J.; Weismann, K.; Kragballe, K.; Nielsen-Kudsk, F.: J. Invest. Dermatol. **100**, 623 (1993)
292 Latini, R.; Maggioni, A. P.; Cavalli, A.: Clin. Pharmacokinet. **18**, 91 (1990)
293 Laurijssens, B. E.; Greenblatt, D. J.: Clin. Pharmacokinet. **30**, 52 (1996)
294 Leach, J. P.; Stolarek, I.; Brodie, M. J.: Seizure **4**, 155 (1995)
295 Leach, J. P.; Brodie, M. J.: Lancet **351**, 203 (1998)
296 Leader, W. G.; Chandler, M. H. H.; Castiglia, M.: Clin. Pharmacokinet. **28**, 327 (1995)
297 Lehmann, K. A.; Freier, J.; Daub, D.: Anaesthesist **31**, 111 (1982)
298 Lehmann, K. A.; Kratzenberg, U.; Schroeder-Bark, B.; Horrichs-Haermeyer, G.: Clin. J. Pain. **6**, 212 (1990)
299 Lemmens, H. J. M.: Clin. Pharmacokinet. **29**, 231 (1995)
300 Lenderink, A. W.; Langen, M. C. J.; Schippers, D.: Pharm. World Sci. **16**, D8 (1994)
301 Lesser, I. M.; Lydiard, B.; Antal, E.; Rubin, R. T.; Ballenger, J. C.; DuPont, R.: Am. J. Psychiatry **149**, 1556 (1992)
302 Lewellen, O. R. W.; Templeton, R. T.: Scand. J. Rheumatol. Suppl. 14, 53 (1976)
303 Lewis, L. D.; Essex, E.; Volans, G. N.; Cochrane, G. M.: Hum. Exp. Toxicol. **12**, 397 (1993)
304 Lieberman, J. A.; Cooper, T. B.; Suckow, R. F.; Steinberg, H.; Borenstein, M.; Brenner, R.; Kane, J. M.: Clin. Pharmacol. Ther. **37**, 301 (1985); Ann. NY Acad. Sci. **463**, 304 (1986)
305 Linder, M. W.; Keck Jr., P. E.: Clin. Chem. **44**, 1073 (1998)
306 Lindholm, A.: Ther. Drug Monit. **17**, 631 (1995)
307 Lindholm, A.; Säwe, J.: Ther. Drug Monit. **17**, 570 (1995)
308 Linnet, K.; Wiborg, O.: Clin. Pharmacol. Ther. **60**, 41 (1996)
309 Lipp, H.-P.: Krankenhauspharm. **17**, 388 (1996)
310 Lipp, H.-P.: Krankenhauspharm. **18**, 104 (1997)
311 Liu, H.; Delgado, M. R.: Clin. Pharmacokinet. **36**, 453 (1999)
312 Lode, H.: Eur. J. Clin. Microbiol. Infect Dis. **10**, 807 (1991)
313 Lössner, A.; Banditt, P.; Tröger, U.: Pharmazie **56**, 50 (2001)
314 Lopez-Herce, J.; Bonet, C.; Meana, A.; Albajara, L.: Ann. Pharmacother. **29**, 1995)
315 Lorenz, R.; Lehn, N.; Born, P.; Herrmann, M.; Neuhaus, H.: Dtsch. Med. Wochenschr. **121**, 223 (1996)
316 Lucien, J.; Dias, V. C.; LeGatt, D. F.; Yatscoff, R. W.: Ther. Drug Monit. **17**, 454 (1995)
317 Ludewig, R.: Akute Vergiftungen, p. 671, WVG, Stuttgart 1999
318 Luer, M. S.; Rhoney, D. H.: Ann. Pharmacother. **32**, 1173 (1998)
319 Lüscher, T. F.; Noll, G.; Stürmer, T.; Huser, B.; Wenk, M.: N. Engl. J. Med. **330**, 718 (1994)
320 Lyseng-Williamson, K.; Jarvis, B.: Drugs **61**, 1765 (2001)
321 Lykkesfeldt, J.; Priemé, H.; Loft, S.; Poulsen, H. E.: Br. Med. J. **313**, 91 (1996)
322 MacDonald, A.; Scarola, J.; Burke, J. T.; Zimmerman, J. J.: Clin. Ther. **22** (Suppl. B), B101 (2000)
323 MacGowan, A.; Lovering, A.; White, L.; Reeves, D.; Collyns, T. A.; Oppenheim, B. A.; Wysocki, M.; Thomas, F.; Wolff, M.; de Hoog, M.; Mouton, J. W.; van den Anker, J. N.; Duffull, S. B.; Begg, E. J.; Saunders, N. J.: Lancet **345**, 645 (1995)
324 Mahalati, K.; Kahan, B. D.: Clin. Pharmacokinet. **40**, 573 (2001)
325 Mahler, Ch.; Verhelst, J., Denis, L.: Clin. Pharmacokinet. **34**, 405 (1998)
326 Mahoney, M. C.; Connolly, B. F.; Smith, C. M.: J. Clin. Pharmacol. **39**, 97 (1999)
327 Maitre, P. O.; Vozeh, S.; Heykants, J.; Thomson, D. A.; Stanski, D. R.: Anesthesiology **66**, 3 (1987)
328 Malabanan, A.; Veronikis, I. E.; Holick, M. F.: Lancet **351**, 805 (1998)
329 Mandelli, M.; Tognoni, G.: Clin. Pharmacokinet. **5**, 424 (1980)
