

Clinical Metal Toxicology

Fifteenth edition

AUGUST 2020

By Peter J. VanDerSchaar MD, PhD

Contributors to this book are:

Lillian Ko, MD

Raymond Pahlplatz, MD

Hasnain Patel, MD

Carin S. Smit, D.Emed.

W.W. VanDerSchaar, PhD

K. Dam, MD

For comments and inquiries

International Board of Clinical Metal Toxicology

P.J.VanDerSchaar

Renheide 2

Leende 5595XJ, The Netherlands

pjvanderschaar@gmail.com

Fifteenth edition: August 2020

Copyright © September 2005

All rights reserved.

No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, recording or any information storage and retrieval system, without permission in writing from the authors.

...maledicta societas contra pharmacopolas circumforaneas...

1 CONTENTS

1	CONTENTS	5
2	PREFACE.....	25
3	WHAT IS METAL AND WHY CAN IT BE TOXIC.....	27
3-1	Periodic Table of the Elements	27
3-1.1	Groups	28
3-2	Mechanisms of toxicity	30
3-2.1	Mimicry	30
3-2.2	Oxidative damage.....	30
3-2.3	Protein adducts in biological systems	30
3-3	Exposure	30
3-3.1	Markers of Exposure	31
3-3.2	Adaptation	31
3-3.3	Sequestration, inclusion bodies.....	31
3-3.4	Metal transport by proteins.....	31
3-3.5	Specific metal-binding proteins	31
3-4	Metals in the treatment of disease	32
3-5	Definitions	32
4	HISTORY OF CHELATING AGENTS	37
4-1	Ancient use of toxic metals	37
4-2	The use of toxic metals with the purpose of poisoning human adversaries	38
4-3	EDTA.....	39
4-3.1	First clinical application.....	39
4-3.2	EDTA and calcium.....	39
4-3.3	Clinical acceptance of EDTA.....	40
4-3.4	The structured denial of EDTA.....	41
4-3.5	The first symposia on EDTA chelation therapy	41
4-3.6	Other developments in EDTA chelation therapy	41
4-4	Organisations.....	42
4-5	Attacks	42
4-6	The Netherlands	43
4-7	The present situation concerning to EDTA	43
4-7.1	The TACT Study.....	44
4-8	IBCMT	45
5	A CHEMISTRY REFRESHER	47
5-1	Reactive oxygen species (ROS).....	52
5-1.1	How reactive oxygen species are formed	52
5-1.2	Types of reactive oxygen species	53
5-1.2.1	Superoxide anion radical ($\bullet\text{O}_2^-$)	53
5-1.2.2	Hydrogen peroxide (H_2O_2)	54
5-1.2.3	Hydroxyl radical ($\bullet\text{OH}$).....	54
5-1.3	Inorganic and Organic	55
5-1.3.1	Nitric oxide (NO)	55
5-1.3.2	Singlet oxygen (IO_2)	55
5-1.3.3	Ozone (O_3).....	56
5-2	Radiation	56
5-2.1	Units used in radiation measurements	56
5-2.1.1	Curie [Ci].....	56
5-2.1.2	Becquerel [Bq]	56
5-2.1.3	Gray [Gy].....	57
5-2.1.4	Q values.....	58
5-2.1.5	REM [rem].....	58
5-2.1.6	Sievert [Sv].....	59
5-2.1.7	Rad [rad]	60
5-2.1.8	SI multipliers	60

5-2.2	Radiation poisoning	60
5-2.2.1	Measuring radiation dosage.....	61
5-2.2.2	Acute (short-term) vs chronic (long-term) effects	61
5-2.3	Exposure levels and symptoms	61
5-3	Chelation and detoxification	64
5-3.1	Chelation	64
5-3.2	Detoxification.....	65
5-3.1.1	Cytochrome P450	65
5-3.1.2	Phase I.....	66
5-3.1.3	Phase II.....	67
5-4	Lipid before peroxidation	68
5-5	Detoxifying properties of the human body.....	68
5-5.1	Glutathione S-transferase	68
5-6	Overview of Reactive Oxygen Species interplay	69
5-7	Overview of phase 1 and 2.....	70
6	TOXIC METALS	71
6-1	General considerations	71
6-2	Arsenic (As).....	72
6-2.1	Sources	73
6-2.2	Biochemistry.....	73
6-2.3	Arsenic and cancer	74
6-2.4	Medical history	74
6-2.5	Clinical Signs and Symptoms	75
6-2.5.1	Acute poisoning	75
6-2.5.2	Chronic poisoning	76
6-2.6	Diagnosis	77
6-2.7	Treatment.....	77
6-2.8	Chelating agents for Arsenic.....	78
6-3	Beryllium (Be).....	78
6-3.1	Sources	78
6-3.2	Biochemistry.....	79
6-3.3	Toxicity	79
6-3.4	Chelating agents for beryllium	81
6-4	Cadmium (Cd)	81
6-4.1	Source.....	81
6-4.2	Biochemistry.....	82
6-4.3	Toxicity	83
6-4.3.1	Symptoms of acute intoxication	84
6-4.3.2	Symptoms of chronic exposure.....	85
6-4.4	Treatment.....	85
6-4.5	Laboratory analysis	86
6-4.6	Chelating agents for cadmium	87
6-5	Chromium(Cr).....	87
6-5.1	Source.....	88
6-5.2	Biochemistry.....	88
6-5.3	Toxicity	89
6-5.4	Symptoms of chromium poisoning.....	90
6-5.4.1	Acute toxicity.....	90
6-5.4.2	Chronic toxicity	91
6-5.5	Therapeutic considerations.....	94
6-5.5.1	Acute severe intoxication.....	94
6-5.5.2	Chronic intoxication.....	95
6-5.6	Therapeutic applications of chromium	95
6-5.7	Chelating agents for chromium	95
6-6	Lead (Pb).....	96
6-6.1	Source.....	96
6-6.2	Biochemistry.....	97
6-6.3	Toxicity	98
6-6.4	Clinical signs and symptoms.....	101
6-6.4.1	Mild symptoms	101
6-6.4.2	Symptoms of acute intoxication	102

