Index

Numbers in italic refer to figures; numbers in bold refer to tables.

abdominal-pelvic surgery antithrombotic prophylaxis, 641
abortion as risk factor in adolescents, 95
acetabular fracture and vena cava filters, 603
acetylcysteine and contrast-induced nephropathy, 481
activated partial thromboplastin time (aPTT), 531–532, 542, 543, 555, 557
acute chest pain, triple rule-out CTA, 474
acute coronary syndrome similarity to pulmonary embolism, 501
acute cor pulmonale and electrocardiogram, 289, 290, 297, 299
acute hemorrhage/infarction syndrome, 82–83
acute illness, and factor VIII, 208
adipocytes role in deep venous thrombosis, 135
administered activity and dose, 416, 485
adolescents
  predisposing factors in, 95–96
  prevalence of pulmonary embolism and DVT, 95
African Americans
  rate of hospitalization, 110
  rates of diagnosis, 73, 108–109
  regional mortality rates, 75–76
age
  and accuracy of clinical assessment, 86
  and alveolar–arterial oxygen difference, 311, 312
  and antithrombotic prophylaxis, 89–90
  and blood gases, 86–87
  and case fatality rate, 29, 79, 91, 92, 225
  and chest radiograph, 82, 85, 86
  and contrast-induced nephropathy, 480
  and D-dimer, 340
  and ECG abnormalities, 86
  and fat embolism syndrome, 514
  and home treatment, 618
  and predisposing factors, 80–81
  and pregnancy-associated DVT, 176–177
  and pulmonary embolectomy, 631
  and rates of diagnosis, 76, 78, 79
  as risk factor, 141
  and risk of breast cancer, 487
  and sensitivity of single-slice CT angiography, 454
  and symptoms of pulmonary embolism, 81–82, 83, 85, 86
  and syndromes of pulmonary embolism, 81, 82
  and vena cava filters, 604–606, 607, 608
  and venous thromboembolism, 78–92
agnogenic myeloid metaplasia and hypercoagulable state, 209
air embolism, 147, 599
air raid shelters and pulmonary embolism, 5
airspace disease, on CT pulmonary angiograms, 476
air travel, 184–186
  and compression stockings, 563
  see also long-distance travelers
Alaskan Natives and venous thromboembolism, 116
alcoholic liver disease and venous thromboembolism, 168
allergic asthma and venous thromboembolism, 157
allergic reactions
  with CT angiography, 471
  with magnetic resonance contrast agents, 493
alpha-1 antitrypsin deficiency and pulmonary vascular abnormalities, 152, 153
alveolar–arterial oxygen difference, 87, 151, 152, 306, 307
age–related values, 311, 312
  calculation, 311
  in combination with blood gases, 314–315
  and pulmonary embolism, 308–314, 502
  relation to $P_{O_2}$, 313, 314
  relation to pulmonary artery pressure, 313–314
  relation to ventilation–perfusion lung scan, 313–314
alveolar dead-space, 321, 322
  calculation, 321
  and diagnosis of pulmonary embolism, 321–322
  for exclusion of pulmonary embolism, 322
  in combination with D-dimer, 322
  in combination with Wells score, 322

© 2016 John Wiley & Sons, Ltd. Published 2016 by John Wiley & Sons, Ltd.
Companion Website: www.wiley.com/go/stein/pulmonary_embolism

647
American College of Chest Physicians Evidence-Based Clinical Practice Guidelines, 639–644
anticoagulant therapy, 639–640
antithrombotic therapy 642–644
aspirin for prevention of VTE, 552
bariatric surgery, 198
catheter-assisted thrombus removal, 594
catheter-related upper extremity DVT, 64
chronic thromboembolic pulmonary hypertension, 637
genotype-guided dosing of warfarin, 526
home treatment, 620, 624
inferior vena cava filters, 154, 611
long-distance travelers, 185–186
management of anticoagulant therapy, 639–640
management of high INR, 640
management of subsegmental PE, 436
patients with heart failure, 130–131
pregnancy-associated VTE, 180
prevention of VTE, 640–644
pulmonary thromboendarterectomy, 637
thrombolytic therapy, 579, 580
American Indians and venous thromboembolism, 116
amniotic fluid embolism, 180–181
Amplatz catheters, 590, 591
anaphylactoid reactions with iodinated contrast material, 257
with magnetic resonance contrast material, 491
with fresh frozen plasma, 528
with protamine sulfate, 533
with hirudin, 543
anemia as risk of contrast induced nephropathy, 480
angiographic catheters for fragmentation of thrombi, 589–590
Angiojet catheter, 591
angioplasty after thrombolytic therapy for deep venous thrombosis, 567, 569, 570
ankle asymmetry in deep venous thrombosis, 215
ankle exercise and venous blood velocity, 565–566
anteroseptal infarction pattern on ECG in pulmonary embolism, 290, 502
antiphospholipid antibodies, 164, 168, 209, 210
anticoagulant prophylaxis, in patients with stroke, 143
anticoagulants
and air travel, 185
American College of Chest Physicians Guidelines, 639–640
and bariatric surgery, 198
and case fatality rate, 25
and D-dimer levels, 341
and DLCO, 58
and DVT, 49, 50, 643
in the elderly, 90
and pregnancy, 180
and pulmonary embolism, 643
and right ventricular enlargement/dysfunction, 31, 33, 35
and sickle cell disease, 159
and VTE, 333
see also novel oral anticoagulants
antiphospholipid syndrome, 208–209, 210
and DVT, 209
antithrombin III
deficiency, 96, 173, 204, 205
and estrogen 192–193,
and fondaparinux, 535
and LMWH, 533
and unfractionated heparin, 531
antithrombin–heparin cofactor assay, 204
antithrombotic prophylaxis
and age, 89–90
and bariatric surgery, 198
and heart failure, 130–131
for prevention of VTE, 642–644
and rheumatoid arthritis, 165
and stroke, 143–144
see also antithrombotic therapy
antithrombotic therapy
American College of Chest Physicians Guidelines, 642–644
in children and infants, 97
choice of anticoagulants, 643
duration of, 643
see also antithrombotic prophylaxis
apixaban, 180, 545, 546, 547, 549, 550
aprotinin, 532
aPTT see activated partial thromboplastin time
argatroban, 540, 542, 543
arterial blood
partial pressure of carbon dioxide, 310, 311
pH of, 308, 310
arterial thrombosis and VTE overlap, 141, 142
arteriovenous shunts and upper extremity deep venous thrombosis, 62, 66
ascending CT shunts and upper extremity deep venous thrombosis, 62, 66
Asians
DVT in 108–113
pulmonary embolism in, 108–113
rate of hospitalization, 110
VTE in, 108–113
aspiration catheters, 589
aspiration thrombectomy, 589
aspirin
extended treatment, 549
and major bleeding, 553
after major orthopedic surgery, 552
mechanism of action, 553
and prevention of DVT, 185, 552–553
for prevention of VTE, 552–553
and treatment of sticky platelet syndrome, 208
and prevention of pulmonary embolism with stroke, 143
asthma
and DVT, 156, 157
and pulmonary embolism, 156, 157
atelectasis
and CT pulmonary angiography, 476
and pulmonary embolism, 269, 277, 282, 303, 305, 306
Index

and chest radiograph according to age, 82, 85, 86
and ventilation - perfusion lung scan, 363
atherosclerosis and venous thromboembolism overlap,
141–142
atrial fibrillation prevalence in pulmonary embolism,
290
atrial flutter prevalence in pulmonary embolism, 290
atrioventricular block prevalence in pulmonary embolism,
290
autopsy
prevalence of deep venous thrombosis at, 8–16
prevalence of pulmonary embolism at, 5–7
small PE, 5
fatal PE, 5
unsuspected PE, 7