330 del Mar Fernandez de Gatta, M.; Calvo, V.; Hernandez, J. M.; Caballero, D.; San Miguel, J. F.; Dominguez-Gil, A.: Clin. Pharmacol. Ther. **60**, 332 (1996)
331 van der Marel, C. D.; van Lingen, R. A.; Pluim, M. A. L.; Scoones, G.; van Dijk, M.; Vaandrager, J. M.; Tibboel, D.: Clin. Pharmacol. Ther. **70**, 82 (2001)
332 Markham, A.; Faulds, D.: Drugs **52**, 429 (1996)
333 Marriner, S. E.; Morris, D. L.; Dickson, B.; Bogan, J. A.: Eur. J. Pharmacol. **30**, 705 (1986)
334 Martens, J.; Meyer, F. P.: Pharmazie **50**, 41 (1995)
335 Marzo, A.; Dal Bo, L.; Wool, C.; Cerutti, R.: Arzneim.-Forsch./Drug Res. **48** (II), 935 (1998)
335a Mason, P. E.; Kerns, W. P.: Acad. Emerg. Med. **9**, 730 (2002)
336 Mayersohn, M.; Guentert, T. W.: Clin. Pharmacokinet. **29**, 292 (1995)
337 McNeely, W.; Goa, K. L.: Drugs **57**, 633 (1999)
338 Meibohm, B.; Wegener, S.: Krankenhauspharm. **13**, 331 (1992)
339 Meyer, F. P.: Internist. Prax. **33**, 611 (1993)
340 Meyer, F. P.: Int. J. Clin. Pharmacol. Ther. **32**, 71 (1994)
341 Michaud, K.; Augsburger, M., Romain, N.; Giroud, C.; Mangin, P.: Forensic Sci. Int. **105**, 185 (1999)
342 Michaëlsson, K.; Lithell, H.; Vessby, B.; Melhus, H.: N. Engl. J. Med. **348**, 287 (2003)
343 Michiels, M.; Hendriks, R.; Heykants, J.: Eur. J. Drug. Metab. Pharmacokinet. **6**, 37 (1981)
344 Mignon, M.; Chau, N. P.; Nguyen-Phouc, B. K.; Sauvage, M.; Leguy, F.; Bonfils, S.: Br. J. Clin. Pharmacol. **14**, 187 (1982)
345 Miljkovic, B.; Pokrajac, M.; Timotijević, I.; Varagic, V.: Eur. J. Drug Metab. Pharmacokinet. **21**, 251 (1996)
345a Milner, D. A.; Hall, M.; Davis, G. G.; Brissie, R. M.; Robinson, C. A.: J. Anal. Toxicol. **22**, 545 (1998)
346 Milton, G. V.; Jann, M. W.: Clin. Pharmacokinet. **28**, 494 (1995)
347 Mimaki, T.: Ther. Drug. Monit. **20**, 593 (1998)
348 Mirfazaelian, A.; Dadashzadeh, S.; Rouini, M. R.: Pharm. Pharmacol. Commun **6**, 563 (2000)
349 Mistry, G. C.; Jensen, B. K.; Rakhit, A.; Huselton, C. A.; Patel, I. H.: Pharm. Res. **12** (Suppl. 9), S-414 (1995)
350 Mizuno, A.; Uematsu, T.; Gotoh, S.; Katoh, E.; Nakashima, M.: J. Pharm. Pharmacol. **48**, 660 (1996)
351 Mlynarek, M. E.; Peterson, E. L.; Zarowitz, B. J.: Ann. Pharmacother. **30**, 219 (1996)
352 Moachon, G.; Kanmacher, I.; Clenet, M.; Matinier, D.: Drugs Today **32**, 327 (1996)
353 Modi, N.; Maggs, A. F.; Clarke, C.; Chapman, C.; Swann, R. A.: Lancet **352**, 70 (1998)
354 Moffat, A. C.; Jackson, J. V.; Moss, M. S.; Widdop, B.: Clarke's isolation and identification of drugs in pharmaceuticals, body fluids, and post-mortem material. 2nd ed., Pharmaceutical Press, London 1986
355 Møller Jensen, K.; Berg Dahl, J.: Arzneim.-Forsch./Drug Res. **44**, 951 (1994)
356 von Moltke, L. L.; Greenblatt, D. J.; Shader, R. I.: Clin. Pharmacokinet. **24**, 141 (1993)
357 Mordel, A.; Halkin, H.; Zulty, L.; Almog, S.; Ezra, D.: Clin. Pharmacol. Ther. **53**, 457 (1993)
358 Morse, G. D.; Shelton, M. J.; O'Donnell, A. M.: Clin. Pharmacokinet. **24**, 101 (1993)
359 Moser, M.; Buchberger, W.: Wien. Klin. Wochenschr. **105**, 497 (1993)
360 Mukherjee, A.; Le, K.; Lieberman, R.: Clin. Pharmacol. Ther. **55**, 149 (1994)
361 Müller, N.; Kapfhammer, H.-P.; Spatz, R.; Hippius, H.: Dt. Ärztebl. **92**, C-236 (1995)
362 Murphy, J. M.; Motiwala, R.; Devinsky, O.: S. Med. J. **84**, 1199 (1991)
363 Myrenfors, P. G.; Eriksson, T.; Sandstedt, C. S.; Sjöberg, G.: J. Intern. Med. **233**, 113 (1993)

364 Netter, P.; Bannwarth, B.; Lapicque, F.; Harrewyn, J.-M.; Frydman, A.; Tamisier, J.-N.; Gaucher, A.; Jean, R.: Clin. Pharmacol. Ther. **42**, 555 (1987)