6-6.5	Laboratory analysis	103
6-6.5.1	Blood.....	103
6-6.5.2	Low-level chronic exposure.....	103
6-6.5.3	Interpreting lead analysis results.....	103
6-6.6	Therapeutic considerations	104
6-6.7	Chelating agents for lead.....	104
6-7	Mercury	105
6-7.1	Sources.....	105
6-7.2	Ecotoxicology	106
6-7.3	Biochemistry	107
6-7.4	Mercury compounds	109
6-7.4.1	Amalgam.....	109
6-7.5.2	Methylmercury.....	110
6-7.4.3	Ethylmercury	110
6-7.4.4	Thiomersal	110
6-7.4	Laboratory analysis	112
6-7.5	Symptoms of acute toxicity.....	113
6-7.6	Chronic mercury poisoning.....	113
6-7.7	Therapeutic considerations	114
6-7.8	Chelating agents for mercury	114
6-8	Nickel (Ni).....	114
6-8.1	Sources.....	115
6-8.2	Biochemistry	115
6-8.3	Nickel content in foods	117
6-8.4	Toxicity.....	117
6-8.4.1	Early symptoms of toxicity.....	119
6-8.4.2	Acute toxicity symptoms of nickel carbonyl.....	119
6-8.5	Therapeutic considerations	120
6-9	Polonium (Po)	120
6-9.1	Solid-state form	121
6-9.2	Sources.....	121
6-9.3	Chemistry.....	122
6-9.4	Applications	123
6-9.5	Toxicity.....	123
6-9.5.1	Acute effects	123
6-9.5.2	Long term effects	124
6-9.6	Body burden limit.....	124
6-9.7	Precautions.....	124
6-9.8	Chelating agents.....	126
7	POTENTIALLY TOXIC METALS.....	127
7-1	Aluminium (Al).....	127
7-1.1	Sources.....	127
7-1.2	Use	128
7-1.3	Biochemistry	129
7-1.4	Absorption and excretion.....	129
7-1.5	Toxicity.....	129
7-1.6	Signs and symptoms	131
7-1.7	Laboratory analysis	132
7-1.8	Treatments.....	132
7-1.9	Chelating agents for aluminium.....	133
7-2	Antimony (Sb)	133
7-2.1	Sources.....	133
7-2.2	Biochemistry	134
7-2.3	Dietary intake.....	134
7-2.4	Toxicity.....	134
7-2.5	Laboratory analysis	134
7-2.6	Chelating agents for antimony.....	135
7-3	Barium (Ba).....	135
7-3.1	Available barium salts.....	135
7-3.2	Sources.....	136

7-3.3	Biochemistry.....	136
7-3.4	Toxicity	136
7-3.5	Treatment.....	137
7-3.6	Chelating agents for Barium	138
7-4	Bismuth (Bi).....	138
7-4.1	Sources	138
7-4.2	Toxicity	139
7-4.2.1	Ingestion and symptoms	139
7-4.2.2	Chronic intoxication.....	140
7-4.3	Treatment.....	140
7-5	Boron (B)	140
7-5.1	Sources	141
7-5.2	Biochemistry.....	142
7-5.3	Toxicity	142
7-5.3.1	Acute toxicity.....	142
7-5.3.2	Chronic toxicity	142
7-5.4	Boron deficiency	143
7-5.4.1	Exceptional needs.....	143
7-5.4.2	RDA	143
7-5.4.3	Therapy	143
7-6	Caesium (Cs).....	143
7-6.1	Sources	144
7-6.2	Biochemistry.....	144
7-6.3	Toxicity	144
7-6.3.1	Radioactive caesium.....	144
7-6.3.2	Non-radioactive caesium compounds.....	145
7-6.4	Medical applications.....	145
7-6.5	Treatment of caesium intoxication	146
7-7	(Tri-valent) Chromium (Cr ³⁺)	146
7-7.1	Dietary sources	146
7-7.1.1	Tissue stores	146
7-7.2	Normal functions.....	146
7-7.3	Deficiency states.....	146
7-7.4	Toxicity	147
7-7.5	Exceptional needs.....	147
7-7.6	Therapy dose	147
7-7.6.1	RDA	147
7-8	Cobalt (Co)	147
7-8.1	Sources	148
7-8.2	Biochemistry.....	148
7-8.3	Toxicity	149
7-8.4	Deficiency states.....	150
7-8.5	Exceptional needs.....	151
7-8.6	RDA.....	151
7-8.7	Therapy dose range.....	151
7-9	Copper (Cu).....	151
7-9.1	Sources	152
7-9.2	Biochemistry.....	152
7-9.3	Toxicity	154
7-9.4	The Hereditary disease of copper metabolism	155
7-9.4.1	Copper deficiency	155
7-9.4.2	Copper excess.....	155
7-9.5	Deficiency states	157
7-9.6	Laboratory and testing information	158
7-9.7	Exceptional needs.....	158
7-9.8	RDA.....	158
7-9.9	Treatments	158
7-9.10	Chelating agents.....	159
7-9.11	Reference range	159
7-10	Fluorine (F).....	159
7-10.1	Sources.....	160
7-10.2	Biochemistry	160

7-10.3	Toxicity	160
7-10.4	Acute poisoning	161
7-10.5	Chronic poisoning	161
7-10.6	Treatment of fluorine intoxication	162
7-11	Gadolinium (Gd).....	163
7-11.1	Sources	164
7-11.2	Applications	164
7-11.3	Toxicity.....	166
7-11.4	Medical applications	168
7-11.5	Chelating agents for gadolinium toxicity.	169
7-11.6	Treatment for gadolinium intoxication, GDD	170
7-11.7	Conclusions	170
7-12	Gallium (Ga).....	171
7-12.1	Sources	171
7-12.2	Biochemistry.....	171
7-12.3	Toxicity	172
7-12.4	Medical application.....	172
7-12.5	Laboratory analysis	172
7-12.6	Treatment of gallium toxicity	172
7-12.7	Chelating agents for gallium.....	172
7-13	Germanium (Ge).....	173
7-13.1	Sources	173
7-13.2	Biochemistry.....	174
7-13.3	Toxicity	174
7-13.4	Medical application.....	175
7-13.5	Treatment of germanium toxicity	175
7-14	Indium (In)	176
7-14.1	Sources	176
7-14.2	Biochemistry.....	176
7-14.3	Toxicity	176
7-14.4	Medical application.....	177
7-14.5	Chelating agent for indium	177
7-15	Iridium (Ir).....	177
7-15.1	Resources	178
7-15.2	Industrial applications.....	178
7-15.3	Medical applications	179
7-15.4	Toxicity	179
7-15.5	Chelating agent for iridium	179
7-16	Iron (Fe)	179
7-16.1	Dietary sources	180
7-16.2	Tissue stores	180
7-16.3	Biochemistry.....	180
7-16.3.1	Hemochromatosis	181
7-16.3.2	Hemosiderosis	182
7-16.4	Toxicity	183
7-16.5	Treatment.....	184
7-16.6	Provocation test	184
7-16.7	Deficiency states	185
7-16.8	Laboratory Information	185
7-16.9	RDA.....	185
7-16.10	Therapy dose range:	185
7-17	Lithium (Li)	185
7-17.1	Sources	186
7-17.2	Biochemistry.....	186
7-17.3	Toxicity	187
7-17.4	Medical application.....	187
7-17.5	Treatment of toxicity	188
7-18	Magnesium (Mg).....	189
7-18.1	Sources	190
7-18.2	Tissue stores	190
7-18.3	Biochemistry.....	190