balloon angioplasty for deep venous thrombosis, 567
balloon-occlusion cineangiography, 429
bariatricsurgery, 136
antithrombotic prophylaxis, 198
and DVT, 198–201
number of operations, 198
and pulmonary embolism, 201
and vena cava filters, 201–202
and VTE, 198, 201–202
Bayes theorem, 234
becquerel (unit), 484
bedside tests in critically ill, 286
echocardiography, 503, 519
ultrasonography, 503, 519
bivalirudin, 540, 542, 543
black people
case fatality rate, 29
children 95
diagnostic tests in, 105–106
DVT in, 103–106
and intracerebral hemorrhage, 584
and IVC filters, 598
mortality rates from pulmonary embolism, 76
pulmonary embolism in, 103–106
rates of diagnosis, 75, 78
women, 177, 178, 179
see also African Americans
bladder, carcinoma of and risk of venous
thromboembolism, 118, 119, 126
bleeding
and vitamin K antagonists, 526–528
and LMWH, 534, 535
and novel oral anticoagulants, 545, 548, 549
and thrombolytic therapy, 567, 569, 570, 575–576
see also hemorrhage; major bleeding;
blood gases, 308–310
and age, 86–87
and alveolar - arterial oxygen difference, 314–315
body mass index (BMI) and venous thromboembolism,
135
and risk of DVT in travelers, 184
bone marrow transplantation and fat embolism, 514
bowel
inflammatory disease and venous thromboembolism,
166–167
brachiocephalic vein thrombosis, 61, 63
brain natriuretic peptide (BNP) and prognosis of
pulmonary embolism, 38–39, 47, 330
in combination with D-dimer for exclusion of
pulmonary embolism, 349
brachiocephalic veins
Gd-MR venography, 67
thromboembolic disease of, 66–67
breast cancer
and risk of venous thromboembolism, 122
and radiation risks, 486–487
bronchospasm with iodinated contrast material, 444
burns
and fat embolism, 514
and vena cava filters, 603
bus travel and venous thromboembolism, 184
calf asymmetry in deep venous thrombosis,
215–218
calf muscle exercise for prevention of deep venous
thrombosis with travel, 185–186, 640
calf pain and deep venous thrombosis, 267, 502
calf veins and compression ultrasound, 244
Canadian model see Wells model
cancer
bladder and VTE, 118, 119, 126
breast and VTE, 122
breast following radiation, 476, 487
cervix and vena cava filters, 607
gastric and VTE, 118
mediastinal simulating chronic thromboemboic
pulmonary hypertension, 635
and DVT, 118–122, 123, 124, 618
and hypercoagulability, 210
metastatic and home treatment of DVT, 618
pancreas and VTE, 118, 119, 121
and pulmonary embolism, 118–126
and prognostic models, 331–332
and radiation, 485
rectum and vena cava filters, 607
and upper extremity DVT, 62–63
and vena cava filters, 123–126, 603, 604
and vena cava thrombosis, 23
and VTE 116–126, 210, 640
carbon dioxide
in arterial blood, 310, 311
measurement of alveolar dead-space volume, 321
carcinoma see cancer
cardiac arrest
and pulmonary angiography, 442
and pulmonary embolectomy, 626
cardiac biomarkers and prognostic scoring systems, 47
cardiac disease and lung scans, 393
cardiac perforation with pulmonary angiography, 442
cardiac surgery and VTE prophylaxis, 641
cardiac troponins
  and diagnosis in coronary care unit, 502
  identifying low-risk patients, 47
  and prognosis, 33 – 35
  and right ventricular dysfunction for prognosis, 35
CARDIOMEGALY
  and clinical assessment, 283
  on chest radiograph, 306
CARDIOPULMONARY ARREST, 182, 585
CARDIOPULMONARY DISEASE
  degrees of complexity with lung scans, 374–375
  and mismatched segmental equivalent defects, 391–394
  and mismatched vascular defects, 395–398, 401–406
  and perfusion defects, 391–394
CARDIOPULMONARY RESUSCITATION AND AMNIOTIC FLUID EMBOLISM, 443
CARTRIDGE, 527
CARTRIDGE 502–513
CARTRIDGE 502–513
CARTRIDGE 502–513
CASE FATALITY RATE
  and age, 25, 29, 79, 91, 92
  early death from PE, 27
  with deep venous thrombosis (DVT), 24–25
  in prior era before imaging tests, 24
  in patients with pulmonary embolism and COPD, 152–154
  from pulmonary embolism, 24–30, 79
  PE compared with DVT, 25
  stable patients, 25
  unstable patients, 27
  and treatment, 25
  untreated mild PE, 24
  and vena cava filters, 604–606, 608–610, 611
  see also mortality; population mortality rate
CATHETER THROMBOLYSIS FOR PULMONARY EMBOLISM, 592
CATHETER ASPIRATION THROMBECTOMY, 589
CATHETER ULTRASOUND-ACCELERATED THROMBOLYSIS FOR PULMONARY EMBOLISM, 593
CATHETER-DIRECTED THROMBOLYTIC THERAPY FOR DEEP VENOUS THROMBOSIS, 567, 569–570, 643
  for upper extremity venous thrombosis, 64
  locoregional, 569
  rheolytic systems, 572
  rotating motorized systems, 572
  ultrasound, 572–573
CATHETER-RELATED UPPER EXTREMITY DVT, 64
CATHETERS
  Amplatz, 590, 591
  aspiration, 589
  EkoSonic Endovascular System, 593
  Greenfield, 589
  suction, 589
  with ultrasonic transducers, 572
CATHETER-TOPEMBOLYSIS, 589–594
CAUCASIANS
  elevated factor VIII levels, 207
  factor V Leiden mutation, 207
  prothrombin G20210A mutation, 207
  rates of diagnosis, 73
  regional mortality rates, 75–76
  see also white people
CD4 cell count and hypercoagulable state with HIV, 173
CELL DAMAGE WITH RADIATION, 487
CENTRAL VENOUS CATHETERS AND UPPER EXTREMITY DVT, 61, 63, 64, 128
CEREBROVASCULAR DISEASE AND PARADOXICAL EMBOLISM, 146
CERVIX, CARCINOMA OF AND VENA CAVA FILTERS, 607
CESAREAN SECTION
  and amniotic fluid embolism, 182–183
  and pregnancy-associated DVT, 176, 177–178, 179
CHEMOTHERAPY AND VTE, 63, 118, 122
CHEST PAIN WITH PULMONARY EMBOLISM, 267
CHEST RADIOGRAPH
  and age with PE, 82, 85, 86
  in children with PE, 97
  and chronic obstructive pulmonary disease with PE, 151
  radiation, 484
  elevated hemidiaphragm and infiltrates, 305–306
  abnormalities in relation to P_2O_5, 306, 307
  with perfusion lung scans, 377–378, 408–409, 518
  and pleural effusion, 304, 305
  abnormalities in relation to pulmonary artery pressure, 306
  and pulmonary embolism, 284, 285, 303–307, 386–387, 408–409, 502
  radiographic signs, 303
  radiographic signs in patients with no prior cardiopulmonary disease, 303
  sensitivity in relation to false positives, 303–304
  vascular signs of pulmonary embolism, 305
  with very low probability ventilation–perfusion lung scans, 385–387
CHILDREN, also see infants
  antithrombotic therapy, 97
  black, 95
  exposure to radiation, 485, 487
  imaging tests in, 96–97
  nephrotic syndrome in and VTE, 172
  predisposing factors in, 95–96
  prevalence of pulmonary embolism, 95
  venous thromboembolism in 95–96, 98
  white, 95
CHOLESTEROL AND PULMONARY EMBOLISM, 139
CHONDROITIN SULFATE AND HEPARINOID, 535
CHRONIC LIVER DISEASE AND VTE, 168–169
CHRONIC OBSTRUCTIVE PULMONARY DISEASE (COPD), 128
  and DVT, 149–154, 618
  and pulmonary embolism, 149–154, 286
  and vena cava filters, 607
  ventilation–perfusion lung scans, 363
  and VTE, 149
CHRONIC THROMBOEMBOLIC PULMONARY HYPERTENSION, 634–636
  American College of Chest Physicians Guidelines, 637
  clinical manifestations, 634
Index