365 Neuvonen, P. J.; Pohjola-Sintonen, S.; Tacke, U.; Vuori, E.: Lancet **342**, 1419 (1993)
366 Neuvonen, P. J.; Varhe, A.; Olkkola, K. T.: Clin. Pharmacol. Ther. **60**, 326 (1996)
367 Nichols, M. H.; King, W. D.; James, L. P.: Ann. Emerg. Med. **29**, 511 (1997)
368 Niebch, G.; Borbe, H. O.; Hummel, T.; Kobal, G.: Arzneim.-Forsch./ Drug Res. **42**, 1343 (1992)
369 Nielsen, J. C.; Bjerring, P.; Arendt-Nielsen, L.: Br. J. Clin. Pharmacol. **31**, 267 (1991)
370 Nilsen, O. G.: Clin. Pharmacokinet. **26**, 16 (1994)
371 N. N.: Bundesgesundhbl. **41** (6), 271 (1998)
372 N. N.: Bundesgesundhbl. **41** (6), 270 (1998)
373 Noble, S.; Balfour, J. A.: Drugs **51**, 424 (1996)
374 Nudelman, E.; Vinuela, L. M.; Cohen, C. I.: J. Clin. Psychiatry **59**, 433 (1998)
375 Nulman, I.; Berkeovitch, M.; Klein, J.; Pastuszak, A.; Lester, R. S.; Shear, N.; Koren, G.: J. Clin. Pharmacol. **38**, 926 (1998)
376 Ochs, H. R.; Gugler, R.: Internist **25**, 336 (1984)
377 Oellerich, M.; Armstrong, V. W.; Kahan, B.; Shaw, L.; Holt, D. W.; Yatscoff, R.; Lindholm, A.; Halloran, P.; Gallicano, K.; Wonigeit, K.; Schütz, E.; Schran, H.; Annesley, T.: Ther. Drug Monit. **17**, 642 (1995)
378 Oellerich, M.; Sybrecht, G. W.; Klein, H.: Internist **23**, 174 (1982)
379 Oertel, R.; Rahn, R.; Kirch, W.: Clin. Pharmacokinet. **33**, 417 (1997)
380 Öström, M.; Eriksson, A.; Throson, J.; Spigset, O.: Lancet **348**, 339 (1996)
381 Ohkubo, T.; Osanai, T.; Sugawara, K.; Ishida, M.; Otani, K.; Mihara, K.; Yasu N.: J. Pharm. Pharmacol. **47**, 340 (1995)
382 Ohlsson, A.; Lindgren, J.-E.; Wahlen, A.; Agurell, S.; Hollister, L. E.; Gillespie, H. K.: Clin. Pharmacol. Ther. **28**, 409 (1980)
383 Oikkonen, M.; Kärkelä, J.; Seppälä, T.: Eur. J. Clin. Pharmacol. **47**, 445 (1995)
384 Okonkwo, P. O.; Ogbuokiri, J. E.; Ofoegbu, E.; Klotz, U.: Clin. Pharmacol. Ther. **53**, 426 (1993)
385 Osselton, M. D.; Hammond, M. D.; Moffat, A. C.: J. Forensic Sci. Soc. **20**, 187 (1980)
386 Overo, K. F.: Eur. J. Clin. Pharmacol. **14**, 69 (1978)
387 Overo, K. F.: Prog. Neuropsychopharmacol. Biol. Psychiat. **6**, 311 (1982)
388 Overo, K. F.: Psychopharmacol. **86**, 253 (1985)
389 Paap, C. M.; Nahata, M. C.: DICP Ann. Pharmacother. **23**, 646 (1989)
390 Paintaid, G.; Alván, G.; Berninger, E.; Gustafsson, L. L.; Idrizbegovic, E.; Karlsson, K. K.; Wakelkamp, M.: Clin. Pharmacol. Ther. **55**, 317 (1994)
391 Pak, C. Y. C.; Sakhaee, K.; Rubin, C. D.; Zerwekh, J. E.: Am. J. Med. Sci. **313**, 23 (1997)
391a Palmer, R. B.; Alakiya, P.; Baca, J. E. C.; Nolte, K. B.: J. Forensic Sci. **44**, 851 (1999)
392 Pass, S. E.; Miyagawa, C. I.; Healy, D. P.; Ivey, T. D.: Ann. Pharmacother. **35**, 409 (2001)
393 Paterson, S. C.: Forensic Sci. Int. **27**, 129 (1985)
394 Pecar, A.; Lindner, W.; Mönch, V.; Münch, G.; Roos, R.: Krankenhauspharmazie **13**, 591 (1992)
395 Pentz, B.; Strubelt, O.; Gehlhoff, C.: Dt. Ärztebl. **43**, 2815 (1979)
396 Perel, J. M.: Clin. Chem. **34**, 881 (1988)
397 Perez-Reyes, M.; Jeffcoat, A. R.: Life Sci. **51**, 553 (1992)
398 Perucca, E.; Grimaldi, R.; Crema, A.: Clin. Pharmacokinet. **10**, 498 (1985)
399 Perruca, E.; Bialer, M.: Clin. Pharmacokinet. **31**, 29 (1996)
400 Peruche, B.; Schulz, M.: Pharm. Ztg. **141**, 1396 (1996)
401 Peruche, B.; Schulz, M.: Pharm. Ztg. **141**, 2920 (1996)
402 Peters, D. H.; Friedel, H. A.; McTavish, D.: Drugs **44**, 750 (1992)
