

## 6 Anhang

### 6.1 Literaturverzeichnis

1. Allain P, Le Bouil A et al.: Pharmacokinetics of low-dose lithium in healthy volunteers. Therapie 1994; 49: 321-324.
2. Amdisen A: Serum level monitoring and clinical pharmacokinetics of lithium. Clin Pharmacokinet 1977; 2: 73-92.
3. Armengol J, Man GCW et al.: Effects of the respiratory cycle on cardiac output measurements: reproducibility of data enhanced by timing the thermodilution injections in dogs. Crit Care Med 1981; 9: 852-854.
4. Band DM, Linton RAF et al.: The shape of indicator dilution curves used for cardiac output measurement in man. J Physiol (Lond) 1997; 498(1): 225-229.
5. Bazaral MG, Petre J et al.: Errors in thermodilution cardiac output measurements caused by rapid pulmonary artery temperature decreases after cardiopulmonary bypass. Anesthesiology 1992; 77(1): 31-37.
6. Bland JM, Altman DG: Statistical methods for assessing agreement between two methods of clinical measurement. Lancet 1986; 1: 307-310.
7. Böttiger BW, Rauch H et al.: Continuous versus intermittent cardiac output measurement in cardiac surgical patients undergoing hypothermic cardiopulmonary bypass. J Cardiothor Vasc Anesth 1995; 9: 405-411.
8. Braun U, Hempel V: Überwachung während der Anästhesie. In Doenicke A, Kettler D et al. (Hrsg.): Anästhesiologie. 7. Auflage, Berlin; Heidelberg; New York: Springer-Verlag, 1995; 399-433.
9. Buhre W, Weyland A et al.: Comparison of cardiac output assessed by pulse-contour analysis and thermodilution in patients undergoing minimally invasive direct coronary artery bypass grafting. J Cardiothorac Vasc Anesth 1999; 13(4): 437-440.

10. Calabrese JR, Gullede AD: Psychotropics during pregnancy and lactation: a review. *Psychosomatics* 1985; 26(5): 413-416, 424-426.
11. Castor G, Klocke RK et al.: Simultaneous measurement of cardiac output by thermodilution, thoracic electrical bioimpedance and Doppler ultrasound. *Br J Anaesth* 1994; 72(1): 133-138.
12. Cohen JA, Blackshear RH et al.: Increased pulmonary artery perforating potential of pulmonary artery catheters during hypothermia. *J Cardiothorac Vasc Anesth* 1991; 5(3): 234-236.
13. Connors AF Jr, Speroff T et al.: The effectiveness of right heart catheterization in the initial care of critically ill patients. *JAMA* 1996; 276: 889-897.
14. Critchley LA: Impedance cardiography. The impact of a new technology. *Anaesthesia* 1998; 53(7): 677-684.
15. Critchley LAH, Critchley JAHH: A meta-analysis of studies using bias and precision statistics to compare cardiac output measurement techniques. *Journal of Clinical Monitoring and Computing* 1999, 15(2): 85-91.
16. Dalen JE, Bone RC: Is it time to pull the pulmonary artery catheter? *JAMA* 1996; 276: 916-918.
17. Delhaas T, Mook GA et al.: Respiration and measurement of cardiac output by thermodilution and central or peripheral dye dilution. *J Appl Physiol* 1992; 73(3): 1047-1051.
18. Eckberg DL, Harkins SW et al.: Baroreflex control of plasma norepinephrine and heart period in healthy subjects and diabetic patients. *J Clin Invest* 1986; 78: 366-374.
19. Edfeldt H, Lundvall J: Sympathetic baroreflex control of vascular resistance in comfortably warm man. Analyses of neurogenic constrictor responses in the resting forearm and in its separate skeletal muscle and skin tissue compartments. *Acta Physiol Scand* 1993; 147: 437-447.