651
diagnosis, 634–635
medical therapy, 636
prevalence after acute pulmonary embolism, 634
pulmonary thromboendarterectomy, 636
cigarette smoking and VTE, 141
circulatory collapse in pulmonary embolism, 280, 282–285
cirrhosis and VTE, 168
CK-MB see creatine kinase isoenzyme MB
climate and prevalence of VTE, 76
see also seasonal variability
clinical assessment
of pulmonary embolism and no prior cardiopulmonary
disease 265–271
combinations of signs and symptoms, 270, 271
chest radiograph, 282, 283
electrocardiogram, 281
isolated dyspnea syndrome, 283
circulatory collapse syndrome, 285, 285
PaO2, 283
predisposing factors, 266, 267
pulmonary infarction syndrome, 283
relation to right-sided pressures, 272, 273, 283
signs of acute PE, 267–270
symptoms of acute PE, 267
syndromes of acute PE, 267, 280–285
validity of clinical assessment, 271
clinical assessment all patients irrespective of prior
cardiopulmonary disease, 275–278
combinations of signs and symptoms, 277, 278
in critically ill, 286–288
dyspnea, hypoxia and normal chest radiograph, 277, 278
predisposing factors, 275
symptoms of PE, 275, 276
syndromes of PE, 275
according to age, 86
with computed tomography, 449
with CT angiography, 468–471, 517
CT venography, 468–471
with D-dimer assays, 236
DVT, 220–221, 223, 234–235
lower extremity DVT, 215–218
with perfusion lung scan, 377
with ventilation–perfusion lung scan, 373, 389, 401–406
clinical models for pulmonary embolism, 324–327
clinical scoring systems
for deep venous thrombosis, 220–221
empirical assessment, 327
Geneva system, 324
pulmonary embolism rule-out criteria, 326, 327
Pisa clinical model, 326
Wells model, 324
coagulation assays, 205
coagulation cascade, 204, 205, 207–209, 524, 540
coagulation proteins
effect of estrogen on, 192
and oral contraceptives, 189
coagulopathy
in children, 96,
in amniotic fluid embolism, 182
collateral veins on postmortem venograms, 12
compression stockings
in bariatric surgery, 198
after general surgery, 561–562
and long-distance air travel, 185–186, 563
mechanism of action, 561
in medical patients, 562
after orthopedic surgery, 562–563
and post-thrombotic syndrome, 563
recommendations, 640–644
and venous blood velocity, 562
compression ultrasound
accuracy, 241–243
accuracy in calf veins, 244
with D-dimer assays, 236
diagnostic criteria for DVT, 241
in patients with pulmonary embolism, 244
outcome with serial tests, 615
with upper extremity DVT, 63
equipment, 240
compared with venous phase CT imaging, 244
outcome after negative ultrasound, 244
computed tomographic (CT) pulmonary angiography
advances since PIOPED II, 473–476
ancillary findings, 476
breast doses of radiation, 473–476
in children, see infants 96, 97
with clinical assessment, 468–471, 517
and contrast-induced nephropathy, 480–481
complications, 471–472
in coronary care unit, 503
diagnostic yield of, 473–474
in the elderly, 87
and dipyridamole, 481
dual-energy, 474–476, 484
effective dose of radiation, 484
evolution of technology, 473
false positive rate, 473
and fentanyl, 481
and metformin, 481
multidetector sensitivity, specificity, predictive value, 467
multidetector with clinical assessment, 468–469
multidetector with venous phase venography, 467–470
posttest probability, 470
predictive value according to largest vessel, 467
and non-steroidal anti-inflammatory drugs, 481
outcome, 473, 478–479
peri-procedural hemofiltration, 481
PIOPED II methods, 458–466
PIOPED II results, 467–472
postprocedural hemodialysis, 481
in pregnant women, 179, 180
in sickle cell disease, 159
resolution, 56, 57
validity of negative, 473, 516–517
computed tomographic (CT) pulmonary angiography
(continued)
quantification of pulmonary embolism, 440
radiation exposure, 486–487
for right ventricular enlargement, 33
sensitivity and specificity according to sex, 100–101
single slice CT, 448
single slice CT with clinical assessment, 449
4-slice CT, 449
4-slice CT with clinical assessment, 449
16-slice CT, 453, 454
64-slice and more, 473, 474
with venous phase imaging, 449
triple rule-out, 474
and subsegmental pulmonary embolism, 436, 437
trends in use, 356–357,
and thrombolytic therapy, 585
and V–Q SPECT, 416
computed tomographic (CT) venography, 250–253
ascending CT venography compared with conventional
venous phase imaging, 470
complications of ascending CT venography, 250
methods of ascending CT venography, 250
venous phase CT venography methods, 250
venous phase CT venography, diagnostic criteria, 251
venous phase CT venography, validity, 251, 252,
467–470
venous phase CT venography, sensitivity for VTE, 252,
253
venous phase CT venography discontinuous images, 253
venous phase CT venography recommendations, 253
with clinical assessment, 468–471
in coronary care unit, 503
in PIOPED II, 458, 460–461, 467–472
location of thrombi, 471
contrast-enhanced magnetic resonance (MR) angiography,
490–491
contrast-induced nephropathy, 480–481
acetylcysteine, 481
congestive heart failure, 480
dipyridamole, 481
fendolapam, 481
hemodialysis, 481
hemofiltration, 481
hydration, 480–481
in PIOPED I and PIOPED II, 480
metformin, 481
nonionic contrast material, 480
iso-osmolar contrast material, 480
nonsteroidal anti-inflammatory drugs, 481
contrast material
adverse reactions to iodinated, 442–495
gadolinium, 258, 493–495
nonionic, 480
pulmonary angiography, 428–429, 443, 444
see also contrast-induced nephropathy
contrast venography, 64, 65, 87, 106–107
adequacy of visualization, 238
complications, 237
correlation with I-125 fibrinogen uptake, 238
diagnostic criteria, 237
method of, 237
correlation of postmortem contrast venography with
dissection, 238
coronary blood flow in, pulmonary embolism, 296–297
coronary care unit (CCU)
diagnosis of pulmonary embolism, 501–503
brain natriuretic peptide, 502
diagnostic pathways, 503
dyspnea and tachypnea, 502
echocardiography, 503
electrocardiogram, 502
lung scans, 503
patients in extremis, 503
Pa02 and alveolar-arterial oxygen gradient, 502
predisposing factors, 501
scoring systems, 502
signs, 502
troponin, 502
corticosteroids and hypercoagulability, 157
craniotomy and VTE prophylaxis, 641
C-reactive protein with chronic liver disease, 168
creatine kinase isoenzyme MB and prognosis of pulmonary
embolism, 3–40
critically ill patients assessment, 286–287, 444
Crohn’s disease and VTE, 166, 167
crushing injury and fat embolism syndrome, 514
cryptogenic strokes and paradoxical embolism, 146, 147
CT angiography see computed tomographic (CT)
pulmonary angiography
CT angiography index
and prognosis, 332
for quantification of PE, 440
CT pulmonary angiograms
see computed tomographic (CT) pulmonary
angiography
CT venography see computed tomographic (CT)
venography
cultural differences in home treatment of DVT, 618
curie (unit), 483
CYP2C9
in Asians, 113
and warfarin resistance, 526
cytomegalovirus disease in hypercoagulable state with HIV,
173
dabigatran, 180, 545, 546, 549, 550
danaparoid, 535
D-dimer
and age, 340–341
with alveolar dead-space fraction, 322
and angina, 502
assays, 335–337
and severity of pulmonary embolism, 340
with BNP, 349
causes of false positives in emergency department, 342
with clinical assessment,
for DVT 234–236
with clinical assessment for PE, 346–348, 516, 518–519
with compression ultrasound to exclude DVT, 236
proportion of outpatients with suspected PE, negative
D-dimer, and non-high clinical assessment, 348
and CT pulmonary angiography, 473
decreasing levels with anticoagulant therapy, 340–341
decreasing levels after onset of symptoms, 340
description of tests, 336
with NT-proBNP, 349
predicting risk of recurrent VTE, 332–333
prognostic value with pulmonary embolism, 342
for prediction of DVT, 260
in pregnancy, 340, 341
for exclusion of PE, 335–340
and prognosis, 47
and race, 340
in rheumatoid arthritis, 164
death
eyearly, 27
in hospitals, 5
in nursing homes, 5
and pulmonary angiography, 442, 443, 445
scoring predictors, 47
and fat embolism syndrome
dep deep venous thrombosis (DVT)
acute, 241, 255, 258
and air travel, 184–186
in Alaskan Natives, 116
in American Indians, 116
ascending CT venography, 250
associated with pulmonary embolism, 50
in Asians, 108–113
and asthma, 156, 157
and atherosclerosis overlap with risk factors, 141–142
and bariatric surgery, 198–201
in black people, 103–106
and cancer, 118–122, 123, 124, 618
case fatality rate, 24–25
causing pulmonary embolism, 49, 50
charges for emergency department visits and
hospitalization, 619–620
in children, 96
and chronic liver disease, 168–169
and chronic obstructive pulmonary disease, 149–154, 618
clinical assessment, 215–219, 223
clinical assessment plus ultrasound, 223, 224
clinical scoring system for assessment, 220–222
collateral veins, 12
and compression stockings, 561–563
compression ultrasound, 223, 236, 240–244
contrast venography, 237–238, 250
D-dimer, 225–230
D-dimer with clinical probability, 234, 235
D-dimer with compression ultrasound, 236
and diabetes mellitus, 162, 618
eyearly discharge with, 617, 618
in emergency departments, 21–23
in the elderly, 78, 79,
empirical assessment, 220, 221
forward thrombosis, 12
and fever, 316
fibrinogen uptake test, 248
and HIV, 173–174, 618
home treatment of, 617–620, 642
in hospitals, 19–21, 24
impedance plethysmography, 247–248, 499–500, 615
incidence according to sex, 99
and inflammatory bowel disease, 166
and intermittent pneumatic compression, 558–559
magnetic resonance venography, 255–258
methods in PIOPED II, 458–459, 461, 464
micro particles for predicting, 260
and nephrotic syndrome 171–172
and novel oral anticoagulants, 545–549
and obesity, 133–137
and oral contraceptives, 187–189
in patients with heart failure, 128–129, 130
in patients with pulmonary embolism, 8, 49, 50
predisposing factors in children and adolescents, 95–96
physical examination, 215, 217
pregnancy-associated, 95, 104, 176–80
prevalence at autopsy, 8–16
prevalence in adolescents, 95
prevalence in infants and children, 95
P-selectin for predicting, 260
rate of organization, 8
regional rates of diagnosis, 73, 74, 75
retrograde thrombosis, 12
and rheumatoid arthritis, 164, 165
seasonal variability, 69, 70
and sickle cell disease, 158–160
and silent pulmonary embolism, 506, 507
and stroke, 143–144
thrombolytic therapy for, 567–573
untreated, 49, 50
and vena cava filters, 603, 604, 643
venous phase CT venography, 250–253, 503
in white people, 103–106, 108–110
see also lower extremity DVT; paradoxical embolism;
upper extremity DVT
dermatan sulfate in heparinoid, 535
dermatan sulfate cofactor, 208
desirudin, 542, 543
diabetes mellitus and venous thromboembolism, 162–163
diagnosis
diagnosis (continued)
and race, 105 – 106
rate of, 73, 75, 76, 78, 79, 108 – 109
and sex, 99 – 101
diagnostic approach to pulmonary embolism, 516 – 519
allergy to contrast material, 518
clinical assessment with D-dimer, 516
discordance between clinical probability and CT angiogram, 517
impaired renal function, 518
lung ultrasound, 519
patients in extremis, 519
perfusion lung scans with chest radiograph, 518
pregnant women, 518
SPECT, 518
V-Q lung scans since PIOPED, 517 – 518
validity of negative CT angiogram, 516 – 517
venous phase venography, 516
venous ultrasound, 517
women of reproductive age, 518
diagnostic tests
in the elderly, 87 – 89
and race, 105 – 106
according to sex, 100
dialysis to reverse anticoagulant effects, 542
see also hemodialysis
diethylstilbestrol and VTE in men, 192
diffusing capacity of the lung for carbon monoxide (DLCO) impairment after PE, 58, 576
digital subtraction pulmonary angiography (DSA), 428
effective dose of radiation, 484
interpretation, 429
peripheral injection, 431 – 432
dipyridamole and contrast-induced nephropathy, 481
direct thrombin inhibitors
parenteral, 540 – 543
agatromab, 543
bivalirudin, 543
hirudin, 542 – 543
monitoring, 542
reversal, 542
sites of action, 542
oral, 545 – 550
approval date, 546
bleeding, 545
dabigatran, 545 – 550
effectiveness, 545
extended treatment, 550
idarucizumab for reversal, 545
indications, 546
in pregnancy, 180
mechanism of action, 547
monitoring, 545
pharmacology, 549 – 550
reversal of bleeding, 545
mechanism of action, 545
monitoring, 542
reversal of anticoagulant effects, 542
disfibrinogenemia, 208, 209
DLCO see diffusing capacity of the lung for carbon monoxide
DNA
damage from radiation, 487
testing for factor V Leiden, 207
testing for prothrombin G20210A, 207
Doppler ultrasonography
and venous blood velocity with ankle exercise, 565
use in the elderly, 87, 88
dose-length-product (DLP) and radiation exposure, 483
dosiflexion repetitive, and venous blood velocity, 565 – 566
DTPA see 99mTc-diethylenetriamine pentaacetate
dual-energy computed tomographic (CT) pulmonary angiography, 474 – 476, 484
duplex ultrasonography, 240, 241, 242
dysplasminogenemia, 208, 209
dyspnea, 79, 81, 82, 182, 502
and fever, 316
early death in pulmonary embolism, 27
ecarin clotting time (ECT), 542, 543
echocardiography
and age, 86
bedside tests, 503, 519
diagnosis of pulmonary embolism, 352 – 354
for patients in coronary care unit, 503
transsthoracic, 635
with venous ultrasonography, 352, 519
economy class syndrome, 184
edema
bilateral with DVT, 216
and compressing stockings in travelers, 185
interstitial, 305
leg, 185, 563
lower extremity, 599
and lower extremity DVT, 215
perivascular on CT pulmonary angiogram, 472
unilateral with DVT, 216
see also pulmonary edema
edoxaban, 546, 549, 550
effort thrombosis and upper extremity DVT, 61
elastic stockings
see compression stockings
elderly, the
acute hemorrhage/infarction syndrome, 82 – 83
diagnosis of pulmonary embolism, 78, 79, 80
DVT in, 78, 79, 80
pulmonary embolism at autopsy, 5, 7
treatment of, 90 – 92
use of diagnostic tests in, 87 – 89
electrocardiogram (ECG)
definitions of abnormalities, 289 – 290
duration of abnormalities, 294–295
mechanism of abnormalities, 297–299
and pneumonia, 298, 300
prevalence of abnormalities, 289–294
and pulmonary embolism, 282, 283,
289–301
relation of abnormalities to severity
of PE, 295–297
relation of changes to right ventricular dilatation,
299–300
ELISA see enzyme-linked immunosorbent assay
embolectomy, 39, 47, 592, 610
catheter-tip, 589–594
emergency departments pulmonary embolism and DVT
in, 18–23, 27
charges for DVT, 619
empyema
CT pulmonary angiography, 476
and left-axis deviation 293
and perfusion defects, 476
pulmonary angiography, 153, 428
ventilation–perfusion lung scans, 363
wedge angiography, 153
empirical assessment
DVT; 220, 221
pulmonary embolism, 324–327
endocannabinoid system and mortality paradox in obesity,
136
endothelial cells in acquired thrombophilia, 209,
and P-selectin, 260
and heparin binding, 531
and intravascular coagulation, 540
and intermittent pneumatic compression, 558
dysfunction in diabetes mellitus, 162
with chronic liver disease, 168
injury in acquired thrombophilia, 209
Weibel-Palade bodies, 260
enoxaparin 136, 547
and bariatric surgery, 198
dose, 534
and prevention of DVT, 185, 534
enzyme-linked immunosorbent assay (ELISA), 225, 230,
234, 236, 335–337, 340
see also quantitative rapid ELISA
erythema with upper extremity deep venous thrombosis,
62
erthrocyte sedimentation rate in fat embolism syndrome,
511
E-selectin in black women with DVT, 105
estrogen
and diabetes mellitus, 163
effect on coagulation proteins, 192
in men, 192
oral contraceptive drugs, 187–189, 192
transdermal administration, 192
see also oral contraceptives
European Association of Nuclear Medicine Guidelines for
SPECT, 412, 415
factor Va inhibitors, 540
factor V–Leiden, 105, 111, 116, 168, 207
and air travel, 184
and coagulation assays, 205
and DVT, 207
and oral contraceptives, 188–189
and pulmonary embolism, 207
and tamoxifen, 195
and testosterone, 192–193
and thrombophilia, 210
testing for, 207
factor VIII
and DVT, 207–208
factor VIIIa inhibitors, 540
factor Xa inhibitors
apixaban, 545–549
approval dates, 545–546
bleeding, 545, 548
doxaban, 545–549
effectiveness, 545–546, 548
extended treatment, 549
for prophylaxis following hip or knee replacement,
545–547
mechanism of action, 545, 546
pharmacology, 549–550
in pregnancy, 180
reversal of bleeding, 545
doxabxan, 545–549
fat embolism syndrome, 363, 511–514
and acute chest syndrome, 158
clinical description, 511
mortality, 511
in non-orthopedic patients, 515
prevalence, 511
prevalence according to fracture, 511–514
fatty liver and fat embolism syndrome, 514
femoral vein ligation, 597
femoral veins on postmortem venograms, 8, 11, 13, 15
fendolopam and contrast-induced nephropathy, 481
fever
and DVT, 316
in pulmonary embolism, 316–317
and VTE in coronary care unit, 502
fibrin and thrombus organization, 8
fibrin degradation products, 157, 168
fibrin-binding MR contrast agents, 258
fibrinogen uptake test, 248
fibrinolysis, 35, 37
catheter-directed, 593
impaired, 208
and intermittent pneumatic compression, 558
fibrous mediastinitis simulating chronic thromboembolic
pulmonary hypertension, 635
flight-related DVT, 184
see also air travel; long-distance travelers
flow-related artifacts and CT pulmonary angiography, 472
fluorescence polarization immunoassays for diagnosis of
hyperhomocysteinemia, 208
focal oligemia on chest radiograph, 305
fondaparinux, 536
use in pregnancy, 180, 536
foot pumps, 558, 559
forward thrombosis, 12
fractures and fat embolism syndrome, 511–514
fragmentation of pulmonary emboli, 592
with angiographic catheters, 589–590
with catheter-tip device, 590
and rt-PA, 590
gadolinium containing contrast material, 258, 491–495
gadolinium-enhanced magnetic resonance (MR)
pulmonary angiography, 491, 493
gadolinium-enhanced magnetic resonance (MR) venography, 64, 67, 255–257
gangrene from warfarin, 528, 567
gastric carcinoma and VTE, 118
 genetic disease following radiation exposure, 487
Geneva system for prognosis, 43, 44, for probability of pulmonary embolism, 324–326, 331, 348, 516
gestodene in oral contraceptives, 189
glucocorticoids and VTE risk, 157
glycoprotein IIb/IIIa and radiolabeled markers, 426
graduated compression stockings, 561–563
and venous blood velocity, 561
after general surgery, 561
after orthopedic surgery, 562
for prevention of post-thrombotic syndrome, 563
in long distance air travel, 563
in medical patients, 561
mechanism of action, 561
Greenfield catheter, 589
Greenfield filters, 597, 599, 600
heart, enlargement of, and very low probability lung scan, 386, 389
heart failure
and antithrombotic prophylaxis, 130–131
and D-dimer, 502
and DVT, 128–129, 130, 501, 618
and pulmonary embolism, 128–130, 265, 501
and VTE, 128–131
heart-type fatty acid binding protein (H-FABP) and prognosis, 40, 47
height, and risk of DVT, 184, 185
hemidiaphragm
on chest radiograph, 303, 305
and very low probability lung scan, 386, 389
hemodialysis
for contrast nephropathy, 481
for reversal of anticoagulant effect, 542
hemodynamic instability
and pulmonary embolectomy, 626
and vena cava filters, 608–610
hemofiltration for contrast nephropathy, 481
hemophilic factors, 111–113
hemothysis, 81, 82, 86, 101
and pulmonary embolism, 267, 275, 281, 306
hemorrhage
intracerebral with thrombolytic therapy, 584–585
and lepirudin, 543
and unfractionated heparin, 533
hemorrhagic stroke
and VTE, 143
and thrombolytic therapy, 579
heparin unfractionated
and antithrombin III deficiency, 204
and bariatric surgery, 136
bleeding risk, 533
and disfibrinogenemias, 208
and DVT, 25, 555
immediate therapeutic levels and recurrent events, 555–557
initial dosing, 531
monitoring, 531–532
non-bleeding complications, 533
osteoporosis, 533
reversal of anticoagulant effect, 533
site of action, 532
patients with stroke, 143
in pregnancy, 180
and protein C deficiency, 205
and pulmonary embolism, 555, 576
and recurrent VTE, 555–557
resistance, 532–533
reversal of anticoagulant effect, 533
skin necrosis, 533
thrombolytic therapy, 579
thrombocytopenia, 209, 533
see also low-molecular-weight heparin (LMWH)
heparin–antithrombin complex, 542
heparin–antithrombin III complex, 531
heparin cofactor II, 173, 208
heparin-induced thrombocytopenia (HIT) treatment, 209, 542–543
heparinoid, 535
H-FABP see heart-type fatty acid binding protein
hiatal hernias and ancillary findings on CT pulmonary angiography, 476
high-risk patients scoring system for PE risk, 43, 331
for contrast-induce nephropathy, 480, 481
hilar enlargement
on chest radiograph, 305
very low probability lung scan, 386, 389
hip arthroplasty, antithrombotic prophylaxis, 642
hip fracture, antithrombotic prophylaxis, 642
hip replacement, 535, 543, 558, 562
and novel oral anticoagulants, 545, 547
and vena cava filters, 603, 610
hirudin, 540, 542–543
HIT see heparin-induced thrombocytopenia
HIV see human immunodeficiency virus
Homan's sign, 215, 216
home treatment
of deep venous thrombosis, 617–620
according to age, 618
according to comorbid conditions, 618
before novel oral anticoagulants, 617
cautious approach, 617
charges for hospitalization and emergency
department, 619
decreasing length of hospital stay, 618
recommendations, 620
since novel oral anticoagulants, 619
home treatment of pulmonary embolism,
622–624
identification of low risk patients, 43–47
length of hospital stay, 619, 622
before novel oral anticoagulants, 622
since novel oral anticoagulants, 622
outcome, 622–623
recommendations, 624
homocysteine, 193, 208
hormone replacement therapy, 189
hospitalization
see length of hospital stay
hospitals
deaths in, 5
diagnostic imaging in, 356–357
DVT in, 19–21, 24
pulmonary embolism in, 18, 25–29
see also bedside tests; hospitalization
human immunodeficiency virus (HIV), 105, 173–174,
618
Hunter, John, 13
hydrolyser catheter, 591
hypercoagulable state
acquired dysfibrinogenemia, 209
acquired thrombophilia, 208, 209
elevated factor VIII, 207, 208
elevated factor XI, 208
antiphospholipid syndrome, 208, 209
antithrombin III deficiency, 204
diagnostic approach, 210
heparin cofactor II deficiency, 208
heparin-induced thrombocytopenia, 209
hyperhomocysteinemia, 208
inherited dysfibrinogenemias, 208
and HIV, 173
factor V Leiden, 207
inherited thrombophilia, 204
and myeloproliferative disorders, 209
malignancy, 210
and prostate cancer, 192
plasmin generation disorder, 208
protein C deficiency, 204, 205
protein S deficiency, 205, 206
prothrombin G202210A mutation
and proximal upper vein thrombosis, 63
and sickle-cell disease 158
sticky platelet syndrome, 208
hypercoagulable syndrome, 204–210
hyperemetic zones on chest radiograph, 305
hyperhomocysteinemia, 208
hypertension
and risk of VTE, 139, 141
see also pulmonary hypertension
hypocapnia in pulmonary embolism, 314
hypoxemia in pulmonary embolism, 314
and acute chest syndrome, 158
and electrocardiographic changes, 297, 299
I-125 fibrinogen tests and DVT after venography, 238
image noise on CT angiograms, 472
imaging tests
availability in hospitals, 356–357
in children, 96–97
trends in, 356–357
immobilization
and antithrombotic prophylaxis and pulmonary
embolism, 266, 275, 501
and upper extremity DVT, 63
impedance plethysmography (IPG)
diagnosis of DVT, 247–248, 499–500
and serial tests to exclude pulmonary embolism, 499
outcome after negative impedance plethysmogram, 249
indinavir and VTE risk, 173
indwelling catheters in children and VTE, 95–96
infants
antithrombotic therapy, 97
prevalence of pulmonary embolism, 95
inferior vena cava (IVC)
thrombi at autopsy, 11
gadolinium-enhanced-MR venography, 257
ligation, 597
inferior vena cava (IVC) filters
see vena cava filters
infiltrates on chest radiograph, 303, 305, 306
inflammation and thrombophlebitis, 13–15
inflammatory bowel disease and VTE, 166–167
INR see international normalized ratio
insulin and protamine sulfate reaction, 533
intensive care units
diagnosis of pulmonary embolism in, 286
use of intermittent pneumatic compression, 559
intercellular adhesion molecule in blacks, 105
interleukin-6 with non-alcoholic liver disease, 168
intermittent pneumatic compression (IPC)
compliance in use, 559
and DVT, 558–559
after general surgery, 558
after orthopedic surgery, 558–559
mechanism of action, 558
international normalized ratio (INR), 90, 523
and direct thrombin inhibitors, 542
management with vitamin K antagonist, 640
optimal level, 523–525
reversal of, 527–528
stability of, 525
interstitial edema on chest radiograph, 305
interstitial lung disease and physiological dead space, 321
intracerebral hemorrhage, 582, 584–585
intraluminal filling defects on pulmonary angiograms, 427, 428
on CT pulmonary angiograms, 461
on MR angiograms, 491, 494
IPC see intermittent pneumatic compression
IPG see impedance plethysmography
ipsilateral asymmetry and DVT, 216
ischemic stroke and VTE, 143–144, 146, 147
iso-osmolar contrast material, 480
IVC see inferior vena cava