403 Philbin, D. M.; Rosow, C. E.; Schneider, R. C.; Koski, G.; D'Ambra, M. N.: Anesthesiology **74**, 389 (1991)
404 Phillips, B. A.; Chrystyn, H.: Pharm. J. **247**, R18 (1991)
405 Pisano, P.; Durand, A.; Autret, E.; Desnuelle, C.; Pinsard, N.; Serrtrice, G.; Legout, V.; Jourbert, M.; Blin, O.: Eur. J. Clin. Pharmacol. **51**, 167 (1996)
406 Piscitelli, S. C.; Occhipinti, D. J.; Danziger, L. H.; Hill, C.; West, D. P.; Fischer, J. H.: Ann. Pharmacother. **27**, 1526 (1993)
407 Pitt, B.; Berry, H.: Postgrad. Med. J. **67**, 323 (1991)
407a Plomp, T. A.; Battista, H. J.; Unterdorfer, H.; van Ditmarsch, W. C.; Maes, R. A.: Arch. Toxicol. **48**, 245 (1981)
408 Pollak, P. T.; Zbuk, K.: Clin. Pharmacol. Ther. **68**, 92 (2000)
409 Pond, S. M.; Armstrong, J. G.; Hederson, A.: Lancet **342**, 687 (1993)
410 Poortman, A. J.; Lock, E.: Forensic Sci. Int. **100**, 221 (1999)
411 Porras, A. G.; Holland, S. D.; Gertz, B. J.: Clin. Pharmacokinet. **36**, 315 (1999)
412 Posner, J.; Bye, A.; Dean, K.; Peck, A. W.; Whiteman, P. D.: Eur. J. Clin. Pharmacol. **29**, 97 (1985)
413 Potkin, S. G.; Shen, Y.; Pardes, H.; Phelps, B. H.; Zhou, D.; Shu, L.; Korpi, E.; Wyatt, R. J.: Psychiatry Res. **12**, 167 (1984)
414 Pottier, J.; Cousty-Berlin, D.; Busigny, M.: Rheumatology **7**, 70 (1982)
415 Preskorn, S. H.; Fast, G. A.: J. Clin. Psychiatry **52** (Suppl. 6), 23 (1991)
416 Privitera, M. D.: Ann. Pharmacother. **27**, 1169 (1993)
417 Raber, J. H.; Shinar, C.; Finkelstein, S.: Ann. Pharmacother. **27**, 719 (1993)
418 Radwanski, E.; Holbert, J.; Symchowicz, S.; Zampaglione, N.: J. Clin. Pharmacol. **27**, 530 (1987)
419 Rambeck, B.; Wolf, P.: Clin. Pharmacokinet. **25**, 433 (1993)
420 Rathore, S. S.; Curtis, J. P.; Wang, Y.; Bristow, M. R.; Krumholz, H. M.: JAMA **289**, 871 (2003)
421 Rayner, C. R.; Galbraith, K. J.; Marriott, J. L.; Duncan, G. J.: Ann. Pharmacother. **36**, 1230 (2002)
422 Reeker, W.; Schneider, G.; Felgenhauer, N.; Tempel, G.; Kochs, E.: Dtsch. Med. Wochenschr. **125**, 249 (2000)
423 Regenthal, R.; Krüger, M.; Köppel, C.; Preiß, R.: Anästhesiol. Intensivmed. **40**, 129 (1999)
424 Reiter, P. D.; Stiles, A. D.: Ann. Pharmacother. **27**, 727 (1993)
425 Renshaw, P. F.; Guimaraes, A. R.; Fava, M.; Rosenbaum, J. F.; Pearlman, J. D.; Flood, J. G.; Puopolo, P. R.; Clancy, K.; Gonzalez, R. G.: Am. J. Psychiatry **149**, 1592 (1992)
426 Repetto, M. R.; Repetto, M.: Clin. Toxicol. **35**, 345 (1997)
427 Repetto, M. R.; Repetto, M.: Clin. Toxicol. **35**, 1 (1997)
428 Repetto, M. R.; Repetto, M.: Clin. Toxicol. **36**, 287 (1998)
429 Repetto, M. R.; Repetto, M.: Clin. Toxicol. **37**, 1 (1999)
430 Reuman, P. D.; Neiberger, R.; Kondor, D. A.: Pediatr. Infect. Dis. J. **11**, 132 (1992)
431 Rey, E.; Tréluyer, J.-M.; Pons, G.: Clin. Pharmacokinet. **36**, 409 (1999)
432 Richter, O.; Ern, B.; Reinhardt, D.; Becker, B.: Pediatr. Pharmacol. **3**, 329 (1983)
433 Riesselmann, B.; Rosenbaum, F.; Roscher, S.; Schneider, V.: Forensic Sci. Int. **103**, S49 (1999)
434 Rindone, J. R.; Sloane, E. P.: Ann. Pharmacother. **26**, 515 (1992)
435 Rochdi, M.; Sabouraud, A.; Baud, F. J.; Bismuth, C.; Scherrmann, J. M.: Hum. Exp. Toxicol. **11**, 510 (1992)
436 Rodvold, K. A.; Gotfried, M. H.; Danziger, L. H.; Servi, R. J.: Antimicrob. Agents Chemother. **41**, 1399 (1997)
437 Rodvold, K. A.: Clin. Pharmacokinet. **37**, 385 (1999)
438 Rogers, S. L.; Friedhoff, L. T.; and the Donepezil Study Group: Dementia **7**, 293 (1996)
439 Romano, M. J.; Gaylor, A.; Sang Jr., C. J.: Pharmacother. **22**, 766 (2002)