7-18.4	Toxicity.....	191
7-18.5	Normal range	193
7-18.6	Therapy dose range	193
7-18.7	Deficiency states.....	193
7-18.8	Exceptional needs	193
7-18.9	Treatment of hypermagnesemia.....	193
7-18.10	Magnesium Chloride vs Magnesium Sulfate	193
7-19	Manganese (Mn)	195
7-19.1	Sources.....	195
7-19.2	Biochemistry	196
7-19.3	Intoxication.....	197
7-19.3.1	Acute intoxication of manganese	198
7-19.3.2	Chronic intoxication.....	199
7-19.4	Deficiency states.....	200
7-19.5	Exceptional needs	200
7-19.6	Laboratory findings	200
7-19.6.1	Additional tests	200
7-19.6.2	Treatment of manganese poisoning.....	201
7-19.7	RDA	201
7-20	Molybdenum (Mo)	201
7-20.1	Sources.....	202
7-20.2	Tissue stores	202
7-20.3	Biochemistry	202
7-20.4	Toxicity.....	203
7-20.5	Treatment of toxicity	203
7-20.6	Deficiency states.....	203
7-20.7	Exceptional needs	203
7-20.8	RDA	203
7-20.9	Therapy dose range	204
7-21	Osmium	204
7-21.1	Sources.....	204
7-21.2	Biochemistry	204
7-21.3	Symptoms of intoxication.....	205
7-21.4	Laboratory analysis	205
7-21.5	Treatment of Osmium poisoning	205
7-21.6	Chelating agents.....	206
7-22	Palladium (Pd).....	206
7-22.1	Sources.....	206
7-22.2	Biochemistry	207
7-22.3	Toxicity.....	207
7-22.4	Symptoms of toxicity.....	207
7-22.4.1	Suspected early symptoms of palladium exposure	207
7-22.4.2	Suspected symptoms of advanced toxicity	208
7-22.5	Laboratory analysis	208
7-22.6	Therapeutic considerations of palladium poisoning	208
7-23	Phosphorus (P)	208
7-23.1	Sources.....	209
7-23.2	Biochemistry	209
7-23.3	Deficiency states.....	209
7-23.4	RDA	210
7-24	Platinum (Pt).....	210
7-24.1	Sources.....	210
7-24.2	Biochemistry	210
7-24.3	Toxicity.....	211
7-24.4	Laboratory analysis	212
7-24.5	Therapeutic recommendations for platinum poisoning.....	213
7-25	Rubidium	213
7-25.1	Sources.....	213
7-25.2	Biochemistry	214
7-25.3	Medical application	214
7-26	Selenium (Se).....	215

7-26.1	Sources	215
7-26.2	Biochemistry	216
7-26.3	Toxicity	217
7-26.3.1	Acute toxicity of selenium	217
7-26.3.2	Chronic toxicity	217
7-26.3.3	Treatment of toxicity	217
7-26.4	Deficiency states	218
7-26.5	Treatment of selenium poisoning	218
7-26.6	Exceptional needs	218
7-26.7	Seleno-methionine	218
7-26.8	RDA	219
7-27	Silver (Ag)	219
7-27.1	Sources	220
7-27.2	Biochemistry	220
7-27.3	Toxicity	221
7-27.3.1	Acute toxic effects of silver	222
7-27.4	Symptoms	223
7-27.5	Laboratory analysis	223
7-27.6	Therapeutic considerations of silver poisoning	223
7-28	Tellurium (Te)	224
7-28.1	Sources	224
7-28.2	Toxicity	224
7-28.3	Symptoms	225
7-28.4	Treatment of tellurium poisoning	225
7-29	Thallium (Tl)	225
7-29.1	Sources	226
7-29.2	Biochemistry	226
7-29.3	Toxicity	227
7-29.4	Laboratory analysis	229
7-29.5	Treatment of thallium poisoning	229
7-30	Thorium (Th)	229
7-30.1	Sources	229
7-30.2	Biochemistry	230
7-30.3	Toxicity	230
7-30.4	Symptoms of thorium inhalation	231
7-30.5	Laboratory analysis	231
7-30.6	Treatment of thorium poisoning	231
7-31	Tin (Sn)	231
7-31.1	Source	232
7-31.2	Biochemistry	233
7-31.3	Toxicity of Tin	233
7-31.4	Symptoms	235
7-31.5	Treatment of tin poisoning	235
7-31.6	Chelating agents for tin	235
7-32	Titanium dioxide	236
7-32.1	Sources	236
7-32.2	Biochemistry	236
7-32.3	Toxicity	237
7-32.4	Applications	237
7-33	Uranium (U)	238
7-33.1	Sources	238
7-33.2	Toxicity	240
7-33.3	Laboratory analysis	241
7-33.4	Therapeutic considerations of uranium poisoning	241
7-33.4.1	Prevention guidelines	241
7-33.4.2	Therapeutic guidelines	242
7-33.5	Chelating agents for uranium	244
7-34	Vanadium (V)	245
7-34.1	Sources	245
7-34.2	Biochemistry	246
7-34.3	Clinical uses	247