JUPITER trial, statins, 142

kallikrein in diabetes mellitus, 162
Kaposi's sarcoma and hypercoagulable state in HIV infection, 173
knee arthroscopy antithrombotic prophylaxis, 642
knee replacement
antithrombotic prophylaxis, 535, 558, 562
and novel oral anticoagulants, 545, 547
and vena cava filters, 603, 610

81mKr, 359

late dead-space fraction in diagnosis of PE, 321, 322

left turbidimetric assay
for exclusion of DVT, 225, 226
for exclusion of PE, 335, 336
left-axis deviation, 291, 293, 294, 300
left coronary flow in PE, 296, 297
legs
crossing and venous blood flow, 566
edema in travelers, 185, 563
with vena cava filters, 599–601
injury antithrombotic prophylaxis, 642
pain, 218
ulceration post-thrombotic syndrome and thrombolytic therapy, 567

see also ankle exercise; calf muscle exercise; leg tests
leg tests serial, 52, 499–500, 615–616
length of hospital stay
for deep venous thrombosis, 619
according to race, 106, 110, 111
according to sex, 101
for pulmonary embolism, 619,
according to race, 106, 110, 111
according to sex, 101
lepirudin, 542, 543
leukemia
and VTE, 118
and home treatment of DVT, 618
leukocytes in organization of thrombi, 8
leukocytosis in acute pulmonary embolism, 319–320
levonorgestrel, 189
liver disease and venous thromboembolism, 168–170
LMWH see low-molecular-weight heparin
long-distance travelers, 640

see also see also air travel; flight-related DVT

lower extremities, gadolinium-enhanced-MR venography, 255, 256
lower extremity edema with vena cava filters, 599, 601
lower leg injuries, antithrombotic prophylaxis, 642
lower limb exercise in travelers, 185–186
low-molecular-weight heparin (LMWH), 533–534
and bariatric surgery, 198
and bleeding, 534, 535
prevention of DVT in travelers, 185
monitoring, 533
site of action, 534
and protein C deficiency, 205
reversal of anticoagulant effect, 535
use in pregnancy, 180
low-risk patients, scoring systems, 43–47, 330, 331

lungs
alveolar dead-space, 321–322
examination, 269, 502

lung scans
advances since PIOPED, 407
use according to age, 88, 96–97
trends in use, 356–357
diagnostic criteria prior to PIOPED, 363–366
diagnostic criteria in PIOPED, 368
diagnostic criteria, trinary interpretation, 377
diagnostic criteria, PIOPED revised, 381–384
diagnostic criteria, PISA-PED, 377
diagnostic criteria, very low-probability, 385–390
results of PIOPED, 367–373
results according to complexity of lung disease, 374–375
with clinical assessment, 372–373
perfusion scans interpreted with chest radiograph, 377, 408–409
interpretation according to largest vessels involved, 379–380
probability according to number of mismatched segmental equivalent perfusion defects, 392–394
probability based on mismatched vascular defects, 395–400
probability according to prior cardiopulmonary disease and number of mismatched vascular defects, 398–399
probability with clinical assessment, number of mismatched vascular segments and prior cardiopulmonary disease, 401–406
results in outpatients with modified PIOPED criteria, 408
outcome with trinary criteria, 408
in pregnancy, 179, 180

techniques, 358–362
see also perfusion lung scans; ventilation lung scans;
ventilation–perfusion (V–Q) lung scans

lung ultrasound in diagnosis of PE, 519

lupus anticoagulant
in children, 96
with liver disease, 168
testosterone and VTE, 193
and hypercoagulable syndrome, 209
lymph nodes on CT pulmonary angiography, 476
lymphoma
  and vena cava filters, 607
  and VTE, 118
  and home treatment of DVT, 618