440 Rooney, M.; Massey, K. L.; Jamali, F.; Rosin, M.; Thomson, D.; Johnson, D. H.: J. Clin. Pharmacol. **36**, 760 (1996)
441 Roots, I.: Internist **27**, 40 (1986)
442 Rose, S. R.: Am. J. Hosp. Pharm. **51**, 3065 (1994)
443 Rosenkranz, B.; Frölich, J. C.: Dtsch. Ärztebl. **82**, B-1769 (1985)
443a Saito, T., Takeichi, S., Nakajima, Y.; Yukawa, N.; Osawa, M.: J. Anal. Toxicol. **21**, 584 (1997)
444 Saivin, S.; Hulot, T.; Chabac, S.; Potgieter, A.; Durbin, P.; Houin, G.: Clin. Pharmacokinet. **35**, 331 (1998)
445 Salazar, D. E.; Marathe, P. H.; Fulmor, I. E.; Lee, J. S.; Raymond, R. H.; Uderman, H. D.: J. Clin. Pharmacol. **35**, 1109 (1995)
446 Salkowski, A. A.; Penney, D. G.: Vet. Hum. Toxicol. **36**, 455 (1994)
447 Sanathanan, L. P.; Peck, C. C.: Controlled Clin. Trials **12**, 780 (1991)
448 Sanquer, S.; Breil, M.; Baron, C.; Dahmane, D.; Astier, A.; Lang, P.: Lancet **351**, 1557 (1998)
449 Sauro, S. C.; DeCarolis, D. D.; Pierpont, G. L.; Gornick, C. C.: Ann. Pharmacother. **36**, 1682 (2002)
450 Sawyer, C. A.; Baker, A. B.; Ramzan, I.; Regaglia, F.: J. Clin. Pharmacol. **38**, 160 (1998)
451 Schall, U.; Katta, T.; Pries, E.; Klöppel, A.; Gastpar, M.: Dt. Ärztebl. **91**, C-556 (1994)
452 Schaller, K.-H.; Angerer, H.; Lehnert, G.: Dt. Ärztebl. **90**, C-1430 (1993)
453 Schapel, G. J.; Beran, R. G.; Vajda, F. J. E.; Berkovic, S. F.; Mashford, M. L.; Dunagan, F. M.; Yuen, W. C.; Davies, G.: J. Neurol. Neurosurg. Psychiatry **56**, 448 (1993)
454 Schentag, J. J.; Nix, D. E.; Adelman, M. H.: DICP Ann. Pharmacother. **25**, 1050 (1991)
455 Schiødt, F. V.; Ott, P.; Christensen, E.; Bondesen, S.: Clin. Pharmacol. Ther. **71**, 221 (2002)
456 Schmid, I.; Paulweber, B.; Pechböck, W.; Oberkofler, H.; Patsch, W.: Toxichem. Krimtech. **67**, 96 (2000)
457 Schmidt, N.; Sittl, R.; Brune, K.; Geisslinger, G.: Pharm. Res. **10**, 441 (1993)

458 Schmoldt, A.; Schulz, M.; Frese, J. H.: In Bauer, G. (ed.): Gerichtsmedizin. Festschrift für Wilhelm Holczabek, p. 529, Franz Deuticke, Wien 1998
459 Schmoldt, A.; Iwersen, S.; Schlüter, W.: Clin. Toxicol. **35**, 405 (1997)
460 Scholz, J.; Bause, H.; Schulz, M.; Klotz, U.; Krishna, D. R.; Pohl, S.; Schulte am Esch, J.: Br. J. Clin. Pharmacol. **38**, 369 (1994)
461 Scholz, J.; Schulz, M.; Steinfath, M.; Höver, S.; Bause, H.: J. Mol. Med. **73**, 145 (1995)
462 Scholz, J.; Steinfath, M.; Schulz, M.: Clin. Pharmacokinet. **31**, 275 (1996)
463 Schulz, J.: Pharm. Ztg. **137**, 1626 (1992)
464 Schulz, M.; Schmoldt, A.: ZAC Zeitschr. antimikr. antineopl. Chemother. **10**, 33 (1992)
465 Schulz, M.; Schmoldt, A.; Donn, F.; Becker, H.: Eur. J. Clin. Pharmacol. **34**, 633 (1988)
466 Schulz, M.; Meyer, W.; Schmitz, W.; Scholz, J., Schmoldt, A.: Arzneimittelther. **7**, 169 (1989)
467 Schulz, M.; Schmoldt, A.: Pharmazie **49**, 614 (1994)
468 Schulz, M.; Schmoldt, A.: Anaesthesist **43**, 835 (1994)
469 Schulz, M.; Schmoldt, A.: Pharmazie **52**, 895 (1997)
470 Schulz, M.; Peruche, B.: Pharm. Ztg. **139**, 3346 (1994)
471 Schwab, M.; Oetzel, C.; Jägle, C.; Mörike, K.; Gleiter, C. H.; Eichelbaum, M.: Naunyn-Schmiedeberg's Arch. Pharmacol. **363** (Suppl.), R 132 (2001)
472 Schwietert, H. R.; Peeters, P. A. M.; Dingemanse, J.; Thiercelin, J.F.; Necciari, J.; de Bruin, H.; Jonkman, J. H. G.: Eur. J. Clin. Pharmacol. **51**, 175 (1996)
473 Scott, D. B.; Lee, A.; Fagan, D.: Anesth. Analg. **69**, 563 (1989)
474 Scott, L. J.; Goa, K. L.: Drugs **60**, 1095 (2000)