7-34.4	Toxicity.....	247
7-34.5	Chelating agents for vanadium.....	248
7-35	Zinc (Zn).....	249
7-35.1	Sources.....	249
7-35.2	Biochemistry	251
7-35.3	Zinc deficiency	253
7-35.4	Zinc and copper	253
7-35.5	Zinc and iron	254
7-35.6	Zinc and disease.....	254
7-35.7	Intake of zinc.....	256
7-35.8	Toxicity.....	256
7-35.9	Excessive needs.....	257
7-35.10	Treatment of zinc poisoning	258
7-35.10.1	Dosage Upper levels (UL) for zinc for infants, children, and adults:.....	259
8	TOXIC METALS AND HOMOEOPATHY	261
9	CHELATING AGENTS	267
9-1	Synthetic chelating agents	267
9-1.1	EDTA.....	267
9-1.1.1	Chemical structure	267
9-1.1.2	Stability constant.....	268
9-1.1.3	pH	268
9-1.1.4	Affinity	269
9-1.1.5	Relative concentrations.....	269
9-1.1.6	In vitro versus in vivo	269
9-1.1.7	Pharmacological actions	270
9-1.1.8	CaNa ₂ EDTA or MgNa ₂ EDTA	270
9-1.1.9	EDTA and clotting	271
9-1.1.10	The role of platelets	272
9-1.1.11	Glycoprotein IIb/IIIa	272
9-1.1.12	Prevention of platelet aggregation	273
9-1.1.13	Glycoprotein IIb/IIIa inhibitors	273
9-1.1.14	Adverse effects of GP IIb/IIIa-inhibitors.....	274
9-1.1.15	EDTA's action on platelets.....	274
9-1.1.16	Pseudothrombocytopenia	274
9-1.1.17	Absorption and metabolism of EDTA	275
9-1.1.18	EDTA related toxicity and reactions	276
9-1.1.18.1	Nephrotoxicity	276
9-1.1.18.2	Hypocalcemia	278
9-1.1.18.3	Hypoglycemia	279
9-1.1.18.4	Systemic reactions.....	280
9-1.1.18.5	Fatigue.....	281
9-1.1.18.6	Phlebitis	281
9-1.1.18.7	Dermatitis	282
9-1.1.18.8	Embolization	282
9-1.1.18.9	Seizures.....	282
9-1.1.18.10	Related problems.....	282
9-1.1.18.11	Summary complications EDTA	283
9-1.2	Calcium EDTA.....	284
9-1.3	DMSA.....	285
9-1.3.1	Synonym:.....	285
9-1.3.2	Formula.....	285
9-1.3.3	Properties	285
9-1.3.4	Uses.....	285
9-1.3.5	Side effects	286
9-1.3.6	Dosage	286
9-1.4	DMPS.....	287
9-1.4.1	Synonym: Dimaval, Unithiol	287
9-1.4.2	Formula: 2,3-bis(sulfanyl)propane-1-sulfonic acid. DMPS is a <u>thiol compound</u>	287
9-1.4.3	Properties	287
9-1.4.4	Provocation test	288
9-1.4.5	Side effects	288
9-1.4.6	Dosage:	288
9-1.4.7	Supplied as	289

9-1.4.8	Advantage of DMPS IV over oral DMSA.....	289
9-1.5	DTPA	289
9-1.5.1	Formula.....	289
9-1.5.2	Pharmacology.....	289
9-1.6	CaNa ₃ DTPA.....	290
9-1.6.1	Formula.....	290
9-1.6.2	Use	290
9-1.6.3	Contraindications CaNa ₃ DTPA.....	291
9-1.6.4	Warnings and precautions	291
9-1.6.5	Dosage	292
9-1.6.6	Supplied as	292
9-1.7	ZnNa ₃ DTPA	292
9-1.7.1	Formula.....	292
9-1.7.2	Indications.....	293
9-1.7.3	Contraindications	293
9-1.7.4	Adverse reactions	294
9-1.7.5	Overdosage	294
9-1.7.6	Dosage	294
9-1.7.7	Supplied as	294
9-1.8	Tetrathiomolybdate (TTM)	294
9-1.8.1	Indications.....	294
9-1.8.2	Research.....	295
9-1.8.3	Side effects	296
9-1.9	Deferoxamine	296
9-1.9.1	Synonym	296
9-1.9.2	Formula.....	296
9-1.9.3	Properties.....	296
9-1.9.4	Uses.....	296
9-1.9.5	Side effects	296
9-1.9.6	Contraindications	296
9-1.9.7	Dosage	296
9-1.9.8	Supplied as	297
9-1.10	Deferiprone.....	297
9-1.10.1	Synonyms	297
9-1.10.2	Formula.....	297
9-1.10.3	Properties.....	297
9-1.10.4	Use	298
9-1.10.5	Toxicity.....	298
9-1.10.6	Contraindications	299
9-1.10.7	Side effects	299
9-1.10.8	Dosage	299
9-1.10.9	Supplied as	299
9-1.11	Trientine	299
9-1.11.1	Synonym	299
9-1.11.2	Properties.....	300
9-1.11.3	Indications Trientine.....	300
9-1.11.4	Contraindications	300
9-1.11.5	Adverse effects	301
9-1.11.6	Supplied as	301
9-1.12	D-penicillamine.....	301
9-1.12.1	Synonym	301
9-1.12.2	Formula	301
9-1.12.3	Uses.....	302
9-1.12.4	Contraindications	302
9-1.12.5	Side effects D.Pen	302
9-1.12.6	Treatment.....	302
9-1.12.7	Dosage	303
9-1.12.8	Supplied as	303
9-1.13	Prussian blue.....	303
9-1.13.1	Synonym	303
9-1.13.2	Formula.....	303
9-1.13.3	Uses.....	303
9-1.13.4	Properties.....	303
9-1.13.5	Toxicity.....	305
9-1.13.6	Adverse effects of Prussian Blue	305
9-1.13.7	Supplied as	305

9-1.14	British anti-lewisite BAL	305
9-1.14.1	Synonym	305
9-1.14.2	Formula	305
9-1.14.3	Properties	306
9-1.14.4	Contraindications	306
9-1.14.5	Supplies as	306
9-2	Natural chelating agents	306
9-2.1	Alpha-lipoic acid	306
9-2.2	Carnosine	306
9-2.2.1	Properties	306
9-2.2.2	Antioxidant	307
9-2.2.3	Crosslinking prevention	308
9-2.2.4	Metal chelation	308
9-2.2.5	Inhibits glycosylation	308
9-2.2.6	Other actions	309
9-2.2.7	Dosage	310
9-2.3	Algae	310
9-2.3.1	Ascophyllum nodosum	310
9-2.3.2	Chlorella	311
9-2.4	Cilantro	311
9-2.5	HMD	312
9-2.6	Lactoferrin	313
9-2.6.1	Normal functions	313
9-2.6.2	Chelating actions	314
9-2.6.3	Immunity	314
9-2.6.4	Anti-viral action	314
9-2.6.5	Anti-cancer action	315
9-2.6.6	Antibacterial properties	315
9-2.6.7	Antioxidant effects	315
9-2.6.8	Precautions	316
9-2.6.9	Contraindications	316
9-2.6.10	Dosage	316
9-2.7	N-acetylcysteine (NAC)	316
9-2.8	Vitamin C	316
9-2.9	Zeolite	316
9-2.9.1	Biochemistry	316
9-2.9.2	Clinical application	318
9-2.9.3	Adverse effects	318
9-2.9.4	Contraindications	318
9-2.9.5	Dosage	318
10	PROVOCATION TESTS FOR TOXIC METALS	321
10-1	Provocation of toxic metals in urine by a chelator or chelators	321
10-1.1	Baseline urine	322
10-1.2	Challenged (provoked) urine	323
10-1.3	Chelator-specific reference ranges	323
10-1.4	Protocol for toxic metal provocation test with DMPS	324
10-1.5	Protocol for toxic metal provocation test with DMSA	325
10-1.6	Protocol for toxic metal provocation test with ZnDTPA/DMPS	325
10-1.7	Protocol for toxic metal provocation test with MgEDTA/DMPS	326
10-1.8	Protocol for toxic metal provocation test with MgEDTA/DMSA	327
10-1.9	Protocol for toxic metal provocation test with DMSA/ZnDTPA/DMPS	327
10-2	The Oligoscan	328
10-3	Hair elemental analysis	329
11	PROCEDURES FOR PREPARING THE PATIENT FOR ADMINISTRATION OF CHELATING AGENTS	331
11-1	History and physical examination	331
11-2	Synthetic chelating agents	331
11-2.1	EDTA	331
11-2.1.1	Pre-treatment evaluation	331
11-2.1.1.1	Selection of patients – indications	331
11-2.1.1.2	Contraindications	337
11-2.1.1.3	Teratogenesis	340

