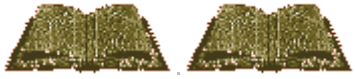
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Technical Books Section



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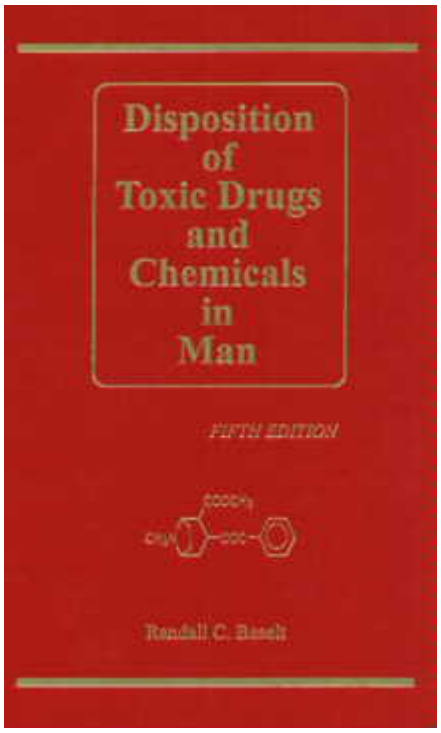
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THE FATE OF TOXIC DRUGS

Disposition of Toxic Drugs and Chemicals in Man 5th Edition *by* Randall C. Baselt. Hard Bound, 7" x 10"
Chemical Toxicology Institute, P.O. Box 8209, Foster City, California 94404. Publication Date 2000; xvi + 919 pages: ISBN 0-9626523-3-4: Library of Congress Catalog Card No. 99-72382: Hardback edition, 2001: Price $119.00

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The single most important thing a toxicologist requires in his day-to-day life is a reliable data source on all drugs, poisons and toxins. Very frequently I have been called in an Emergency room, and asked to opine in the case of a patient, who has ingested, say, twenty tablets of Amitryptine. What is the fatal dose of Amitryptiline? What is going to be the fate of this drug in the body? What are its metabolites, and how can we test for them? What tests need to be conducted to know to know if the patient is in danger or not? What blood concentration is fatal, and which is the safe limit? These and several similar questions need to be answered before any meaningful advice can be given in such cases.

View this book on Amazon

Randall C. Baselt, the author

Dr. Randall C. Baselt is an analytical toxicologist with 35 years experience in forensic, clinical and industrial toxicology. For more information about him, the linked page (page003).

The book under review serves this purpose beautifully well. Written in an A-Z dictionary style, this book deals with as many as 483 substances, ranging from Acebutolol (a beta-adrenoceptor antagonist used in the treatment of hypertension) to Zopiclone (a hypnotic agent). Each substance is dealt with in a separate section. The book is in its fifth edition now. It is interesting to note that in the first edition, which appeared some 22 years before, less than 200 substances were dealt with. But the work has proved so popular, that editions after editions appeared, and in each edition, the authors increased the amount of information. Robert Cravey, a forensic Toxicologist joined as a co-author in the third edition. But Cravey has since retired, so the current edition appears under the single authorship of Randall C. Baselt.

Table 1: List of drugs/Substances/Poisons dealt with in this book (Cont'd in table 2)

1. Acebutolol	51. Bromazepam	101. Cimetidine
2. Acetaldehyde	52. Bromide	102. Citalopram
3. Acetaminophen	53. Brompheniramine	103. Clenbuterol
4. Acetohexamide	54. Buflomedil	104. Clobazam