20. Ehrlich BE, Clausen C et al.: Lithium pharmakinetics: single-dose experiments and analysis using a physiological model. *J Pharmacokinet Biopharm* 1980; 8(5): 439-461.
21. Eisenberg PR, Jaffe AS et al.: Clinical evaluation compared to pulmonary artery catheterisation in the hemodynamic assessment of critically ill patients. *Crit Care Med* 1984; 12(7): 549-553.
22. Erb K, Stammer H et al.: Evaluation of the noninvasive estimates of cardiac output by Doppler aortoechography according to test-theoretical principles. *Int J Clin Pharmacol Ther* 1997; 35(4): 170-174.
23. Espersen K, Jensen EW et al.: Comparison of cardiac output measurement techniques: thermodilution, Doppler, CO<sub>2</sub>-rebreathing and the direct Fick method. *Acta Anaesthesiol Scand* 1995; 39(2): 245-251.
24. European society of intensive care medicine: Expert panel: The use of the pulmonary artery catheter. *Intensive Care Med* 1991; 17(3): I-VIII.
25. Fabel G: Exogenous harmful substances in pregnancy and their effects on the embryo and fetus. *Zentralbl Gynakol* 1988; 110(24): 1546-1555.
26. Faravelli C, Di Bernardo M et al.: Effects of chronic lithium treatment on the peripheral nervous system. *J Clin Psychiatry* 1999; 60(5): 306-310.
27. Fishman AP: The Fick principle and the steady state. *Am J Respir Crit Care Med* 2000; 161: 692-693.
28. Freeman MP, Stoll AL: Mood stabilizer combinations: a review of safety and efficacy. *Am J Psychiatry* 1998; 155(1): 12-21.
29. Froese N, Friesen R: Measurement of cardiac output--transtracheal Doppler versus thermodilution. *Can J Anaesth* 1991; 38(7): 931-934.
30. Gödje O, Hoeke K et al.: Continuous cardiac output by femoral arterial thermodilution calibrated pulse contour analysis: Comparison with pulmonary arterial thermodilution. *Crit Care Med* 1999; 27(11): 2407-2412.

31. Gödje O, Thiel Ch et al.: Less invasive, continuous hemodynamic monitoring during minimally invasive coronary surgery. Ann Thorac Surg 1999; 68: 1532-1536.
32. Gómez CMH, Palazzo MGA: Pulmonary catheterization in anaesthesia and intensive care. Br J Anaesth 1998; 81: 945-956.
33. Goodnick PJ, Schorr-Cain CB: Lithium pharmacokinetics. Psychopharmacol Bull 1991; 27: 475-491.
34. Gore JM, Goldberg RJ et al.: A community-wide assessment of the use of pulmonary artery catheters in patients with acute myocardial infarction. Chest 1987; 92: 721-727.
35. Gotshall RW, Wood VC et al.: Comparison of two impedance cardiographic techniques for measuring cardiac output. Ann Biomed Eng 1989; 17: 495-505.
36. Heerdt PM, Pond CG et al.: Comparison of cardiac output measured by intrapulmonary artery Doppler, thermodilution, and electromagnetometry. Ann Thorac Surg 1992; 54(5): 959-966.
37. Hogue CW, Cerza RF et al.: Comparison of continual thermodilution cardiac output with electromagnetometry. Anesthesiology 1993; 79: 467A.
38. Horgan JH, Proctor JD: The acute effects of lithium chloride infusion on some hemodynamic parameters. Arch Int Pharmacodyn Ther 1974; 210(1): 5-11.
39. Irlbeck M, Forst H et al.: Die kontinuierliche Messung des Herzzeitvolumens mit der Pulskonturanalyse. Anaesthesist 1995; 44: 493-500.
40. Jansen JR, Schreuder JJ et al.: Thermodilution technique for measurement of cardiac output during artificial ventilation. J Appl Physiol 1981; 51(3): 584-591.
41. Jansen JR, Versprille A: Improvement of cardiac output estimation by the thermodilution method during mechanical ventilation. Intensive Care Med 1986; 12(2):71-79.