11-2.1.1.4	Patient Informed Consent	340
11-2.1.2	Laboratory testing	341
11-2.1.2.1	Mandatory tests	341
11-2.1.2.2	Additional tests	342
11-2.1.3	Calculations for EDTA chelation therapy – glomerular filtration rate (GFR)	342
11-2.1.4	EDTA chelation treatment procedure	342
11-2.1.4.1	Forms of EDTA	342
11-2.1.4.2	Carrier solutions.....	343
11-2.1.4.3	Ingredients	344
11-2.1.4.4	Renal function tests	351
11-2.1.4.5	Frequency of treatment.....	351
11-2.2	DMSA.....	354
11-2.1.5	Mercury in infants.....	355
11-2.1.6	Procedure for heavy metal detoxification in children	356
11-2.1.6.1	Selection criteria	356
11-2.1.6.2	Consent	356
11-2.1.6.3	History.....	357
11-2.1.6.4	Physical examination	357
11-2.1.6.5	DMSA: different regimes	359
11-2.1.6.6	General recommendations.....	359
11-2.1.6.7	Common side effects	359
11-2.3	DMPS	360
11-2.4	Calcium DTPA.....	360
11-2.4.1	Summary.....	362
11-2.5	Zinc DTPA	362
11-2.5.1	Contamination of californium, americium, curium, berkelium or plutonium	362
11-2.5.2	Dosage and administration with contamination of californium, americium, etc.	363
11-2.6	Combined treatment of CaNa ₃ DTPA and ZnNa ₃ DTPA.....	365
11-2.6.1	Guidelines for the combined treatment of CaNa ₃ DTPA and ZnNa ₃ DTPA.....	365
11-2.7	Summary of DTPA administration with contamination of radioactive material	365
11-2.8	Administration as part of a chelation program for non-radioactive metals and non-acute intoxication.....	366
11-2.9	Combining chelating agents DMSA, DMPS and DTPA	366
11-2.10	Tetrathiomolybdate	366
11-2.10.1	Dosage	367
11-2.11	Deferoxamine	367
11-2.12	Deferiprone.....	367
11-2.12.1	Dosage	367
11-2.12.2	Supplied	367
11-2.13	Trientine	368
11-2.13.1	Dosage	368
11-2.13.2	Adverse effects	369
11-2.13.3	Patient monitoring	369
11-2.14	Prussian blue (PB)	369
11-2.14.1	Dosage and administration	369
11-2.14.2	Therapy guidelines for radiocaesium	370
11-2.14.3	Therapy of thallium poisoning	370
11-2.14.4	Summary of administration	371
11-2.15	D-penicillamine.....	371
11-2.15.1	Dosage	372
11-2.16	BAL.....	372
11-2.16.1	Dosage	372
11-2.16.2	Side effects	372
11-2.16.3	Supplied	372
11-2.17	Mercury intoxication as a result of amalgam fillings.....	372
11-2.18	Carnosine.....	373
11-2.18.1	Use	373
11-2.18.2	Dosage	373
11-2.18.3	Side effects	373
11-2.19	Algae	373
11-2.19.1	Chlorella.....	373
11-2.20	Cilantro	374
11-2.20.1	Use	374
11-2.20.2	Dosage	374
11-2.21	Lactoferrin	374

11-2.21.1	Dosage	374
11-2.21.2	Adverse reaction	374
12	LABORATORY ANALYSES	375
12-1	Renal function	376
12-1.1	Serum creatinine.....	376
12-1.2	Creatinine in the urine	377
12-1.3	β_2 -microglobulin	378
12-1.3.1	Indications and limitations	378
12-1.4	Blood urea nitrogen (BUN)	379
12-1.5	Uric acid	379
12-2	Cardiovascular risk markers.....	379
12-2.1	Lipids	380
12-2.2	Total cholesterol	380
12-2.3	LDL cholesterol.....	380
12-2.4	HDL cholesterol	381
12-2.5	Triglycerides	381
12-3	Lipoproteins	382
12-3.1	Lipoprotein(a) or Lp(a).....	382
12-3.2	Apolipoprotein A-1 or Apo-A1.....	382
12-3.3	Apolipoprotein B or Apo-B	383
12-3.4	The Ratio of Apo-B/Apo-A1	383
12-4	Homocysteine.....	383
12-5	Fibrinogen.....	384
12-6	D-dimer.....	384
12-6.1	Principles of D-dimer testing.....	385
12-7	Plasma Viscosity (PV)	387
12-8	Glucose metabolism	387
12-9	Glycation.....	388
12-10	Antithrombotic and Anticlotting Agents	389
12-10.1	Medical uses.....	389
12-10.2	Adverse effects	389
12-10.3	Interactions	389
12-10.4	Types	390
12-10.4.1	Coumarins (vitamin K antagonists)	390
12-10.4.2	Heparin and derivative substances	390
12-10.4.3	Low molecular weight heparin.....	390
12-10.4.4	NOAC, or DOAC.	391
12-11	Transferrin, ferritin.....	392
12-11.1	Transferrin	392
12-11.2	Ferritin.....	393
12-12	Porphyrins in urine as a toxic metal biomarker.....	393
12-13	Enzymes	395
12-13.1	Creatine phosphokinase (CPK).....	395
12-13.2	Creatine kinase isoenzyme (CK-MB)	395
12-13.3	Troponin 1 (Tn1)	395
12-13.4	Lactate dehydrogenase (LDH)	396
12-13.5	ASAT, ALAT and γ -GT	396
12-13.6	B-type natriuretic peptide (BNP).....	396
12-13.7	Glutathione S-transferase.....	397
12-13.7.1	Glutathione S-transferase Mu-1 (GSTM1).....	397
12-13.7.2	Glutathione S-transferase Pi-1 (GSTP1)	397
12-13.7.3	Glutathione S-transferase theta-1 (GSTT1).....	398
12-14	Cations	398
12-14.1	Potassium and magnesium	398
12-14.2	Calcium.....	399
12-14.3	Other cations	399
12-15	Hormones.....	399
12-15.1	Adrenocortex hormones	399
12-15.2	Male and female hormones	400
12-15.3	PSA.....	400