MAA see 99mTc-macro aggregated albumin
magnetic resonance direct thrombus imaging, 255, 258
magnetic resonance imaging units, availability in hospitals, 356
magnetic resonance (MR) pulmonary angiography
  complications, 491–495
  contrast-enhanced, 490–491
  for diagnosis of acute pulmonary embolism, 490–496
  gadolinium-enhanced, 491, 493
  with MR venography, 256–257, 491
  nephrogenic fibrosing dermopathy, 493–494
  nephrogenic systemic fibrosis, 493–494
  perfusion imaging, 495–496
  in PIOPED III, 490, 491, 493
  since PIOPED III, 491
  and sickle cell disease, 159–160
  without contrast material, 495
magnetic resonance (MR) venography,
  complications, 257–258
  direct thrombus imaging, 258
  diagnostic criteria, 256
  for diagnosis of DVT, 255–258
  gadolinium-enhanced, 64, 67, 255–257
  of the lower extremities, 255, 256
  of upper extremities, 64, 67, 257
  with MR pulmonary angiography, 256–257, 491
  of the veins of the thighs, 255, 256
  venous phase MR venography, 491
  without contrast material, 255
major bleeding
  and aspiration thrombectomy, 589
  and aspirin, 553
  and bivalirudin, 543
  definition, 526, 582, 583
  and fondaparinux, 536
  and fragmentation with catheters, 590
  and LMWH, 534, 535
  and rt-PA, 583
  scores for predicting, 526–527
  at site of catheter insertion, 582–583, 584
  and streptokinase, 584
  and thrombolytic therapy, 579, 580, 582–584
  and ultrasound-accelerated thrombolysis, 593
  and unfractionated heparin, 533
  and urokinase, 584
  and vitamin K antagonists, 526
  see also bleeding
maternal death and pulmonary embolism, 176, 182
medialstinal carcinoma in suspected chronic
  thromboembolic pulmonary hypertension, 635
  mediastinum, enlargement in very low probability lung scan, 386, 389
men
  case fatality rate, 29
  estrogen in, 192
  incidence of DVT in, 99
  incidence of pulmonary embolism in, 99
  and IVC filters, 598
  obese, 133, 135
  rates of diagnosis, 73, 76, 78
  stress and VTE risk in, 141
  testosterone in, 192–193
  use of diagnostic tests, 100
  VTE in, 99–102
metformin and contrast-induced nephropathy, 481
methemoglobin and direct thrombus imaging with MR, 258, 260
Miller index for quantification of PE, 441
mismatched vascular defects, 395–398, 399, 401–406
Mobin–Uddin umbrella filter, 597
mortality
  and fat embolism syndrome, 511
  in obese patients, 135–136
  from PE in patients with heart failure, 129–130, 305
  and pulmonary embolectomy, 626
  from pulmonary embolism, 75–76, 104–105, 332, 342
  regional rates, 75–76
  and right ventricular enlargement, 31, 33, 34, 37
  scoring predictors, 44
  seasonal variability, 69, 70
  and thrombolytic therapy, 577–580
  with vena cava filters, 605–611
MR venography see magnetic resonance (MR) venography
MTHFR mutation, 168
mucus plugs and misinterpretation of CT pulmonary angiograms, 472
musculoskeletal pain and abnormal D-dimer, 341
myeloproliferative disorders and hypercoagulable syndrome, 209–210
and VTE, 118
myocardial infarction
  and D-dimer, 502
  distinguishing from pulmonary embolism on electrocardiogram, 291
myocardial ischemia on electrocardiogram, 297
myocardial perforation with pulmonary angiography, 442, 444
myocardial stretch and natriuretic peptide in pulmonary embolism, 349
myocardial underoxygenation, 297
myoglobin and prognosis of pulmonary embolism, 38, 47
National Hospital Discharge Survey (NHDS), 18, 69, 108, 128, 133, 135, 147, 156, 162, 164, 166, 173, 176, 182, 247, 356, 511, 597, 626
Nationwide Emergency Department Sample, 27, 617
Nationwide Inpatient Sample, 19, 24, 25, 126, 135, 136, 198, 201, 584, 617
natriuretic peptides and prognosis of pulmonary embolism, 38–39
  with D-dimer for exclusion of pulmonary embolism, 349
necrosis
   skin with vitamin K antagonists, 528, 533, 562
neoplasms
   and D-dimer, 341
   ventilation–perfusion lung scan, 363
   and VTE, 118, 122
nephrogenic fibrosing dermopathy (NFD), 258, 490,
   493–495
nephrogenic systemic fibrosis (NSF), 258, 490, 493–495
   nephropathy from iodinated contrast material, 480–481
nephrotic syndrome and VTE, 171–172
neutrophils and pulmonary embolism, 319
NFD see nephrogenic fibrosing dermopathy
nitroglycerin and heparin resistance, 532
nocturnal asthma and pulmonary embolism, 157
non-steroidal anti-inflammatory drugs and
   contrast-induced nephropathy, 481
novel oral anticoagulants, 545
   and bleeding, 545, 548, 549
   effectiveness, 545–549
   extended treatment with, 549, 550
   mechanism of action, 545
   pharmacology, 550–551
see also anticoagulants
NSF see nephrogenic systemic fibrosis
NT-proBNP
   and prognosis in pulmonary embolism, 38–39, 47, 331
   in coronary care unit, 502
   with D-dimer for exclusion of pulmonary embolism, 349
Nurses’ Health Study, 139, 141, 163
nursing mothers and warfarin, 525
nutritional factors in VTE, 141

obesity
   age-dependence of risks, 133–135
   bariatric surgery, 136, 137
   antithrombotic prophylaxis, 198
   in blacks, 105
   definitions of, 135
   and DVT, 133–137
   mechanism of DVT in, 135
   morbid, 198
   mortality paradox, 135–136
   and oral contraceptives, 188
   and pulmonary embolism, 133–136, 141
   and VTE, 133–137, 141
obstructive lung disease
   differentiating from pulmonary embolism, 321
   use of 99mTc-Technegas, 360
oligemia
   on chest radiograph, 303, 306
   pulmonary angiography, 427, 428
oral contraceptives
   dose, 187
   duration of use, 187–188
   and DVT, 184, 185, 187–189