42. Janssens U, Hanrath P: Pulmonalarterienkatherisierung beim kritisch Kranken - noch gerechtfertigt? *Intensivmed* 1998; 35 (Suppl 1): 19-32.
43. Jermain DM, Crismon ML et al.: Population pharmacokinetics of lithium. *Clin Pharm* 1991; 10: 376-381.
44. Kamal GD, Symreng T et al.: Inconsistent esophageal Doppler cardiac output during acute blood loss. *Anesthesiology* 1990; 72(1):95-99.
45. Keinanen O, Takala J et al.: Continuous measurement of cardiac output by the Fick principle: clinical validation in intensive care. *Crit Care Med* 1992; 20(3): 360-365.
46. Keyl C, Rodig G et al.: A comparison of the use of transoesophageal Doppler and thermodilution techniques for cardiac output determination. *Eur J Anaesthesiol* 1996; 13(2): 136-142.
47. Klockgether-Radke A, Rathgeber J et al.: Unbeabsichtigte intracardiale Fixierung eines Swan-Ganz-Katheters. *Der Anaesthesist* 1995; 44(2): 116-118.
48. Koenig SC, Reister CA et al.: Evaluation of transit-time and electromagnetic flow measurement in a chronically instrumented nonhuman primate model. *J Invest Surg* 1996; 9(6): 455-461.
49. Konarzewski W: Pulmonary artery catheterisation. Pulmonary artery catheters should be banned from intensive care units. *BMJ* 1996; 313: 1328.
50. Kurita T, Morita K et al.: Comparison of the accuracy of the lithium dilution technique with the thermodilution technique for measurement of cardiac output. *Br J Anaesth* 1997; 79: 770-775.
51. Kusumoto F, Venet T et al.: Measurement of aortic blood flow by Doppler echocardiography: temporal, technician, and reader variability in normal subjects and the application of generalizability theory in clinical research. *J Am Soc Echocardiogr* 1995; 8: 647-653.

52. LaMantia KR, O'Connor T et al.: Comparing methods of measurement: an alternative approach. *Anesthesiology* 1990; 72: 781-783.
53. Latson TW, Whitten CW et al.: Ventilation, thermal noise, and errors in cardiac output measurements after cardiopulmonary bypass. *Anesthesiology* 1993; 79(6): 1233-1243.
54. Lazor MA, Pierce ET et al.: Evaluation of the accuracy and response time of STAT-mode continuous cardiac output. *J Cardiothorac Vasc Anesth* 1997; 11: 432-436.
55. Lefrant JY, Bruelle P et al.: Training is required to improve the reliability of esophageal Doppler to measure cardiac output in critically ill patients. *Intensive Care Med* 1998; 24(4): 347-352.
56. Lewis GJ, Poole-Wilson PA et al.: Use of electromagnetic flow probes to assess myocardial performance in man. *Eur J Cardiol* 1978; 7(4):283-292.
57. Lichtenthal PR, Wade LD: Accuracy of the Vigilance/ IntelliCath continuous cardiac output system during and after cardiac surgery. *Anesthesiology* 1993; 77: 477A.
58. LiDCO Ltd.: Diagram of LiDCO sensor. (2000 Februar 18; 14:00)  
[http://www.lidco.com/pages/sensor\\_diagram.html](http://www.lidco.com/pages/sensor_diagram.html)
59. LiDCO Ltd.: Overview of the blood sampling and measurement system. (2000 Februar 18; 14:00) <http://www.lidco.com/pages/lidcooverview.html>
60. Linton R, Band D et al.: Lithium dilution cardiac output measurement: A comparison with thermodilution. *Crit Care Med* 1997; 25: 1796-1800.
61. Linton RAF, Band DM et al.: A new method of measuring cardiac output in man using lithium dilution. *Br J Anaesth* 1993; 71: 262-266.
62. Linton RAF, Linton NWF et al.: A new method of analysing indicator dilution curves. *Cardiovasc Res* 1995; 30: 930-938.

63. Luisier PA, Schulz P et al.: The pharmacokinetics of lithium in normal humans: expected and unexpected observations in view of basic kinetic principles. *Pharmacopsychiatry* 1987; 20: 232-234.
64. Mackenzie JD, Haites NE et al.: Method of assessing the reproducibility of blood flow measurement: factors influencing the performance of thermodilution cardiac output computers. *Br Heart J* 1986; 55(1): 14-24.
65. Mancia G, Grassi G: Baroreceptor control of the circulation in man. An update. *Clin Exp Hypertens* 1995; 17: 387-397.
66. Manthey J, Dietz R et al.: Baroreceptor-mediated release of vasopressin in patients with chronic congestive heart failure and defective sympathetic responsiveness. *Am J Cardiol* 1992; 70: 224-228.
67. Mappes A, Gründel M, Lindert J et al.: Keine Korrelation von arteriellem Blutdruck und LiDCO-Herzzeitvolumen in der Herzchirurgie. *Anästhesiologie & Intensivmedizin* 2000; A2330: 444.
68. Marcus WL: Lithium: a review of its pharmacokinetics, health effects, and toxicology. *J Environ Pathol Toxicol Oncol* 1994; 13: 73-79.
69. Mason RW, McQueen EG et al.: Pharmacokinetics of lithium: elimination half-time, renal clearance and apparent volume of distribution in schizophrenia. *Clin Pharmacokinet* 1978; 3: 241-246.
70. Min BG, Fich S et al.: Accuracy of calibration of electromagnetic flow-probe by dye dilution method. *Bull N Y Acad Med* 1977; 53(9): 829-840.
71. Mutschler E: Arzneimittelwirkungen. Stuttgart: Wiss. Verl.-Ges., 1996; 160-161.
72. Niederle P, Starek A et al.: Assessment of stroke volume and cardiac output by Doppler echocardiography. *Cor Vasa* 1988; 30(5): 338-344.
73. Nishikawa T, Dohi S: Errors in the measurement of cardiac output by thermodilution. *Can J Anaesth* 1993; 40(2): 142-153.