12-16	C-reactive protein	400
12-16.1	Hs-CRP	401
12-16.1.1	The role of hs-CRP in predicting new cardiovascular events	401
12-17	Microorganisms	402
12-17.1	Chlamydia pneumoniae, CPn	402
12-17.2	Helicobacter pylori.....	403
12-17.3	Cytomegalovirus, CMV	403
12-17.4	Nanobacter.....	403
12-18	Essential and metabolic fatty acids	404
12-19	Vitamin and antioxidant profile	404
12-20	Melatonin	405
12-21	Amino acids	405
12-21.1	Taurine	405
12-21.2	L-methionine.....	406
12-21.3	L-Arginine.....	406
12-22	Summary of laboratory testing	406
12-23	Non-invasive testing procedures	407
12-23.1	Stress tolerance test	407
12-23.2	Ultrafast CT scan	408
12-23.3	Arteriograph.....	409
12-24	Invasive scanning techniques	413
13	ANTIOXIDANTS.....	415
13-1	Alpha-lipoic acid (ALA)	415
13-1.1	Structure.....	415
13-1.2	Function.....	416
13-1.2.1	Enzyme cofactor	416
13-1.2.2	Antioxidant.....	416
13-1.2.3	Deficiency	417
13-1.2.4	Disease.....	417
13-1.2.4.1	Diabetes mellitus	417
13-1.2.4.2	Myocardial infarction.....	418
13-1.2.4.3	Hepatitis.....	418
13-1.2.4.4	Cataract	418
13-1.2.4.5	Ageing.....	418
13-1.2.5	Food sources	419
13-1.2.5.1	Biosynthesis.....	419
13-1.2.6	Toxicity.....	419
13-1.2.7	Supplements	419
13-1.2.7.1	Racemic (S) vs R- α -lipoic acid.....	420
13-1.2.8	Dosage for Alpha-lipoic acid	420
13-1.2.9	Drug interactions.....	421
13-1.2.10	Possible side effects	421
13-2	DMSO (Dimethylsulfone) and MSM (Methylsulfonylmethane)	421
13-3	Carnosine.....	422
13-3.1	Formula	423
13-3.2	Functions	423
13-3.2.1	Antioxidant – free radical protection	423
13-3.2.2	Anti-glycosylation	423
13-3.2.3	Chelating agent.....	423
13-3.2.4	Other actions.....	423
13-3.3	Deficiency.....	424
13-3.4	Dietary sources	424
13-3.5	Drug interactions	424
13-3.6	Side effects.....	424
13-3.7	Dosage	424
13-4	Glutathione	424
13-4.1	Function.....	425
13-4.2	Applications	426
13-4.3	Depletion	427
13-4.3.1	Liver diseases	427
13-4.3.2	Lung	427
13-4.3.3	Immunity disorders.....	428

13-4.3.4	Neurodegeneration related to glutathione depletion.....	428
13-4.3.5	Alzheimer's disease (AD).....	428
13-4.3.6	Atherosclerosis.....	429
13-4.3.7	Pancreatitis.....	429
13-4.3.8	Crohn's disease, gastrointestinal inflammation.....	429
13-4.3.9	Metal intoxication diseases.....	429
13-4.4	Repleting glutathione.....	430
13-4.5	Oral vs intravenous glutathione.....	430
13-4.3.1	Oral dosing with GSH.....	431
13-4.3.2	N-acetylcysteine (NAC).....	431
13-4.3.3	L-cysteine.....	431
13-4.3.4	L-methionine.....	432
13-4.3.5	SAMe.....	432
13-4.6	Synthetic products.....	432
13-4.7	Diet.....	432
13-4.8	Toxicity and contraindications.....	433
13-5	L-Arginine.....	433
13-5.1	Indications for L-arginine.....	434
13-5.2	Contraindications and adverse reactions.....	434
13-5.3	Drug interactions.....	435
13-5.4	Dosage and administration.....	435
13-6	Taurine.....	436
13-6.1	Normal functions.....	436
13-6.2	Contraindication.....	436
13-6.3	Body stores.....	436
13-6.4	Exceptional needs.....	436
13-6.5	Dosage.....	437
13-7	Melatonin.....	437
13-7.1	Normal functions.....	437
13-7.2	Contraindications.....	437
13-7.3	Dosage.....	437
13-7.4	Melatonin and metals.....	437
13-8	N-acetylcysteine (NAC).....	438
13-8.1	Uses.....	438
13-8.2	Dosage.....	439
13-9	Trimethylglycine (TMG).....	439
13-9.1	Synonym.....	439
13-9.2	Normal functions.....	439
13-9.3	Dosage.....	439
Ubiquinone		439
13-10.1	Synonym.....	439
13-10.2	Normal functions.....	439
13-10.3	Exceptional needs.....	440
13-10.4	Ubiquinol.....	440
13-10.5	Dosage.....	440
13-11	Vitamin A.....	441
13-11.1	Synonym.....	441
13-11.2	Normal function and chemical structure.....	441
13-11.3	Antagonist.....	441
13-11.4	Dosage.....	441
13-11.5	Dietary sources.....	442
13-11.6	Tissue stores.....	442
13-11.7	Toxicity.....	442
13-11.8	Exceptional needs.....	442
13-12	Vitamin C.....	442
13-12.1	Synonym.....	442
13-12.2	Antagonists.....	442
13-12.3	Dosage.....	442
13-12.4	Dietary sources.....	442
13-12.5	Tissue stores.....	442
13-12.6	Normal functions.....	442