475 Shannon, M.: Ann. Intern. Med. **119**, 1161 (1993)
476 Shibata, N.; Kitamura, A.; Yoshikawa, Y.; Inoue, T.; Bamba, T.; Takada, K.: Pharm. Pharmacol. Commun. **6**, 501 (2000)
477 Shinn, A. F.: Drug Saf. **7**, 245 (1992)
477a Shrestha, M.; Hendrickson, R. G.; Henretig, F. M.: Clin Toxicol. **39**, 282 (2001)
478 Simons, F. E. R.; Bergman, J. N.; Watson, W. T. A.: J. Allergy Clin. Immunol. **98**, 1062 (1996)
479 Sindrup, S. H.; Gram, L. F.; Brosen, K.; Eshoj, O.; Mogensen, E. F.: Pain **42**, (1990)
480 Sindrup, S. H.; Grodum, E.; Gram, L. F.; Beck-Nielsen, H.: Ther. Drug. Monit. **13**, 408 (1991)
481 Singer, A. J.; Mofenson, H. C.; Caraccio, T. R.; Ilasi, J.: Clin. Toxicol. **32**, 577 (1994)
482 Singleton, M. A.; Rosen, J. I.; Fisher, D. M.: Can. J. Anaesth. **34**, 152 (1987)
483 Sivenius, J.; Kalviainen, R.; Ylinen, A.: Epilepsia **32**, 539 (1991)
484 Skeith, K. J.; Brocks, D. R.: Clin. Pharmacokinet. **26**, 233 (1994)
485 Slain, D.; Roger, P. D.; Cleary, J. D.; Chapman, S. W.: Ann. Pharmacother. **35**, 720 (2001)
486 Smialek, J. E.; Levine, B.; Chin, L.: J. Forensic. Sci. **39**, 159 (1994)
487 Smilkstein, M. J.; Douglas, D. R.; Daya, M. R.; Davie, A.; Whitcomb, D. C.; Cheung, L.; Meyer, K. C.: N. Engl. J. Med. **331**, 1310 (1994)
487a Snook, J.; Burrell-Boothman, D.; Watkins, J.; Colin-Jones, D.: Brit. J. Clin. Pract. **42**, 257 (1988)
488 Sommerburg, C.; Bauer, R.; Orfanos, C. E.; Petres, J.; Thiele, B.; Ulrich, R. E. H.: Dt. Dermatol. **42**, 1316 (1994)
489 Sonntag, O.: Arzneimittel-Interferenzen. Thieme, Stuttgart New York 1985
490 Spencer, C. M.; Goa, K. L.: Drugs **50**, 176 (1995)
491 Spector, R.; Park, G. D.; Johnson, G. F.; Vesell, E. S.: Clin. Pharmacol. Ther. **43**, 345 (1988)
492 Stanek, E. J.; Nelson, C. E.; DeNofrio, D.: Ann. Pharmacother. **31**, 853 (1997)
493 Stanley, T. H.; Bailey, P. L.: Anesthesiology **74**, 388 (1991)
494 Staß, H.; Peltola, H.; Kuhlmann, J.; Rahm, V.: Naunyn-Schmiedeberg's Arch. Pharmacol. **353** (Suppl.), R153 (1996)
495 Stead, A. H.; Moffat, A. C.: Hum. Toxicol. **3**, 437 (1983)
496 Stefan, H.: Dt. Ärztebl. **95**, C-2204 (1998)
496a Stein, S.; Schmoldt, A.; Schulz, M.: Forensic Sci. Int. **113**, 449 (2000)
497 Stein, U.; Steinecke, H.; Pragst, F.; Prügel, M.; Ulrich, P.; Gondro, T.: Toxichem. Krimtech. **66**, 129 (1999)
498 Steinecke, H.; Stein, U.; Lampe, J.; Kluge, S.; Hentschel, H.; Muth, G.: Toxichem. Krimtech. **66**, 100 (1999)
499 Steiner, J. F.: Clin. Pharmacokinet. **30**, 16 (1996)
499a Steentoft, A.; Worm, K.: J. Forensic Sci. Soc. **34**, 181 (1994)
500 Stewart, B. H.; Kugler, A. R.; Thompson, P. R.; Bockbrader, H. N.: Pharm. Res. **19**, 276 (1993)
501 Stimmel, G. L.; Dopheide, J. A.; Stahl, S. M.: Pharmacotherapy **17**, 10 (1997)
502 Stockis, A.; Deroubaix, X.; Jeanbaptiste, B.; Lins, R.; Allemon, A. M.; Laufen, H.: Arzneim.-Forsch./Drug. Res. **45**, 1009 (1995)
503 Stork, C. M.; Hoffman, R. S.: Clin. Toxicol. **32**, 583 (1994)
504 Stoschitzky, K.; Kahr, S.; Donnerer, J.; Schumacher, M.; Luha, O.; Maier, R.; Klein, W.; Lindner, W.: Clin. Pharmacol. Ther. **57**, 543 (1995)
505 Strehl, E.: Krankenhauspharm. **21**, 293 (2000)
506 Strenkoski-Nix, L. C.; Ermer, J.; DeCleene, S.; Cevallos, W.; Mayer, P. R.: Am. J. Health-Syst. Pharm. **57**, 1499 (2000)
507 Sturner, W. Q.; Garriott, J. C.: J. Forensic Sci. **17**, 440 (1972)
508 Sullivan, P.; Bekir, S.; Jaffar, Z.; Page, C.; Jeffery, P.; Costello, J.: Lancet **343**, 1006 (1994)