74. Northridge DB, Findlay IN et al.: Non-invasive determination of cardiac output by Doppler echocardiography and electrical bioimpedance. Br Heart J 1990; 63(2): 93-97.
75. O'Brien T: Persönliche Mitteilung.
76. Perrino AC, O'Connor T et al.: Transtracheal Doppler cardiac output monitoring: comparison to thermodilution during noncardiac surgery. Anesth Analg 1994; 78(6): 1060-1066.
77. Pfeiffer K, Widmann M et al.: Unbemerkte Nahtfixation eines Swan-Ganz-Katheters in der Arteria pulmonalis während Herzoperation. Anaesthesist 1995; 44(11): 782-784.
78. Poust RI, Mallinger AG et al.: Pharmacokinetics of lithium in human plasma and erythrocytes. Psychopharmacol Commun 1976; 2: 91-103.
79. Präsidium der Deutschen Gesellschaft für Anästhesiologie und Intensivmedizin: Rechtsherzkatheter (Swan-Ganz-Katheter). Stellungnahme des Präsidiums der Deutschen Gesellschaft für Anästhesiologie und Intensivmedizin. Anästhesiologie & Intensivmedizin 1997; 5(38): 246-247.
80. Raaijmakers E, Faes TJC et al.: A meta-analysis of three decades of validating thoracic impedance cardiography. Crit Care Med 1999; 27: 1203-1213.
81. Rieke H, Weyland A et al.: Kontinuierliche HZV-Messung nach dem Fickschen Prinzip in der Kardioanaesthesia. Anaesthesist 1990; 39(1):13-21.
82. Rödig G, Prasser C et al.: Continuous cardiac output measurement: pulse contour analysis vs thermodilution technique in cardiac surgical patients. Br J Anaesth 1999; 82(4): 525-530.
83. Runciman WB, Ilsley AH et al.: Thermodilution cardiac output--a systematic error. Anaesth Intensive Care 1981; 9(2): 135-139.
84. Ryan T, Page R et al.: Transoesophageal pulsed wave Doppler measurement of cardiac output during major vascular surgery: comparison with the thermodilution technique. Br J Anaesth 1992; 69(1): 101-104.

85. Schmid ER, Schmidlin D et al.: Continuous thermodilution cardiac output: clinical validation against a reference technique of known accuracy. *Intensive Care Med* 1999; 25: 166-172.
86. Shellock FG, Riedinger MS et al.: Thermodilution cardiac output determination in hypothermic postcardiac surgery patients: room vs ice temperature injectate. *Crit Care Med* 1983; 11: 668-670.
87. Shoemaker W, Appel L, Kram H et al.: Prospective trial of supranormal values of survivors as therapeutic goals in high-risk surgical patients. *Chest* 1988; 94: 1176-1186.
88. Shoemaker W, Kram H, Appel L et al.: The efficiaciy of central venous and pulmonary artery catheters and therapy based upon them in reducing mortality and morbidity. *Archives of Surgery* 1990; 125: 1332-1338.
89. Shoemaker WC, Appel PL et al. : Multicomponent noninvasive physiologic monitoring of circulatory function. *Crit Care Med* 1988; 16: 482-490.
90. Siegel LC, Fitzgerald DC et al.: Simultaneous intraoperative measurement of cardiac output by thermodilution and transtracheal Doppler. *Anesthesiology* 1991; 74(4): 664-669.
91. Sladen RN: Temperature and ventilation after hypothermic cardiopulmonary bypass. *Anesth Analg* 1985; 64: 816-820.
92. Spencer KT, Lang RM et al.: Doppler and electromagnetic comparisons of instantaneous aortic flow characteristics in primates. *Circ Res* 1991; 68(5): 1369-1377.
93. Spiegel T v., Hoeft A: Transpulmonale Indikatorverfahren in der Intensivmedizin. *Anaesthesist* 1998; 47: 220-228.
94. Stetz CW, Miller RG et al.: Reliability of the thermodilution method in the determination of cardiac output in clinical practice. *Am Rev Respir Dis* 1982; 126(6): 1001-1004.