13-12.7	Toxicity	443
13-12.8	Exceptional needs	443
13-12.9	Chelation	443
13-13	Vitamin E	443
13-13.1	Biochemistry	443
13-13.2	Tocopherols	444
13-13.3	Tocotrienols	445
13-13.4	Vitamin E deficiency	446
13-13.4.1	Abetalipoproteinaemia	446
13-13.4.2	Heart disease	446
13-13.4.3	Parkinson's disease	446
13-13.4.4	Alzheimer's disease	446
13-13.4.5	Cancer	447
13-13.4.6	Cataracts	447
13-13.5	Other vitamin E applications	447
13-13.6	Deficiency of vitamin E and excessive needs	448
13-13.7	Food sources of vitamin E	448
13-13.8	Toxicity	448
13-13.9	Forms of Vitamin E	448
13-13.10	Dosage	449
14	ADJUNCTIVE HEALTH MEASURES	453
14-1	Dietary guidelines	453
14-1.1	Dietary measures	453
14-1.1.1	Calcium	453
14-1.1.2	Vitamin D	454
14-1.1.3	Vitamin B ₁₂	454
14-1.1.4	Vitamin E	454
14-1.1.5	Carbohydrates	454
14-1.1.6	Meat	455
14-1.2	Summarizing	455
14-2	Nutritional supplements	456
14-2.1	Water-soluble vitamins	456
14-2.1.1	Vitamin B ₁	456
14-2.1.2	Vitamin B ₂	457
14-2.1.3	Vitamin B ₃	457
14-2.1.4	Niacinamide	458
14-2.1.5	Vitamin B ₅	458
14-2.1.6	Vitamin B ₆	459
14-2.1.7	Vitamin B ₁₂	459
14-2.1.8	Vitamin B ₁₅	461
14-2.1.9	Biotin	461
14-2.1.10	Folic acid	462
14-2.1.11	Vitamin C	462
14-2.1.12	Bioflavonoids	462
14-2.1.13	Choline	463
14-2.1.14	PABA	465
14-2.2	Fat-soluble vitamins	466
14-2.2.1	Vitamin A	466
14-2.2.2	Vitamin D	466
14-2.2.3	Vitamin E	469
14-2.2.4	Vitamin K	469
14-2.3	Minerals and trace elements	473
14-2.3.1	Calcium (Ca)	473
14-2.3.2	Magnesium (Mg)	474
14-2.3.3	Potassium (K)	474
14-2.3.4	Sodium (Na)	475
14-2.4	Lipids and fatty acids	475
14-2.4.1	Sources of fats	476
14-2.4.2	Formulas	476
14-2.4.3	Saturated vs unsaturated fatty acids	477
14-2.4.4	Trans- and cis-fatty acids	477
14-2.4.5	Essential fatty acids	477
14-2.4.6	EPA and DHA	479

14-3	Miscellaneous.....	479
14-3.1	Alpha-lipoic acid (ALA)	479
14-3.2	DMSO and MSM.....	479
14-3.3	Glutathione	481
14-3.4	L-arginine.....	481
14-3.5	L-carnitine, N-acetyl-L-carnitine, L-propionyl-carnitine.....	481
14-3.5.1	L-carnitine	481
14-3.5.1.1	Biochemistry	481
14-3.5.1.2	Body stores.....	482
14-3.5.1.3	Typical functions of L-carnitine	482
14-3.5.1.4	Carnitine deficiency	482
14-3.5.1.5	Supplementation.....	483
14-3.5.1.6	Dosage	483
14-3.5.1.7	Toxicity, adverse effects	483
14-3.5.2	Acetyl-L-carnitine (ALC).....	484
14-3.5.2.1	Pharmacokinetics	484
14-3.5.2.2	Clinical indications	484
14-3.5.2.3	Dosage	485
14-3.5.2.4	Toxicity	485
14-3.5.3	L-propionyl carnitine (LPC)	485
14-3.5.3.1	Clinical indications	485
14-3.5.3.2	Dosage	486
14-3.5.3.3	Toxicity	486
14-3.5.3.4	Acetyl-L-carnitine vs L-propionyl-carnitine vs L-carnitine.....	486
14-3.5.3.5	Body stores.....	487
14-3.5.3.6	Exceptional needs	487
14-3.6	Lactoferrin.....	487
14-3.7	Lecithin	487
14-3.7.1	Chemical composition.....	487
14-3.7.2	Hydrolysed lecithin.....	487
14-3.7.3	Wherefrom does lecithin come?	488
14-3.7.4	Properties and applications.....	488
14-3.7.5	Deficiency	488
14-3.7.6	Food sources	488
14-3.7.7	Toxicity.....	489
14-3.7.8	Health benefits.....	489
14-3.7.9	Daily dose recommendations.....	489
14-3.8	Liposome	490
14-3.9	Phosphatidylcholine (PC)	490
14-3.9.1	Synonyms	490
14-3.9.2	Chemistry.....	491
14-3.9.3	Function.....	491
14-3.9.4	Possible health benefits	491
14-3.10	Taurine.....	493
14-3.11	Melatonin	493
14-3.12	Policosanol	493
14-3.12.1	Function	493
14-3.12.2	Research	493
14-3.12.3	Therapy dose range.....	493
14-3.13	Pterostilbene.....	494
14-3.13.1	Pharmacokinetics.....	494
14-3.13.2	Indications.....	494
14-3.13.3	Toxicity.....	495
14-3.13.4	Dosage	495
14-3.14	Resveratrol	495
14-3.14.1	Formula.....	495
14-3.14.2	Properties	495
14-3.14.3	Role of resveratrol.....	496
14-3.14.4	Pharmacokinetics.....	496
14-3.14.5	Therapy dose range.....	497
14-3.15	Trimethylglycine (TMG)	497
14-3.16	Ubiquinone - Ubiquinol	497
14-4	Adjunctive measures	497
14-4.1	Smoking.....	497
14-4.2	Exercise	498