5. Acetone
6. Acetonitrile
7. Acetylmethadol
8. Acetylsalicylic Acid
9. Acrylonitrile
10. Albuterol
11. Aldrin
12. Alfentanil
13. Alphaprodine
14. Alprazolam
15. Alprenolol
16. Aluminum
17. Amantadine
18. Amikacin
19. Amiodarone
20. Amitriptyline
21. Amlodipine
22. Amobarbital
23. Amoxapine
24. Amphetamine
25. Amygdalin
26. Anileridine
27. Aniline
28. Antimony
29. Antipyrine
30. Aprobarbital
31. Arsenic
32. Astemizole
33. Atenolol
34. Atracurium
35. Atropine
36. Azide
37. Baclofen
38. Barbital
39. Barium
40. Benzene
41. Benzidine
42. Benzonatate
43. Benzphetamine
44. Benztropine
45. Benzyl Alcohol
46. Beryllium
47. Betaxolol
48. Biperiden
49. Bismuth
55. Buformin
56. Bupivacaine
57. Buprenorphine
58. Bupropion
59. Buspirone
60. Butabarbital
61. Butalbital
62. Butane
63. Butaperazine
64. Butethal
65. Butorphanol
66. Butyl Nitrite
67. Cadmium
68. Caffeine
69. Camphor
70. Captopril
71. Carbamazepine
72. Carbaryl
73. Carbon Disulfide
74. Carbon Monoxide
75. Carbon Tetrachloride
76. Carbromal
77. Carisoprodol
78. Cathinone
79. Cetirizine
80. Chloral Hydrate
81. Chloramphenicol
82. Chlordane
83. Chlordecone
84. Chlordiazepoxide
85. Chlormethiazole
86. Chlormezanone
87. Chlorobenzene
88. Chloroform
89. Chloroprocaine
90. Chlorquine
91. Chlorothiazide
92. Chlorphenesin Carbamate
93. Chlorpheniramine
94. Chlorphentermine
95. Chlorpromazine
96. Chlorpropamide
97. Chlorprothixene
98. Chlorpyrifos
105. Clomipramine
106. Clonazepam
107. Clonidine
108. Clorazepate
109. Clozapine
110. Cobalt
111. Cocaine
112. Codeine
113. Colchicine
114. Copper
115. Cresol
116. Cumene
117. Cyanide
118. Cyclizine
119. Cyclobenzaprine
120. Cyclohexane
121. Cyclopropane
122. Cyclosporine
123. Cyproheptadine
124. Dantrolene
125. DDT
126. Desipramine
127. Dexfenfluramine
128. Dextromethorphan
129. Dextromoramide
130. Diazepam
131. Diazinon
132. Dibenzepine
133. Dibucaine
134. p-Dichlorobenzene
135. Dichloromethane
136. 2,4-Dichlorophenoxy acetic Acid
137. Diclofenac
138. Dicumarol
139. Dicyclomine
140. Dieldrin
141. Diethylpropion
142. Diethyltoluamide
143. Diflunisal
144. Digitoxin
145. Digoxin
146. Dihydrocodeine
147. Diltiazem
148. Dimethylformamide

50. Borate	99. Chlorzoxazone	149. Dimethylsulfoxide
	100. Chromium	150. Dimethyltryptamine

Open the book anywhere, and you would find all data pertaining to a particular drug neatly divided into five sub-headings: (i) Occurrence and Usage (ii) Blood concentrations (iii) Metabolism and excretion (iv) Toxicity and (v) Analysis. In addition, there are a number of useful references at the end of each section. In the beginning of each section, important information pertaining to that drug is given. These include the half life of the drug in plasma (T½), Volume of Distribution (V_d), Fraction bound to Plasma proteins (F_b) and Dissociation constant (Pka). The structure of the drug is also given which is very helpful. I tried finding several drugs and poisons which interested me, and the book never failed me. Strychnine is a very commonly talked about poison in India, and I was very curious to know if this poison is dealt with in this book. Sure enough I found detailed information on this poison on page 790. In a jiffy, I could get to know its exact structure, its volume of distribution (which by the way is 13 L/kg), its half life and its pKa. In some cases, (as in the case of strychnine), certain data are not known, and the author rightly uses the "?" mark to denote this. For instance, in the case of strychnine, the portion bound to plasma proteins (F_b) is not known, and the author denotes it like this: "F_b:?". This could perhaps spur on toxicologists looking for new subjects to start investigation on.

The first sub-title in each section is "Occurrence and Usage". Under this sub-title, the author tells us where the drug comes from and how is it used. This gives a very good "handle" to the reader to get some grasp on the subject. For instance, in the case of Strychnine, we are told that it comes from the seed of Strychnos nux-vomica, and is still used in certain countries as a tonic to improve circulation and muscle tone. I tried many exotic sounding names in this book, and every time got sound information which helped me "understand" the drug to go further on. What for instance is Tramadol, and how it is used? Well, it is a synthetic opioid-receptor agonist that has been used clinically as a narcotic analgesic since 1977. What is 4,4'-Methylenebis(2-chloroaniline)? Also known as MOCA, this substance is used as a curing agent for epoxy resins and isocyanate polymers. This substance, although solid at room temperatures, may be absorbed following inhalation or dermal contact.