509 Sweet, R. A.; Pollock, B. G.; Kirshner, M.; Wright, B.; Altieri, L. P.; DeVane, C. L.: J. Clin. Pharmacol. **35**, 876 (1995)
510 Sweetman, S. C. (ed.): Martindale. The complete drug reference. 33rd ed., Pharmaceutical Press, London 2002
511 Takahara, S.; Kokado, Y.; Kameoka, H.; Takano, Y.; Jiang, H.; Moutabarrik, A.; Ishibashi, M.; Okuyama, A.; Sonoda,T: Transplant. Proc. **26**, 2106 (1994)
512 Tarbah, F. A.; Zweipfennig, P.; Pier, S.; Temme, O.; Daldrup, T.: Toxichem. Krimtech. **68**, 21 (2001)
513 Tegeder, I.; Bremer, F.; Oelkers, R.; Schüttler, J.; Brune, K.; Geisslinger, G.: Naunyn-Schmiedeberg's Arch. Pharmacol. **355** (Suppl.), R129 (1996)
514 Terhaag, B.; Grünert, A.; Richter, K.; Bahlmann, G.; Gloris, A.: Z. Klin. Med. **42**, 1463 (1987)
515 Terhaag, B.; Möbus, U.; Oertel, R.; Richter, K.; Feller, K.: medicamentum **2**, 40 (1992)
516 Terra, S. G.; Washam, J. B.; Dunham, G. D.; Gattis, W. A.: Pharmacotherapy **19**, 1123 (1999)
517 Theisohn, M.; Heimann, G.: Eur. J. Clin. Pharmacol. **22**, 545 (1982)
518 Thiermann, H.; Mast, U.; Eyer, P.; Hibler, A.; Pfab, R.; Felgenhauer, J.; Zilker, T.: Naunyn-Schmiedeberg's Arch. Pharmacol. **353** (Suppl.), R146 (1996)
519 Tomson, T.; Johannessen, S. I.: Eur. J. Clin. Pharmacol. **55**, 697 (2000)
520 Tonkin, A. L.; Bochner, F.: Clin. Pharmacokinet. **27**, 169 (1994)
520a Tracqui, A.; Kintz, P.; Ludes, B.: J. Anal. Toxicol. **22**, 430 (1998)
521 Traeger, S. M.; Haug III, M. T.: Clin. Toxicol. **24**, 329 (1986)
522 Troupin, A. S.; Montouris, G.; Hussein, G.: J. Epilepsy **10**, 26 (1997)
523 Tse, F. L. S.; Jaffe, J. M.: Eur. J. Clin. Pharmacol. **32**, 361 (1987)
524 Tune, L.; Coyle, J. T.: Arch. Gen. Psychiatry **37**, 293 (1980)
525 Ufkes, J. G. R.; de Vos, J. W.; Geerlings, P. J.; van Wilgenburg, H.: Pharm. World. Sci. **16** (Suppl.), D 6 (1994)
526 Ufkes, J. G. R.; de Vos, J. W.; van Brussel, G. H. A.: Pharm. World. Sci. **20**, 83 (1998)
527 Uges, D. R. A.: Pharm. Weekbl. **130**, 180 (1995)
528 Uges, D. R. A. (Ed.): Orientierende Angaben zu therapeutischen und toxischen Konzentrationen von Arzneimitteln und Giften in Blut, Serum oder Urin. VCH, Weinheim 1990, and: Therapeutic and Toxic Drug Concentration List. www.tiaft.org/members 'or' www.gtfch.org/intern, searched October 2002.
529 Ujhelyi, M. R.; Colucci, R. D.; Cummings, D. M.; Green, P. J.; Robert, S.; Vlasses, P. H.; Zarowitz, B. J.: DICP Ann. Pharmacother. **25**, 1047 (1991)
530 Ulrich, S.; Wurthmann, C.; Brosz, M.; Meyer, F. P.: Clin. Pharmacokinet. **34**, 227 (1998)
531 Ulrich, S.; Meyer, F. P.: Psychopharmakother. **6**, 100 (1999)
532 Ulrich, S.; Danos, P.; Müller, D.; Lehmann, D.; Leschinger, A.; Treuheit, T.-O.; Partscht, G.; Wolter, M.; Pester, U.: Eur. J. Clin. Pharmacol. **55** (3), A25 (1999)
533 Undre, N.; Möller, A.; The FK 506 European Study Group: Transpl. Int. **7** (Suppl. 1), S-15 (1994)
534 USP DI: Volume I – drug information for the health care professional, 23rd ed., US Pharmacopoeial Convention Inc., Micromedex Inc., Englewood 2003
535 Vale, J. A.; Proudfoot, A. T.: Lancet **346**, 547 (1995)
536 Vandenbrom, R. H. G.; Wierda, J. M. K. H.: Anesthesiology **69**, 996 (1988)
537 Vaughan Williams, E. M.: J. Clin. Pharmacol. **32**, 964 (1992)
538 Venkataramanan, R.; Lever, J.; Jain, A.; Burckart, G.; Flowers, J.; Warty, V.; Fung, J.; Todo, S.; Starzl, T.: Pharm. Res. **10** (Suppl.), S-390 (1993)
539 Venkataramanan, R.; Swaminathan, A.; Prasad, T.; Jain, A.; Zuckerman, S.; Warty, V.; McMichael, J.; Lever, J.; Burckart, G.; Starzl, T.: Clin. Pharmacokinet. **29**, 404 (1995)