14-4.2.1	Types of exercise	498
14-4.3	Stress control	499
15	TOXIC METALS AND SYNDROMES.....	501
15-1	Atherosclerosis	501
15-1.1	How does atherosclerosis start?	501
15-1.2	Inflammation.....	502
15-1.2.1	Direct effects of inflammation.....	502
15-1.2.1.1	Tissue plasminogen activator (tPA)	502
15-1.2.1.2	Prostacyclin PGI ₂ and thromboxane TXA ₂	502
15-1.2.2	Indirect effects of inflammation	502
15-1.3	Growth factors	503
15-1.3.1	Platelet-derived growth factor (PDGF)	503
15-1.3.2	Platelet aggregation	503
15-1.3.3	Transforming growth factors- β (TGFs- β).....	503
15-1.3.4	Tumour necrosis factors (TNF).....	504
15-1.3.4.1	Tumour necrosis factor- α (TNF- α)	504
15-1.3.4.2	Tumour necrosis factor- β (TNF- β)	504
15-1.3.5	Vascular endothelial growth factor (VEGF)	504
15-1.3.6	VCAM and ICAM.....	504
15-1.3.7	Interleukins, IL.....	505
15-1.3.7.1	Interleukin-1 (IL-1)	505
15-1.3.7.2	Interleukin-6 (IL-6)	505
15-1.4	Anti-inflammatory agents	505
15-1.4.1	Transforming growth factor- α (TGF- α)	505
15-1.5	Risk factors.....	506
15-1.5.1	Asymmetric dimethylarginine (ADMA)	506
15-1.5.2	Consequences of ADMA.....	506
15-1.5.3	Nitric oxide (NO)	507
15-1.5.4	eNOS	507
15-1.5.5	Angiogenesis	507
15-1.5.6	Diabetes.....	511
15-1.5.7	Fibrinogen.....	512
15-1.5.8	Hemochromatosis	512
15-1.5.9	Homocysteine	513
15-1.5.9.1	How does homocysteine contribute to atherosclerosis?.....	513
15-1.5.9.2	Methylation and transsulfuration to detoxify homocysteine	513
15-1.5.9.3	Genetic factors in homocysteinemia	514
15-1.5.10	Hypertension.....	515
15-1.5.11	Inflammation, infectious agents.....	515
15-1.5.11.1	Chlamydia pneumoniae	515
15-1.5.11.2	Cytomegalovirus (CMV).....	516
15-1.5.11.3	Epstein-Barr virus (EBV).....	516
15-1.5.11.4	Helicobacter pylori	516
15-1.5.11.5	Paradontosis	517
15-1.5.12	Lipid peroxidation.....	517
15-1.5.13	Cholesterol oxidation	517
15-1.5.13.1	Low-density lipoprotein (LDL)	518
15-1.5.13.2	Plaque formation.....	519
15-1.5.14	Lipoprotein(a), Lp(a)	520
15-1.5.15	Can HDL cholesterol become proatherogenic?	520
15-1.6	Antioxidants	521
15-1.7	Laboratory tests for atherosclerosis and risk factors	521
15-1.7.1	Fibrinogen	522
15-1.7.2	The Coronary Calcium Score. CCS	522
15-1.8	Prevention and treatment.....	523
15-1.8.1	Nutritional supplements	523
15-1.8.1.1	Alpha-lipoic acid (ALA).....	523
15-1.8.1.2	Choline.....	523
15-1.8.1.3	Coenzyme Q10 (ubiquinone, ubiquinol).....	523
15-1.8.1.4	Essential fatty acids	524
15-1.8.1.5	L-arginine.....	524
15-1.8.1.6	L-carnitine.....	524
15-1.8.1.7	Taurine.....	525
15-1.8.1.8	Proanthocyanidins	525
15-1.8.1.9	Policosanols	525

15-1.8.1.10	TMG. Trimethylglycine	525
15-1.8.2	Trace mineral supplements	525
15-1.8.2.1	Chromium (Cr)	526
15-1.8.2.2	Magnesium (Mg)	526
15-1.8.2.3	Selenium (Se)	526
15-1.8.2.4	Zinc (Zn)	526
15-1.8.3	Vitamins	526
15-1.8.3.1	Vitamin C	526
15-1.8.3.2	Vitamin E	527
15-1.8.3.3	Vitamin K ₂ (Menaquinone)	527
15-1.8.4	Herbal supplements	527
15-1.8.4.1	Bromelain	527
15-1.8.4.2	Curcumin	527
15-1.8.4.3	Ginger (Zingiber officinale)	528
15-1.8.4.4	Ginko Biloba	528
15-1.8.4.5	Green tea extract	528
15-1.8.4.6	Gugulipid	529
15-1.8.4.7	Hawthorn berry	529
15-1.9	Treatment of controllable risk factors	529
15-1.9.1	Chlamydia pneumoniae	529
15-1.9.2	Diabetes	529
15-1.9.2.1	Sulfonylureas and CHD	529
15-1.9.2.2	Alpha-lipoic acid	529
15-1.9.2.3	Carnosine	530
15-1.9.2.4	Chromium	530
15-1.9.2.5	Fibre	530
15-1.9.3	Exercise	530
15-1.9.4	Hyperhomocysteinaemia	530
15-1.9.4.1	Homocysteine lowering nutrients	530
15-1.9.4.2	Creatine	530
15-1.9.4.3	Folic acid	531
15-1.9.4.4	Niacin	531
15-1.9.4.5	Niacinamide	531
15-1.9.4.6	Inositol hexaniacinate	531
15-1.9.4.7	Vitamin B ₆	531
15-1.9.4.8	Trimethylglycine (TMG), betaine	532
15-1.9.5	Periodontitis	532
15-1.9.6	Smoking	532
15-1.9.7	Magnesium EDTA intravenous chelation therapy	532
15-1.10	Conventional medical therapy	533
15-1.10.1	Drug treatments medications	533
15-1.10.1.1	Aspirin	533
15-1.10.1.2	Platelet aggregation inhibitors	533
15-1.10.1.3	Magnesium EDTA	534
15-1.10.1.4	Statin drugs	534
15-1.10.1.5	Cholesterol - independent or "pleiotropic" effects of statins	534
15-1.11	Invasive procedures	537
15-1.11.1	Coronary artery bypass	537
15-1.11.2	Angioplasty	537
15-1.11.3	Stenting	538
15-1.11.4	Coronary navigation	539
15-1.11.5	Intra-coronary radiation, brachytherapy	540
15-1.11.6	Atherectomy	540
15-1.12	Management of unstable angina pectoris	540
15-1.12.1	Initial evaluation	540
15-1.12.2	Initial evaluation	541
15-2	Alzheimer's disease	543
15-3	Autism	545
15-4	Diabetes mellitus	561
15-5	Wilson's disease (hepatolenticular degeneration)	564
15-5.1	Pathology	565
15-5.2	Diagnosis	566
15-5.3	How is Wilson's disease inherited?	567
15-5.4	Signs and symptoms	567
15-5.5	Treatment	568
15-6	Multiple sclerosis	569

15-6.1	Causes	569
15-6.2	Methylation and multiple sclerosis	570
15-6.3	A comprehensive program for MS	570
APPENDIX 1		573
Example of informed consent for Mg-EDTA Chelation Therapy.....		573
APPENDIX 2		575
App-2-1	Glomerular filtration rate (GFR)	575
App 2-1.1	The calculation for EDTA chelation therapy	575
App 2-2	Carrier solutions	578
App 2-2.1	Lactated ringers solution.....	578
App 2-2.2	Saline (0,9% or 0,65%) or glucose 5%	578
App 2-3	Ingredients	579
App 2-3.1	Standard ingredients of a MgEDTA chelation infusion	579
App 2-4	Dosage of EDTA.....	580
App 2-5	Infusion rate	580
App 2-6	EDTA equivalents in ml	581
App 2-7	The osmolarity of various ingredients.....	582
App 2-8	Other possible ingredients of an EDTA chelation therapy infusion	583
App 2-9	Calculation of magnesium in MgEDTA.....	584
App 2-10	Other adjunctives	585
App 2-11	Other useful intravenous therapies	585
App 2-12	High vitamin C protocol	585
App 2-13	Example of a multivitamin-mineral program.....	586
App 2-14	Example of variables based on test results and clinical view	586
App 2-15	The affinity of chelating agents for toxic metals	587
APPENDIX 3		589
Medical components unit conversion factors		589