Table 2: List of drugs/Substances/Poisons dealt with in this book (Cont'd from table 1)

151. Dinitro-o-Cresol	201. Fluoxetine	251. Lidocaine
152. Dioxane	202. Fluphenazine	252. Lindane
153. Dioxin	203. Flurazepam	253. Lisinopril
154. Diphenhydramine	204. Flurbiprofen	254. Lithium
155. Diphenoxylate	205. Flvoxamine.	255. Loperamide
156. Diquat	206. Formaldehyde	256. Loratadine
157. Disopyramide	207. Gabapentin	257. Lorazepam
158. Disulfiram	208. Gamma-Hydroxybutyrate	258. Loxapine
159. Dothiepin	209. Gasoline	259. Lysergic Acid Diethylamide (LSD)
160. Doxapram	210. Gentamicin	260. Magnesium
161. Doxepin	211. Glutethimide	261. Malathion
162. Doxylamine	212. Glycopyrrolate	262. Manganese
163. Dyphylline	213. Gold	263. Maprotiline
164. Emetine		

165. Enalapril
166. Encainide
167. Endrin
168. Enflurane
169. Ephedrine
170. Epinephrine
171. Esmolol
172. Estazolam
173. Ethanol
174. Ethchlorvynol
175. Ether
176. Ethinamate
177. Ethosuximide
178. Ethotoin
179. Ethylbenzene
180. Ethyl Chloride
181. Ethylene Glycol
182. Ethylene Oxide
183. Etidocaine
184. Etodolac
185. Etorphine
186. Famotidine
187. Famprofazone
188. Felbamate
189. Felodipine
190. Fenfluramine
191. Fenoprofen
192. Fentanyl
193. Fexofenadine
194. Flecainide
195. Flumazenil
196. Flunitrazepam
197. Fluoride
198. Fluoroacetate
199. Fluorocarbons
200. 5-Fluorouracil .

214. Guaifenesin
215. Halazepam
216. Haloperidol
217. Halothane
218. Heparin
219. Heroin
220. Hexachlorobenzene
221. Hexachlorophene
222. Hexane
223. Hydralazine
224. Hydrochlorothiazide
225. Hydrocodone
226. Hydrogen Sulfide
227. Hydromorphone
228. Hydroxychloroquine
229. Hydroxyzine
230. Ibogaine
231. Ibuprofen
232. Imipramine
233. Indomethacin
234. Insulin
235. Iron
236. Isoflurane
237. Isoniazid
238. Isopropanol
239. Isoproterenol
240. Isosorbide Dinitrate
241. Kanamycin
242. Kerosene
243. Ketamine
244. Ketobemidone
245. Ketoprofen
246. Ketorolac
247. Labetalol
248. Lamotrigine
249. Lead
250. Levorphanol

264. MBDB
265. Medazepam
266. Mefenamic Acid
267. Melatonin
268. Meperidine
269. Mephenytoin
270. Mephobarbital
271. Mepivacaine
272. Meprobamate
273. Mercury
274. Mescaline
275. Mesoridazine
276. Metaldehyde
277. Metformin
278. Methadone
279. d-Methamphetamine
280. l-Methamphetamine
281. Methanol
282. Methapyrilene
283. Methaqualone
284. Metharbital
285. Methocarbamol
286. Methohexital
287. Methomyl
288. Methotrexate
289. Methotrimeprazine
290. p-Methoxy amphetamine
291. Methoxyflurane
292. Methsuximide
293. Methyl Bromide
294. Methyl n-Butyl Ketone
295. Methyl Chloride
296. Methyldopa
297. 4,4'-Methylenebis (2-chloroaniline)
298. Methylenedioxy amphetamine
299. Methylenedioxy ethylamphetamine
300. Methylenedioxy methamphetamine

The second sub-title in each section is "Blood concentrations". Under this heading the author gives us the various blood concentrations under various different conditions. The figures are basically a summarization of various studies, the author has painstakingly collected from literature. Not only

does he give you the result of the study, but he actually quotes that study, so if the results have intrigued you, you can always go back to the original paper, and dig out more information. Essentially what he does is to separate "chaff from the grain", and give you only the latter. Sample this in the section on d-Methamphetamine: A single oral dose of 0.125 mg/kg produces a peak plasma concentration of 0.020 mg/L at 3.6 hours. This is just one study by Cook et al. published in 1992. But surely this is not the only study related to d-Methamphetamine. Baselt goes ahead and gives you a number of other studies with results. For instance, in another study published in 1996 by Shappell et.al, a 30 mg oral dose produced an average peak serum methamphetamine concentration of 0.094 mg/L at times of 3-5 hours. If you are facing a case of d-Methamphetamine overdose, or if you are planning to conduct research on this drug, these figures are going to be of much help to you.