and factor V Leiden, 188–189
and factor VIII, 208
and modifications of coagulation proteins, 189
and obesity, 136, 188
and postoperative VTE, 188
role of progesterone, 189
and smoking, 188
in teenage users, 95
and VTE, 187
orthopedic surgery
   in Asians risks of VTE, 113
   and aspirin, 552
   in children risks of VTE, 96
   and compression stockings, 562–563
   and intermittent pneumatic compression, 558–559
   and VTE, 113, 558, 642
orthopnea in pulmonary embolism, 267, 275, 501
osteoporosis with unfractionated heparin, 180, 533
outcomes
   outcome versus accuracy, 478–479
   with multidetector scanners, 473
   PIOPED II, 478–479
   scoring predictors, 44, 45, 46, 47
   untreated patients, 50–52
   untreated patients with negative serial noninvasive leg
   tests, 615–616
oxygen
   alveolar–arterial difference, 87, 151, 152, 306, 307
   partial pressure in arterial blood (P_{\text{a}} O_{2}), 297, 299, 306,
   307, 308, 309, 311, 502
P-selectin, 260
pacemaker wires and upper extremity DVT, 61
Pacific Islanders and VTE, 108–110
Paget–Schroetter syndrome in upper extremity DVT, 61
PAI-1 see plasminogen activator inhibitor-1
palpitations and relation to right sided pressures, 274
pancreatic cancer and VTE, 118, 119, 121
pancreatitis and fat embolisms syndrome, 514
panniculitis and fat embolisms syndrome, 514
and alveolar–arterial oxygen difference, 313, 314
paradoxical embolism, 146–147
partial volume artifacts on CT angiograms, 472
patent foramen ovale, and paradoxical embolism, 146, 147
PE see pulmonary embolism
pentasaccharide, 535
peptides, natriuretic, for prognosis of pulmonary
   embolism, 38–39,
   for exclusion of pulmonary embolism 349
PERC see pulmonary embolism rule-out criteria
percutaneous transvenous closure of patent foramen ovale,
   146, 147
perfusion defects, 386, 387, 388
   and cardiopulmonary disease, 391–398, 401–406
   and emphysema, 476
   mismatched segmental, 391–393, 395, 396, 402
   nonsegmental, 386, 389
and occlusion of the pulmonary arteries, 475–476
stripe sign, 387, 389, 476
perfusion lung scans see lung scans
abnormalities, 363, 364
with chest radiograph, 377–378
with clinical assessment, 377
effective dose of radiation, 484
interpretation by PISA-PED, 475–476
with normal chest radiograph, 518
in pregnancy, 180
in pulmonary embolism, 376–378
techniques, 360–361
resolution of, 54, 55, 55
perfusion SPECT
compared with planar V–Q scans, 421
compared with V–Q SPECT, 421
and low-dose noncontrast enhanced CT, 421, 422
radiation dose, 415, 485
pericardial disease on CT pulmonary angiograms, 476
peripherally inserted central catheters (PICCs) and upper extremity DVT, 61, 66
perivascular edema as cause of misdiagnosis on CT pulmonary angiograms, 472
PESI see pulmonary embolism severity index
pH of arterial blood in pulmonary embolism, 308, 310
phlebitis, 13, 194, 195
postvenography, 238
see also thrombophlebitis; toxic endphlebitis
phlebothrombosis, 13–15
physiological dead-space fraction in diagnosis of pulmonary embolism, 321, 322
PICCs see peripherally inserted central catheters
PIOPED see Prospective Investigation of Pulmonary Embolism Diagnosis
PIOPED I see Prospective Investigation of Pulmonary Embolism Diagnosis
PIOPED II see Prospective Investigation of Pulmonary Embolism Diagnosis II
PIOPED III see Prospective Investigation of Pulmonary Embolism Diagnosis III
Pisa clinical model for assessment of probability of pulmonary embolism, 326, 327
PISA-PED see Prospective Investigative Study of Pulmonary Embolism Diagnosis
planar V–Q scintigraphy
and perfusion SPECT, 421
and V–Q SPECT, 416, 419–420
plantarflexion repetitive and venous blood velocity, 565–566
plasma clotting time, 207
plasminogen
conversion to plasmin, 350
dehcreased levels of in hypercoagulable syndrome, 208
plasminogen activator inhibitor-1 (PAI-1), 105, 135, 156, 157, 162, 164, 168, 173, 193, 208
for the exclusion of pulmonary embolism, 350
platelets
activation in asthma, 157
factor 4
in heparin-induced thrombocytopenia, 209
in thrombus organization, 8
transfusion in heparin-induced thrombocytopenia, 209
pleonemia on chest radiograph, 303
pleural-based opacity on chest radiograph, 306
pleural disease, as ancillary finding on CT angiogram 476
pleural effusion
chest radiograph, 304, 305
and pulmonary embolism, 269, 283, 303, 304, 305, 306, 389
pleural friction rub in pulmonary embolism, 269, 274
pleurisy and D-dimer, 341
pleuritic pain
according to age in pulmonary embolism, 81, 82, 86
and D-dimer, 341
and pulmonary embolism, 267, 270, 274, 275, 277, 281, 285
pneumonia
and D-dimer, 341
and electrocardiogram, 298, 300
distinguishing from pulmonary infarction, 319–320
pneumothorax, on chest radiograph 303, 502
polycythemia vera and hypercoagulable syndrome, 209
polyestradiol in men, 192
POMPE-C tool for mortality prediction, 332
population mortality rate, 29–30, 110–111
post-thrombotic syndrome
and compression stockings, 563
and thrombolytic therapy, 567, 570
and upper extremity DVT, 62
postvenography thrombosis, 23
pregnancy, 95, 104
anticoagulant therapy in, 180
and compression stockings, 561
dep deep venous thrombosis, 95, 104, 176–180
D-dimer in, 340, 341
diagnostic approach for PE, 518, 519
and age, 176, 177
and factor VIII, 208
impedance plethysmography, 248
method of diagnosis of PE and DVT, 180, 518, 519
and novel oral anticoagulants, 551
and pulmonary embolism, 177, 178–180
and race, 177
and warfarin, 525
PREPIC see Prévention du Risque d’Embolie Pulmonaire par Interruption Cave
PREPIC2 see Prévention du Risque d’Embolie Pulmonaire par Interruption Cave 2
Prévention du Risque d’Embolie Pulmonaire par Interruption Cave (PREPIC), 603, 604
Prévention du Risque d’Embolie Pulmonaire par Interruption Cave 2 (PREPIC2), 602, 607–608
progesterone in oral contraceptives, 187, 189
prognosis
acute pulmonary embolism, 31–40, 329–333
prognosis (continued)
high risk and low risk patients,
pulmonary embolism severity index (PESI) score, 43, 329
simplified pulmonary embolism severity (PESI) score, 44, 329
Geneva score, 331
low risk patients,
Geneva score, 44
Davies exclusion criteria for early discharge, 45, 332
multimarker prognostic model, 45
Agterof score, 45
Aujesky score, 45, 330
Uresandi score, 45
den Exter score, 45
cardiac biomarkers for low risk, 47
multimarker model, 330, 332
Spanish score, 332
patients with cancer, 332–333
based on CT angiographic severity, 333
based on D-dimer level, 333
D-dimer and recurrent VTE, 333, 334
based on scoring systems, 43–47
identification of high-risk patients, 43
identification of low-risk patients, 43–47
and cardiac troponins, 33–35
and right ventricular enlargement or
dysfunction, 31–33
and thrombolytic therapy with right ventricular
dysfunction and elevated cardiac troponins,
35–37
and myoglobin, 38
and natriuretic peptides, 38
and serum uric acid, 39
and creatine kinase isoenzyme MB, 39
and plasma heart-type fatty acid binding protein, 39
Prospective Investigation of Pulmonary Embolism
Diagnosis I (PIOPED I)
clinical assessment in combination with lung scans, 373
criteria for very low probability, 385–390
diagnostic criteria for lung scans, 368
distribution of interpretations in patients with suspected
pulmonary embolism, 372
distribution of interpretations in patients with proven
pulmonary embolism, 372
interpretation of V-Q scans according to complexity of
disease, 374–375
interpretation of V-Q scans according to largest
pulmonary artery branches involved, 379–380
interpretation of V-Q scans according to number of
mismatched segmental equivalents perfusion
defects, 391–394
interpretation of V-Q scans according to number of
mismatched mismatched vascular perfusion
defects, 395–399
interpretation of V-Q scans according to prior
cardiopulmonary disease, 395–399
Interpretation of V-Q scans according to prior
cardiopulmonary disease and clinical assessment, 401–406
outcome studies, 478
positive predictive value of V-Q scans according to
interpretation probability, 370, 372
revised criteria of interpretation, 381–384
Prospective Investigation of Pulmonary Embolism
Diagnosis II (PIOPED II)
complications, 471–472
CT angiography, 467–472
CT venography, 467–472
diagnostic criteria for DVT, 458–459, 461, 464
DSA angiography, 458, 459, 460, 463–464, 465
location of venous thrombi, 471
lung scan interpretation, 463
methods of, 458–464
criteria for CT diagnosis of PE, 461
Criteria for diagnosis of DVT by venous phase
venography, 461
CT angiography technique, 460
CT venous phase venography, 461
pulmonary angiography technique, 464–465
procedures to minimize risk, 41
reference standard, 459
V-Q techniques, 461–462
chest radiograph, 463
V-Q interpretation
objectives, 458, 467
perfusion imaging techniques, 462
positive predictive value according to largest pulmonary
artery branch, 467
procedures to minimize risks, 461–462
pulmonary angiography techniques, 428
radioaerosol inhalation studies, 462–463
results of, 467–472
sensitivity analysis and specificity of CT angiography,
467
sensitivity and specificity of CT pulmonary angiography
with venous phase venography, 467
sensitivity and specificity of CT pulmonary angiography
with venous phase venography and clinical
assessment, 468
time interval for imaging, 462
venous phase spiral CT, 461
venous ultrasonography techniques, 458, 459, 460
ventilation imaging techniques, 462
ventilation–perfusion lung scans, 458–460, 462, 463, 464
xenon ventilation studies techniques, 462
Prospective Investigation of Pulmonary Embolism
Diagnosis III (PIOPED III)
MR pulmonary angiography, 490, 491, 493
MR venous phase imaging, 491
complications, 491–495
Prospective Investigative Study of Acute Pulmonary
Embolism Diagnosis (PISA-PED)
interpretation of perfusion lung scans, 376–378, 518
protamine sulfate, 533, 535
protease inhibitors and VTE in HIV infection, 173
for treatment of sepsis, 540
protein C deficiency and hypercoagulable syndrome,
204–205
and DVT, 204
and pulmonary embolism, 204
screening tests, 204–205
treatment, 205
types of, 204
protein S deficiency and hypercoagulable syndrome, 205
screening tests, 205
treatment, 205
types of, 205
prothrombin G20210A, 105, 195, 207
testing for, 207
and VTE, 210
prothrombin time, 523, 525
prothrombotic state, 209
P-selectin
for predicting DVT, 260
in combination with Wells score, 260
pseudo-infarction on electrocardiogram, 291, 294, 295, 502
pseudo left-axis deviation on electrocardiogram, 293
PT20210A in chronic liver disease, 168
pulmonary angiography
agreement on interpretation, 430–431
complications of, 442–445
digital subtraction, 431–432
peripheral injection, 431–432
criteria for diagnosis, 428, 429
and contrast-induced nephropathy, 480
for diagnosing pulmonary embolism, 427–433
historical development, 427–428
outcome with normal, 429–430
postmortem angiography, 5
resolution, 56
with emphysema associated with alpha-1 antitrypsin
deficiency, 153
trends in use, 356
quality of, 429
quantification of pulmonary embolism, 440
techniques, 428–429
cineangiography, 429
balloon-occlusion cineangiography, 429,
wendge arteriography, 429–432
use in the elderly, 89
see also computed tomographic (CT) pulmonary
angiography;
subsegmental, 379, 449
pulmonary artery
dilatation of, on chest radiograph, 305–306
infusion of thrombolytic agents into, 574–576
resolution of thrombi in lobar, main or segmental, 57
pulmonary artery pressure
relation to clinical characteristics, 272–274, 282
relation to electrocardiographic abnormalities, 295, 296, 299
and pulmonary angiography complications, 444
radiographic abnormalities, 306
relation to alveolar–arterial oxygen difference, 313–314
pulmonary artery sarcoma and misdiagnosis on CT
angiograms, 472
and suspected chronic thromboembolic pulmonary
hypertension, 635
pulmonary artery stump, and misdiagnosis on CT
angiograms, 472
pulmonary artery trunk on chest radiograph, 303
pulmonary cineangiography, 429
pulmonary consolidation and V-Q lung scan, 363
pulmonary edema
and pulmonary angiography, 443
and pulmonary embolism and chest radiograph, 303, 305
diffuse, and perfusion lung scan 363
pulmonary embolectomy
and age, 631
indications and outcome in case series, 626–628
mortality, 626–629
patients with primary diagnosis of pulmonary
embolism, 629–630
in patients with no comorbid conditions, 629
in stable patients, 629
in unstable patients, 629
use in the elderly, 91, 92
and venacava filters, 606–607, 609–610
pulmonary embolism (PE)
and air travel, 184–185
in Alaskan Natives, 116
and alveolar dead-space, 321–322
and alveolar–arterial oxygen difference, 308–314, 502
in American Indians, 116
and arterial blood gases, 308–314
in Asians/Pacific Islanders, 108–113
and asthma, 156, 157
and bariatric surgery, 201
in black people, 103–106
and cancer, 118–126, 331–332
case fatality rate, 24–30
and chronic liver disease, 168, 169
and chronic obstructive pulmonary disease, 149–154, 286
chronic, 429, 460–461, 464, 465
clinical assessment, 86, 271, 281–282, 286–287,
clinical characteristics, 265–274, 280–285
combinations of signs and symptoms, 270, 277, 278, 281
compression ultrasound, 244, 503
contrast-enhanced spiral CT, 446–454, 461
in the critically ill, 286–287
CT angiography index, 332, 440
and diabetes mellitus, 162
diagnosis, 73, 74, 75, 244, 286, 321–322, 324–327,
echocardiogram, 352–354
in the elderly, 78–79
pulmonary embolism (PE) (continued)
in emergency departments, 18–19, 27
empirical assessment, 324–327
experimentally induced, 298
following DVT, 49, 50
and HIV, 173–174
home treatment of, 622–624
in hospitals, 18, 25–29
identifying low-risk patients, 330, 331
incidence according to sex, 99
in infants and children, 95–98
and inflammatory bowel disease, 166, 167
and leukocytosis, 319–320
massive, 305, 352, 585–6, 589–594
mortality, 75–76, 104–105, 332, 342
and nephrotic syndrome, 171
and novel oral anticoagulants, 545–549
and obesity, 133–136, 141
and oral contraceptives, 187, 188
outcomes studies, 478–479
in patients with heart failure, 128–130, 305
perfusion lung scans, 376–378
PIOPED II, 458–459, 461, 464
predisposing factors, 80–81, 95–96, 266, 275, 276, 280–281, 501
pregnancy-associated, 178–180
prevalence at autopsy, 5–7
prognostic models, 329–333
and pulmonary angiography, 427–433
and pulmonary embolectomy, 629–630
regional differences, 73–77
resolution, 54–59, 576–577
and rheumatoid arthritis, 164
seasonal variability, 69, 70
and sickle cell disease, 158–160
silent, 506–509
and stroke, 143–144
submassive, 305, 592
subsegmental, 435–439
symptoms, 81–82, 83, 85, 86, 101–102, 267, 268, 270, 275, 277, 281, 282, 501
syndromes, 81, 82, 267, 275, 276
thrombolytic therapy, 574–586
and vena cava filters, 603–604, 606, 608–610, 643
venous phase CT venography, 251–253, 516
V–Q SPECT, 412–422
in white people, 103–106, 108–110
withholding treatment, 615–616
see also recurrent pulmonary embolism; silent pulmonary embolism; subsegmental pulmonary embolism