540 Venkataramanan, R., Shaw, L. M.; Sarkozi, L.; Mullins, R.; Pirsch, J.; MacFarlane, G.; Scheller, D.; Ersfeld, D.; Frick, M.; Fitzsimmons, W. E.; Virji, M.; Jain, A.; Braymann, K. L.; Shaked, A.: J. Clin. Pharmacol. **41**, 542 (2001)
541 Wada, D. R.; Mandema, J. W.: Pharm. Res. **11** (Suppl.), S-424 (1994)
542 Wagner, M. L.: Am. J. Hosp. Pharm. **51**, 1657 (1994)
543 Wallemacq, P. E.; Verbeeck, R., K.: Clin. Pharmacokinet. **40**, 283 (2001)

544 Walsh, S. L.; Preston, K. L.; Stitzer, M. L.; Cone, E. J.; Bigelow, G. E.: Clin. Pharmacol. Ther. **55**, 569 (1994)
545 Wang, G. Z.; Maranelli, G.; Perbellini, L.: Int. Arch. Occup. Environ. Health **65**, 285 (1994)
546 Wang, S.; Schram, I. M.; Sund, R. B.: Eur. J. Pharm. Sci. **3**, 231 (1995)
547 Watling, S. M.; Kisor, D. F.: Ann. Pharmacother. **27**, 151 (1993)
548 Watson, J. E.; Tagupa, E. T.: Ann. Pharmacother. **28**, 467 (1994)
549 Weise, M.: Toxichem. Krimtech. **68**, 38 (2001)
550 Wells, T. G.; Young, R. A.; Kearns, G. L.: Drug Saf. **7**, 135 (1992)
551 Welty, T. E.; Copa, A. K.: Ann. Pharmacother. **28**, 1335 (1994)
552 von Werder, K.; Schulz, M.: Prophylaxe und Therapie der Osteoporose, p. 100, WVG, Stuttgart 1991
553 Wessel, T.; Unger, W.; Wilhelms, E.: Krankenhauspharm. **17**, 335 (1996)
554 White, M. C.; De Silva, P.; Havard, C. W. H.: Neurology **31**, 145 (1981)
555 White, R. H.; Zhou, H.; Romano, P.; Mungall, D.: Clin. Pharmacol. Ther. **58**, 588 (1995)
556 White, S.; Wong, H. Y.: Clin. Chem. **44**, 1110 (1998)
557 Wildsmith, J. A. W.; Tucker, G. T.; Cooper, S.; Scott, D. B.; Covino, B. G.: Br. J. Anaesth. **49**, 461 (1977)
558 Wilimzig, C.; Latz, R.; Vierling, W.; Mutschler, E.; Trnovec, T.; Nyulassy, S.: Eur. J. Clin. Pharmacol. **49**, 317 (1996)
559 Williams, N. E.; Calvey, T. N.; Chan, K.: Br. J. Anaesth. **55**, 27 (1983)
560 Willkens, R. F.: Drugs **40** (Suppl. 5), 34 (1990)
561 Wilson, A. P. R.: Clin. Pharmacokinet. **39**, 167 (2000)
562 Wilson, E. A.; Sills, G. J.; Forrest, G.; Brodie, M. J.: Epilepsy Res. **29**, 161 (1998)
563 Winek, C.; Wahba, W.; Jannssen, J.; Rozin, L.: Forensic Sci. Int. **78**, 165 (1996)
564 Winkler, M.; Christians, U.: Drug Safety **12**, 348 (1995)
565 Winchell, G. A.; King, J. D.; Chavez-Eng, C. M.; Constanzer, M. L.; Korn, S. H.: J. Clin. Pharmacol. **42**, 61 (2002)
566 Woosley, R. L.; Chen, Y.; Freiman, J. P.; Gillis, R. A.: JAMA **269**, 1532 (1993)
567 Wu, F.; Razzaghi, A.; Souney, P. F.: Pharmacotherapy **13**, 72 (1993)
568 Xu, Z.-X.; Naadimuthu, A.; Lockwood, G.; Berger, B.; Maier, G.; Dukivic, D.: Pharm. Res. **11** (Suppl.), S-334 (1994)
569 Yerasi, A. B.; Butts, J. D.; Butts, J. D.: Am. J. Health-Syst. Pharm. **54**, 85 (1997)
570 Yoshimoto, K.; Saima, S.; Echizen, H.; Nakamura, Y.; Kondo, T.; Yagishita, Y.; Ishizaki, T.: Clin. Pharmacol. Ther. **55**, 693 (1994)
571 Zaleon, C. R.; Guthrie, S. K.: Am. J. Hosp. Pharm. **51**, 2917 (1994)
572 Zeugin, T.; Zysset, T.; Cotting, J.: Ther. Drug Monit. **12**, 187 (1990)
573 Zettinig, G.; Watzinger, N.; Eber, B.; Henning, G.; Klein, W.: Dtsch. Med. Wochenschr. **122**, 1489 (1997)
574 Zhao, J. J.; Rogers, J. D.; Holland, S. D.; Larson, P.; Amin, R. D.; Haesen, R.; Freeman, A.; Seiberling, M.; Merz, M.; Cheng, H.: Biopharm. Drug. Dispos. **18**, 769 (1997)
575 Zhong, D.; Blume, H.: Pharmazie **49**, 736 (1994)
576 Zimmerman, J. J.; Kahan, B. D.: J. Clin. Pharmacol. **37**, 405 (1997)