I was attracted by certain non-conventional poisons. Carbon monoxide, for instance, is a gas, and I wanted to know what the author had to offer us under this section. The first thing I realized was that the values V_d and F_b were unknown for Carbon Monoxide, because both had a question mark in front of them. The plasma half life is 4-5 hours. In the Title "Occurrence and Usage", we are told about the common sources (cigarette smoke, automobile exhaust etc), along with the concentration in each. Some interesting figures are offered under the sub-title "Blood concentrations". Carbon-monoxide is actually produced endogenously by the catabolism of heme at an average rate of 0.4 mL/hour in resting male subjects. This gives a blood concentration of about 0.4-0.7%. Non-smokers living in perfectly clean surroundings must thus have this as their minimum blood concentration. However urban non-smokers smell carbon monoxide through automobile exhausts too, and their concentration is around 1-2%. Smokers have a concentration of about 5-6%.

The third sub-title is quite interesting and tells us about "Metabolism and excretion". How is the drug metabolized in the body? What are its various metabolic products? How is it excreted? These and many other similar questions are dealt with in this section. We all know about the metabolism and excretion of methyl and ethyl alcohol, but how is benzyl alcohol metabolized? Well, the book comes to your rescue; it is rapidly metabolized to benzoic acid which is conjugated with glycine to form hippuric acid, which is excreted in urine. Try some exotic sounding drugs, and the book will not fail you. How is, say, Methyl n-Butyl Ketone (used as a solvent for plastic resins, inks and various cleaning agents) metabolized and excreted? Well, it is metabolized to 2-hexanol, 5-hydroxy-2-hexanone, 2,5-hexanedione, and carbon dioxide! Studies have been quoted where humans were given a labeled oral dose of this compound. It was found that 40% was excreted as carbon-dioxide in breath and 26% as metabolites in urine over an 8 day period.

Table 3: List of drugs/Substances/Poisons dealt with in this book (Cont'd from table 2)

301. Methyl Ethyl Ketone	351. Paraldehyde	401. Propylene Glycol
302. Methylfentanyl	352. Paraquat	402. Propylhexedrine
303. Methylphenidate	353. Parathion	403. Protriptyline
304. Methyl Salicylate	354. Paroxetine	404. Pseudoephedrine
305. Methyprylon	355. Pemoline	405. Psilocybin
306. Metoclopramide	356. Pentachlorophenol	406. Pyrilamine
307. Metoprolol	357. Pentazocine	407. Quazepam
308. Mexiletine	358. Pentobarbital	408. Quetiapine
309. Mianserin	359. Pentoxifylline	409. Quinidine
310. Midazolam	360. Perphenazine	410. Quinine

311. Mirtazapine
312. Moclobemide
313. Modafinil
314. Molindone
315. Moricizine
316. Morphine
317. Nabumetone
318. Nadolol
319. Nalbuphine
320. Naloxone
321. Naltrexoe
322. Naproxen
323. Nefazodone
324. Nicardipine
325. Nickel
326. Nickel Carbonyl
327. Nicotine
328. Nifedipine
329. Nimodipine
330. Nisoldipine
331. Nitrazepam
332. Nitrite
333. Nitrobenzene
334. Nitroglycerin
335. Nitroprusside
336. Nitrous Oxide
337. Nomifensine
338. Nortriptyline
339. Olanzapine
340. Omeprazole
341. Ondansetron
342. Orphenadrine
343. Oxalate
344. Oxazepam
345. Oxprenolol
346. Oxycodone
347. Oxymorphone
348. Oxyphenbutazone
349. Pancuronium
350. Papaverine
361. Phenacetin
362. Phencyclidine (PCP)
363. Phendimetrazine
364. Phenelzine
365. Phenethylamine
366. Phenfonnin
367. Pheniramine
368. Phenmetrazine
369. Phenobarbital
370. Phenol
371. Phensuximide
372. Phentermine
373. Phenylbutazone
374. Phenylephrine
375. Phenylpropanolamine
376. Phenytoin
377. Pholcodine
378. Phosphine
379. Pimozide
380. Pindolol
381. Piroxicam
382. Platinum
383. Polybrominated Biphenyls
384. Polychlorinated Biphenyls
385. Potassium
386. Prazepam
387. Prazosin
388. Prilocaine
389. Primaquine
390. Primidone
391. Procainamide
392. Procaine
393. Prochlorperazine
394. Procyclidine
395. Promethazine
396. Propafenone
397. Propane
398. Propofol
399. Propoxyphene
400. Propranolol
411. Ranitidine
412. Remifentanil
413. Remoxipride
414. Risperidone
415. Salicylamide
416. Scopolamine
417. Secobarbital
418. Selegiline
419. Selenium
420. Sertindole
421. Sertraline
422. Sevoflurane
423. Sibutramine
424. Sildenafil
425. Silver
426. Sotalol
427. Strychnine
428. Styrene
429. Succinylcholine
430. Sufentanil
431. Sulindac
432. Sulpiride
433. Sumatriptan
434. Temazepam
435. Terbutaline
436. Terfenadine
437. Tetrachloroethylene
438. Tetraethyllead
439. Tetrahydrocannabino1
440. Thallium
441. Theophylline
442. Thiopental
443. Thioridazine
444. Thiothixene
445. Timolol
446. Tin
447. Tobramycin
448. Tocainide
449. Tolbutamide
450. Tolmetin