Pulmonary Embolism Prevention (PEP) Trial, of aspirin for prophylaxis following oral hip or knee arthroplasty or hip fracture surgery, 552
pulmonary embolism rule-out criteria (PERC), 326–327
pulmonary embolism severity index (PESI), 43–44, 47, 329
see also simplified pulmonary embolism severity index score (simplified PESI score)
pulmonary hemorrhage, syndrome
chest radiograph 306
and triple match, 387
and fever, 316, 317
white blood cell count, 319–320
pulmonary hypertension, progestagen and chest radiograph, 305
and pulmonary angiography, 442, 444–445
see also chronic thromboembolic pulmonary hypertension
pulmonary infarction
chest radiograph, 305
compared with isolated dyspnea syndrome, 283–284
distinguishing from pneumonia, 319–320
and fever, 316–317
ventilation – perfusion lung scan, 363, 387
white blood cell count, 319–320
pulmonary infection and V-Q scan, 363
pulmonary parenchymal abnormalities
and age, 82, 86
and presenting syndromes, 282, 283
and chest radiograph, 303, 306
and V-Q scan, 393
pulmonary parenchymal disease, on CT angiograms, 476
pulmonary scintigraphy, since PIOPED advances since PIOPED, 407
modified PIOPED criteria in mostly outpatients, 408
outcome with low probability V-Q scans, 408
outcome with perfusion SPECT, 409
outcome with V–Q SPECT, 409
perfusion scans with chest radiograph, trinary interpretation, 408–409
pulmonary thromboendarterectomy, 636–637
recommendations by American College of Chest Physicians, 637
pulmonary vascular destruction and angiograms, 428
pulmonary vascular resistance, and resolution after pulmonary embolism, 58
pulmonary vasculitis and vascular occlusion, 363
pulmonary venous hypertension pattern on chest radiograph, 305
pulmonary wedge angiography for small emboli and loss of vascularity, 436
pulmonary wedge arteriography, 429, 430, 431, 432, 436
Q waves on ECG in pulmonary embolism, 290, 295
QRS complex
abnormalities, 294
axis, 290
low voltage, 293, 294, 300
quantitative latex agglutination assay
for exclusion of DVT, 234,
for exclusion of PE, 341, 342, 349
in combination with clinical assessment, 346–348
quantitative rapid ELISA
for exclusion of DVT, 225–230
for exclusion of PE, 335, 336–337, 516
with clinical assessment,
for DVT, 234–235
for PE, 346–348, 515

Index

quantitative latex agglutination assay
for exclusion of DVT, 234,
for exclusion of PE, 341, 342, 349
in combination with clinical assessment, 346–348
quantitative rapid ELISA
for exclusion of DVT, 225–230
for exclusion of PE, 335, 336–337, 516
with clinical assessment,
for DVT, 234–235
for PE, 346–348, 515

race
and D-dimer, 340
and diagnostic tests, 105–106
and hospital stay, 106, 110
and mortality rate from PE, 104–105
and pregnancy-associated DVT, 177
see also African-Americans; American Indians; Asians,
black people; white people
radiation, 483–487
absorbed dose, 483
age-dependency, 487
background, 486
Becquerel, 484
and breast cancer, 485–486
biological effects, 483
cell damage from, 487
Curie, 483
Gray, 483
Roentgen, 483
Sievert, 483
dose-length-product (DLP), 483
effective dose, 483, 484
equivalent dose, 483
exposure, 483
fetal exposure, 487, 519
genetic effects, 487
occupational exposure, 485
radiation with chest radiograph, 485
radiation with conventional digital subtraction angiography, 484
radiation with CT pulmonary angiography, 484
radiation with CT venous phase venography, 484
radiation with perfusion lung scan, 485
radiation with SPECT, 484–485
radiation with ventilation scan, 485
risks of cancer, 485
whole body dose, 484
radioaerosols, 462–463
radiocontrast nephropathy see contrast-induced nephropathy, 480–481
radioisotope facilities, 356
radiolabeled antibodies with SPECT, 426
rales with pulmonary embolism, 283, 502
rectum, carcinoma of, and vena cava filters 607
recombinant activated protein C for treatment of sepsis, recurrent pulmonary embolism, 99–100
and IVC filters, 610
meta-analyses, 582
and rt-PA, 581, 582
and silent pulmonary embolism, 506, 509
thrombolytic therapy, 581–582
and urokinase, 581
recurrent VTE, 99–100, 332–333, 555–557
red cells in thrombus, 8
regional mortality, 75–76
renal insufficiency
and contrast-induced nephropathy, 79, 89, 443–444, 471, 480
and NSF/NFD, 258, 493
renal vein thrombosis in nephrotic syndrome, and PE, 171, 172
resolution
of CT pulmonary angiograms, 56–57
of perfusion lung scans, 54–55
of pulmonary angiograms, 56
of V-Q SPECT, 54, 55
in lobar pulmonary artery, 57, 58
in main pulmonary arteries, 57, 58
in segmental pulmonary arteries, 57–58
diffusing capacity of carbon monoxide (DLCO), 58
respiratory motion artifacts on CT angiograms, 472
restrictive disease and V-Q scan, 363
retrograde disease and V-Q scan, 363
rheolytic technique, 590–591
rheumatoid arthritis and VTE, 164–165
rhonchi in pulmonary embolism, 269, 276
right atrial enlargement on chest radiograph, 300, 301
right-axis deviation, 290, 293, 295, 297, 300
right bundle branch block, 282, 291, 294
complete, 290, 299
incomplete, 86, 289, 295
transient, 289
right coronary flow in experimental pulmonary embolism, 297
and prognosis
right ventricular dysfunction, 31, 35–37, 39
and echocardiogram, 352–354
right ventricular enlargement
and prognosis 31–33, 34, 35, 37, 38
and thrombolytic therapy, 579
and electrocardiogram in pulmonary embolism, 299–300
and echocardiogram in pulmonary embolism, 352–354
and thrombolytic therapy, 578–579
right ventricular failure and paradoxical embolism, 146
right ventricular hypertrophy on ECG, 294, 295, 300
risk assessment of pulmonary embolism, 43–47
rivaroxaban, 180, 545, 546, 547, 549, 550, 617, 624
Index

rt-PA, 574
and catheter fragmentation, 590
intravenous injection, 574
and major bleeding, 583
and recurrent pulmonary embolism, 581, 582
resolution of pulmonary embolism, 576, 577
"safe dose", 583

S1S1T1, 289, 291, 294, 295, 299, 300
S1S2S3, 294, 296, 299, 300
scoring systems for prognosis, 43–47
seasonal variability, 69–71, 76
serial noninvasive leg tests, 499–500
outcome with suspected pulmonary embolism, 499–500
serum creatinine, 443, 471
and contrast media, 480
serum uric acid and prognosis, 39
sex, 99–101
see also men; women
sickle cell disease, 157–160
silent pulmonary embolism, 506–509
and distal DVT, 506
and proximal DVT, 506, 507
and recurrent pulmonary embolism, 506, 509
routine screening, 506
and severity, 506
simplified pulmonary embolism severity index score
(simplified PESI score), 329–330
single photon emission computed tomography (SPECT), 412–425
guidelines for use, 412
outcome after negative V-Q or Q SPECT, 421
radiation dose, 415
using CT angiography as reference standard, 416
perfusion SPECT, 421
perfusion SPECT with noncontrast CT, 421
ventilation SPECT, 415
V-Q SPECT, 415
V-Q SPECT compared with planar V-Q scans, 416
V-Q SPECT combined with noncontrast enhanced CT, 421
V-Q SPECT combined with noncontrast enhanced CT and planar V scan compared with dual energy CT, 421
guidelines for use, 412
with low-dose non-contrast CT, 421
compared with dual energy CT, 421
perfusion SPECT, 421
outcome studies with SPECT, 421
criteria for interpretation, 412
radiation, 415
ventilation SPECT, 416
ventilation-perfusion SPECT, 416
with radiolabeled markers, 426
skeletal abnormalities on CT angiograms, 476
skin necrosis
with vitamin K antagonists, 528
and compression stockings, 562
and unfractionated heparin, 533
smoking
and risk of VTE, 139, 141
oral contraceptives and VTE, 188
Spanish score for prognosis, 331
spinal injury and antithrombotic prophylaxis, 641
spinal surgery and antithrombotic prophylaxis, 641
spin echo and noncontrast MR venography, 255
sputum characteristics in pulmonary embolism, 267, 275
stability and case fatality rate, 25
stable patients
and case fatality rate, 26, 27
prognosis, 31–40
stasis and DVT in travelers, 184, 186
statin therapy and VTE, 142
stenosis of vena cava and filters, 599
stents with DVT, 567, 570
sticky platelet syndrome, 208
streak artifacts and CT angiography, 472
streptokinase, 502, 574
infusion into the pulmonary artery, 575–576
lower doses, 575
and major bleeding, 584
thrombolytic therapy, 576–577
stress as risk for VTE, 141
stroke
and compression stockings, 562
cryptogenic and paradoxical embolism, 146, 147
hemorrhagic and VTE, 143, with thrombolytic therapy, 579
ischemic and VTE, 143–144, 146, 147
ST segment on ECG in pulmonary embolism, 293–295, 296, 300
subclavian vein
Gd-MR venography, 257
thrombosis, 67
subsegmental pulmonary embolism
computed tomographic angiography, 436, 437
incidental, 435
isolated, 435
management, 436
outcome, 436, 438
postmortem, 5
pulmonary wedge angiography, 436
suction catheters for pulmonary embolism, 589
superficial venous thrombosis, 194, 644
superior vena cava (SVC), 61, 63, 64
dilatation in pulmonary embolism, 303
Gd-MR venography, 257
thromboembolic disease of, 66–67
surgery
and compression stockings, 561–562
and D-dimer, 341
general, 558, 561–562
and intermittent pneumatic compression, 558
prevention of VTE, 641–642
and upper extremity DVT, 63
systemic lupus erythematosus (SLE) and thrombophilia, 209
tachycardia
and pneumonia, 300
and pulmonary embolism, 269, 274, 276, 281, 502
tachypnea, 79, 82, 502
and pulmonary embolism, 267–270, 274, 276, 277, 285, 502
tamoxifen
and DVT, 194, 195
and pulmonary embolism, 194, 195
and superficial venous thrombosis, 194
and VTE, 194–196
treatment of breast cancer, 194–195
treatment of infertility, 195
99mTc-apticide, 426
99mTc-diethylenetriamine pentaacetate (DTPA), 359, 462
dose, 415, 485
99mTc-macroaggregated albumin (MAA), 359
dose, 415, 485
99mTc-pyrophosphate (PYP), 360, 462
99mTc-Technegas, 360, 407
dose, 485
in ventilation SPECT, 415–416, 485
TEE see transesophageal echocardiography
testosterone in men, 192–193
thigh pain with pulmonary embolism, 267
thoracic outlet syndrome and upper extremity DVT, 61
thoracic surgery and antithrombotic prophylaxis, 641
thrombectomy and thrombolysis for DVT, 567, 570, 572
thrombin – antithrombin III complexes, 192
for exclusion of pulmonary embolism, 350–351
thrombin inhibition assay and hypercoagulable syndrome, 204
thrombin time (TT) and hypercoagulable syndrome, 208
thrombocytopenia
and fat embolism syndrome, 511
heparin-induced (HIT), 209,
treatment of heparin-induced, 542–543
and unfractionated heparin, 533
thrombocytopsia and hypercoagulable state, 209–210
thromboendarterectomy, 636
thrombolysis
ultrasound-accelerated, 593–594
see also thrombolytic therapy
thrombolytic agents, 525
thrombolytic therapy
for deep venous thrombosis, 567–569
ACCP recommendation, 643
catheter-directed, 569
enhancement with rotating motorized systems, 572
enhancement with rheolytic systems, 572
enhancement with ultrasound, 572–573
locoregional, 569
systemic, 567, 568
for pulmonary embolism, 574–587
ACCP recommendation, 644
and cardiopulmonary arrest, 585–586
combined with aspiration, 589
combined with fragmentation using angiographic catheters, 589
combined with catheter-tip fragmentation device, 590
combined with rheolytic fragmentation, 590–591
combined with ultrasound accelerated thrombolysis, 593
diagnostic tests before, 585
FDA-approved regimens, 574, 575
infusion into the pulmonary artery, 574–575, 592
low doses into the pulmonary artery, 575
and major bleeding, 582–584
mechanism of action, 574
mortality not in shock, 577–578
mortality in shock, 578–579
mortality in unstable patients, 579–580
and recurrent pulmonary embolism, 581–582
during cardiopulmonary arrest, 585–586
resolution of functional abnormalities, 576–577
resolution with streptokinase, 576–577
resolution with urokinase, 576
and right ventricular dilatation, 578
and right ventricular dysfunction, 578
systemic for deep venous thrombosis, 567–568, 567–569
unapproved regimens, 574
use in the elderly, 90–91
and vena cava filters, 579, 606, 608–609
see also thrombolysis
thrombomodulin and role in intravascular coagulation, 540
thrombophilia, 189, 193
acquired, 208–209
asymptomatic, 640–641
diagnostic approach, 210
inherited, 204, 210
and protein C deficiency, 204
and VTE, 204
thrombophlebitis, 13–15
thromboplastins and international sensitivity index, 523, 525
time-of-flight magnetic resonance venography, 63, 255
tissue factor in antiphospholipid syndrome, 209
tissue plasminogen activator (tPA), and impaired fibrinolysis, 208, 209
for treatment of DVT, 569
for treatment of PE, 574–583
for the exclusion of pulmonary embolism, 350–351
toxic endophlebitis, 15
tPA see tissue plasminogen activator
train travel and VTE, 184
transesophageal echocardiography (TEE) and diagnosis of PE, 503
transfusion of platelets in heparin-induced thrombocytopenia, 209
Index