The fourth sub-title is on "Toxicity". What are the adverse reactions to a drug? How much drug could prove fatal to a human being? Questions like these are dealt with under this sub-title. What is the fatal dose of Nitrazepam, a drug commonly used as a hypnotic agent in a dose of about 10mg. Several studies are quoted, and we are told that about 250 mg should be the fatal dose (or about 25 tablets. This gives important insights to the doctor and the toxicologist). Also given are the

concentrations in various organs when the fatal dose is ingested. This is helpful to forensic pathologists, who want to know how the person has actually died. In the current case, we are told that the blood concentrations in a fatal case range from 1.2-9.0 mg/L, liver concentrations range from 0.7-4.0 mg/kg, and urine concentrations from 1-10 mg/L. We are also told that with this particular drug, post-mortem redistribution does not occur.

The final sub-title is "Analysis". Under this heading we are told the various methods employed to analyze that particular drug or poison. You could be faced with a case of a very strange substance, say, Phensuximide (an anticonvulsant succinimide derivative). How are you going to analyze the drug? This book comes to your rescue again. It is done by fluorometric method, and by gas chromatography of the underivatized drug by flame-ionization.

There is a big "Reference" sub-heading at the final part of each section, under which all references quoted in the section are given. The reader could go back to these references if he needs to delve more in a particular toxic substance of his interest. Thus the book serves as a good collection of important references too.

I was very curious to know about certain tradition poisons - tetrahydrocannabinol, morphine, Khat - and every time I delved in the book for these poisons, I emerged with interesting information. Khat, for instance, contains Cathinone, which is structurally and pharmacologically related to amphetamine. Khat (*Catha edulis*) is an ever green shrub, cultivated in East Africa and on the Arabian peninsula. Khat chewing, in several countries, is a social event and the user may consume 100-200 g of leaves over a 3-4 hour period. Chronic abusers may develop psychiatric symptoms such as paranoid psychoses.

Table 4: List of drugs/Substances/Poisons dealt with in this book (Cont'd from table 3)

451. Toluene	462. Tripelennamine	473. Xylene
452. Tramadol	463. Tubocurarine	474. Yohimbine
453. Tranylcypromine	464. Valproic Acid	475. Zidovudine
454. Trazodone	465. Vanadium	476. Zileuton
455. Triazolam	466. Vancomycin	477. Zimelidine
456. Trichloroethane	467. Venlafaxine	478. Zinc
457. Trichloroethylene	468. Verapamil	479. Zipeprol
458. 2,4,5-Trichloro phenoxyacetic acid	469. Vigabatrin	480. Zolmitriptan
459. Trifluoperazine	470. Vinyl Chloride	481. Zolpidem
460. Trihexyphenidyl	471. Warfarin	482. Zomepirac
461. Trimipramine	472. Xylazine	483. Zopiclone

I searched for some exotic poisons, and I found some amazing substances. Gold for example is given in detail as a toxic substance. Monovalent gold compounds are used in the treatment of rheumatoid arthritis. Side effects may include dermatitis and nephrotic syndrome. A person even died after gold injections given over a period of 6 days. The details of his tissue concentrations are given. He was found to have a concentration of 0.4 mg/L of gold in his blood, 2.6 mg/kg in his liver, 0.7 mg/kg in his spleen, 15.7 mg/kg in the kidney cortex and 11.0 mg/kg in the kidney medulla. Quite rare figures, but very useful, if you are dealing with a case of gold poisoning. Not many toxicology books would enlighten you on these poisons.

How would I rate this book? In one word, superb! This is going to be the single most important book in my toxicology library. I would heartily recommend this book to anyone who has anything to do with toxicology. Should be most useful to clinicians, pharmacologists, pharmacists, forensic pathologists, researchers, crime investigators, and any one who is interested in the science of drugs and poisons. The value of the book is enhanced because it deals with a multitude of drugs and poisons, which are not found in other regular texts.

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