trauma
and D-dimer, 341
and antithrombotic prophylaxis, 641–642
and vena cava filters, 603
predisposing factor in children, 96
travel, 184, 266
prophylactic agents, 185
recommendations, 185
see also air travel; flight-related DVT; long-distance travelers
triple rule-out test, 474
troponins and prognosis, 35, 36, 37, 38, 39, 47, 330
tumor emboli and CT angiography, 472
T-wave in pulmonary embolism, 290, 294, 295, 297, 300, 502
two-dimensional gradient echo imaging and MR venography without contrast material, 255
ulcerative colitis and VTE, 166
ultrasound-accelerated thrombolysis for pulmonary embolism, 593–594
ultrasound facilities in hospitals in the United States, 356
unfractionated heparin
see heparin, unfractionated
United Kingdom venous thromboembolism in pregnancy, 176
United States
case fatality rate from DVT, 24–25
case fatality rate from pulmonary embolism, 24–30, 79
chronic thromboembolic pulmonary hypertension, 634
DVT in hospitals, 19–23, 27
home treatment of DVT, 617
home treatment of pulmonary embolism, 622–624
IVC filter insertion in, 597–599
obstetrical deaths in, 176
pulmonary embolism in hospitals, 18–19, 25
regional differences in the rates of diagnosis, 73–76
seasonal variability in mortality, 69
unstable patients case fatality rate, 27, 29
upper extremity DVT
and cancer, 62–63
catheter-related, 64
clinical manifestations, 62
diagnosis, 63–64
and post-thrombotic syndrome, 62
prevalence of, 61–62
and pulmonary embolism, 62
risk factors, 128
treatment, 644
upper respiratory tract infection and D-dimer, 341
uric acid and prognosis, 39
urokinase, 569, 574
and catheter fragmentation, 590
and major bleeding, 584
and recurrent pulmonary embolism, 581
Urokinase Pulmonary Embolism Trial (UPET)
resolution of perfusion defects, 54, 55
chest radiograph, 303
complications of pulmonary angiography, 442
in treatment of pulmonary embolism, 576, 577, 579, 581
Urokinase–Streptokinase Embolism Trial treatment of pulmonary embolism, 576
urticaria
with iodinated contrast material, 471
with plasma transfusion 528
Valsalva maneuver and paradoxical embolism, 146
valve pockets as site of DVT, 15–16
vascular signs and chest radiograph, 305
vasopressors and prognosis, 47
veins inflammation in DTV, 13–15
vena cava filters, 597–611
and age, 604–608
and bariatric surgery, 201–202
and cancer, 607
case fatality rate, 604–610, 611
and chronic obstructive pulmonary disease, 607
complications of, 599–602
and DVT, 603, 604, 643
failure to remove, 602
FDA approved permanent and retrievable filters, 597–598
history of venous interruption, 597
number inserted by year, 597–598
in patients with COPD, 153–154
in unstable patients, 608
in unstable patients receiving thrombolytic therapy, 609
indications, 610
permanent, 597, 598, 599–600, 601, 603
PREPIC study, 603
PREPIC 2 study, 607
for prophylaxis, 603
and pulmonary embolectomy, 606–607, 609–610
and pulmonary embolism, 603–604, 606, 608–610, 643
rates of insertion, 599
regional differences in use in US, 599
retrievable, 597, 598, 600–602, 607–608
and thrombolytic therapy, 579, 606, 608–609
use according to stability, 610–611
use in the elderly, 90
vena cava thrombosis, 23
venous blood velocity
with ankle exercise, 565–566
with graduated compression stockings, 561
venous compression ultrasound, 240–244
venous phase CT venography, 240, 250–253, 461, 503
discontinuous images for, 253
effective dose of radiation, 484
methods of, 250–251
and pulmonary embolism diagnosis, 469–471
venous thromboembolism (VTE)
and age, 78–92
and air travel, 184–185
in Alaskan Natives, 116
American College of Chest Physicians Guidelines on prevention and treatment, 640–644
in American Indians, 116
in Asians/Pacific Islanders, 108 – 113
and asthma, 156 – 157
and bariatric surgery, 198, 201 – 202
and cancer, 118 – 126, 640
in children, 95 – 96, 98
and chronic liver disease, 168 – 169
and chronic obstructive pulmonary disease, 149
and diabetes mellitus, 162 – 163
and heart failure, 128 – 131
and HIV, 173 – 174
and inflammatory bowel disease, 166 – 167
and major bleeding 526 – 527
in men, 99 – 102
and nephrotic syndrome, 171
and novel oral anticoagulants, 545 – 549
and obesity, 133 – 137, 141
and oral contraceptives, 187 – 189
and orthopedic surgery, 113, 558
post-operative, 188, 201
pregnancy-associated, 176 – 180
prevention in nonorthopedic surgical patients, 641
prevention in nonsurgical patients, 640
prevention in orthopedic surgery patients, 641
recurrent, 99 – 100, 332 – 333, 555 – 557
regional rates of diagnosis, 73 – 75
and rheumatoid arthritis, 164 – 165
seasonal variability, 69, 70
and stroke, 143 – 145, 147
in women, 99 – 102
venous ultrasonography, 100, 106, 356, 517
with echocardiography, 352, 519
for patients in coronary care unit, 503
in PIOPED II, 458, 459
ventilation lung scans technique, 358 – 360
ventilation – perfusion (V – Q) lung scans
according to complexity of lung disease, 374 – 375
advances since PIOPED, 407 – 409
and chronic obstructive pulmonary disease, 152
with clinical assessment, 372 – 373, 401 – 406
criteria for interpretation, 363 – 365
diagnosis of pulmonary embolism 363 – 364, 365,
367 – 375, 391 – 401
in the elderly, 87 – 89
modified PIOPED criteria, 381 – 383
outcome, 478 – 479
for patients in coronary care unit, 503
and pulmonary embolism, 367 – 375, 379 – 389,
391 – 399, 401 – 409
and radiation exposure, 487
sensitivity and specificity according to sex, 100 – 101
trinary interpretations, 408
see also lung scans
ventilation – perfusion (V – Q) single photon emission computed tomography (SPECT), 54 – 56, 407, 408,
409, 518
compared with perfusion SPECT, 421
composite reference standards, 416
and CT angiography, 416
diagnosis of pulmonary embolism, 412 – 422
effective dose for, 416
guidelines for interpretation, 412 – 415
guidelines for use, 412
and low-dose noncontrast enhanced CT, 421, 422
outcome studies, 421
and planar V – Q scintigraphy, 416, 419 – 420
radiation dose, 485
see also perfusion SPECT
ventilation scintigraphy, 358
ventilation SPECT, 415
see also perfusion SPECT; ventilation – perfusion (V – Q)
single photon emission computed tomography (SPECT)
ventilatory support, 47, 286, 503
ventricular premature beats, 295
ventricular arrhythmias, 136
Venturi effect catheter fragmentation, 572, 591
vitamin K
and reversal of high INR, 527 – 528
supplementation of warfarin, 525
volumetric capnography and diagnosis of pulmonary embolism, 321
von Willebrand factor
in blacks, 105
in obesity, 135
in asthma treated with corticosteroids, 157
in diabetes mellitus, 162
in rheumatoid arthritis, 164
in HIV infection, 173
V – Q scintigraphy see ventilation – perfusion (V – Q) scintigraphy
V – Q SPECT see ventilation – perfusion (V – Q) single photon emission computed tomography
VTE see venous thromboembolism
Walsh index for quantification of pulmonary embolism, 440 – 441
warfarin
administration, 525
anticoagulation clinics, 525
computerized monitoring, 525
and age, 90
bleeding, 526
bleeding prediction scores, 526 – 527
coeagulation cascade, 524
drug and dietary interactions, 526
genotype-guided dosing, 526
nonhemorrhagic complications of, 528
in nursing mothers, 525
optimal INR level, 523 – 525
and pregnancy, 180, 525
and protein C deficiency, 205
resistance, 526
reversal of high INR, 527, 640
self management, 525
sensitivity to, 113
warfarin (continued)
supplementation with vitamin K, 525
treatment of DVT, 25
Weibel-Palade bodies, 260
Wells scoring system
and alveolar dead-space fraction, 322
DVT, 220–221, 223, 234, 236, 260
with P-selectin, 260
pulmonary embolism, 322, 324, 325, 332, 348, 349, 516
Westermark’s sign on chest radiograph, 306
white blood cell (WBC) count, 319–320
white people
case fatality rate, 29
children, 95
diagnostic tests in, 105–106
DVT in, 103–106, 108–110
and intracerebral hemorrhage with thrombolytic
  therapy, 584
and use of IVC filters, 598
mortality rate, 76
pulmonary embolism in, 103–106, 108–110
rate of hospitalization, 110
rate of diagnosis, 76, 78, 108–109
women, 177, 178, 179
see also Caucasians

whole blood agglutination assay
for deep venous thrombosis, 225–229, 234–235
for pulmonary embolism, 335–339, 346–347
withholding treatment in pulmonary embolism if negative
  serial leg tests, 615–616
women
black mortality, 104
case fatality rate, 29
incidence of DVT in, 99
incidence of pulmonary embolism in, 99
and use of IVC filters, 598
lactating and use of anticoagulants, 180
obese and VTE, 133, 135
pregnant and VTE, 176–180
and diagnostic approach 518–519
of reproductive age diagnostic approach, 518
smoking and pulmonary embolism, 139
use of diagnostic tests in, 100
venous thromboembolism in, 99–102
white mortality, 104
with diabetes mellitus, 163
Worcester pulmonary embolism case fatality rate, 26

133 Xe ventilation lung scan, 358–359, 462
administered activity and dose, 76, 416