95. Stevens JH, Raffin TA et al.: Thermodilution cardiac output measurement. Effects of the respiratory cycle on its reproducibility. *JAMA* 1985; 253(15): 2240-2242.
96. Synder JV, Powner DJ: Effects of mechanical ventilation on the measurement of cardiac output by thermodilution. *Crit Care Med* 1982 Oct;10(10):677-682.
97. Thrush D, Downs JB et al.: Continuous thermodilution cardiac output: agreement with Fick and bolus thermodilution methods. *J Cardiothorac Vasc Anesth* 1995; 9: 399-404.
98. Tibballs J, Hochmann M et al.: Accuracy of the BoMED NCCOM3 bioimpedance cardiac output monitor during induced hypotension: an experimental study in dogs. *Anaesth Intensive Care* 1992; 20: 326-331.
99. Töns C, Klosterhalfen B et al.: Überwachung kritisch kranker Intensivpatienten durch halbinvasives COLD-Monitoring anstelle Pulmonalis-Katheterisierung. *Langenbecks Arch Chir Suppl Kongressbd* 1996; 113: 349-352.
100. Valecha N, Tayal G at al.: Single dose pharmacokinetics of lithium & prediction of maintenance dose in manic depressive patients. *Indian J Med Res* 1990; 92: 409-416.
101. Valtier B, Cholley BP et al.: Noninvasive monitoring of cardiac output in critically ill patients using transesophageal Doppler. *Am J Respir Crit Care Med.* 1998; 158(1): 77-83.
102. van Heerden PV, Baker S et al.: Clinical evaluation of the non-invasive cardiac output (NICO) monitor in the intensive care unit. *Anaesth Intensive Care* 2000; 28(4): 427-430.
103. Walker RG: Lithium nephrotoxicity. *Kidney Int Suppl* 1993; 42: 93-98.
104. Wesseling KH, de Wit B et al.: A simple device for the continuous measurement of cardiac output. *Adv Cardiovasc Phys* 1983; 5: 16-52.

105. Wetzel RC, Latson TW: Major errors in thermodilution cardiac output measurement during rapid volume infusion. *Anesthesiology* 1985; 62(5): 684-687.
106. Wippermann CF, Huth RG et al.: Continuous measurement of cardiac output by the Fick principle in infants and children: comparison with the thermodilution method. *Intensive Care Med* 1996; 22(5): 467-471.
107. Witzleb E: Funktionen des Gefäßsystems. Schmidt RF, Thews G (Hrsg.): *Physiologie des Menschen*. 24. Auflage, Berlin; Heidelberg; New York: Springer-Verlag, 1990; 505-572.
108. Wong DH, Tremper KK et al.: Noninvasive cardiac output: simultaneous comparison of two different methods with thermodilution. *Anesthesiology* 1990; 72(5): 784-792.
109. Woog RH, McWilliam DB: A comparison of methods of cardiac output measurement. *Anaesth Intensive Care* 1983; 11(2): 141-146.
110. Yelderman M, Quinn MD et al.: Thermal safety of a filamented pulmonary catheter. *J Clin Monit* 1992; 8(2): 147-149.
111. Yelderman M: Continuous measurement of cardiac output with the use of stochastic system identification techniques. *J Clin Monit* 1990; 6: 322-332.
112. Yelderman ML, Ramsay MA et al.: Continuous thermodilution cardiac output measurement in ICU patients. *J Cardiothor Vasc Anesth* 1992; 6(3): 270-274.
113. Yoshida K, Smith B et al.: Psychotropic drugs in mothers' milk: a comprehensive review of assay methods, pharmacokinetics and of safety of breast-feeding. *J Psychopharmacol* 1999; 13(1): 64-80.
114. Young LE, Blissitt Kjet al.: Measurement of cardiac output by transoesophageal Doppler echocardiography in anaesthetized horses: comparison with thermodilution. *Br J Anaesth* 1996; 77(6): 773-780.

115. Zierler K: Indicator dilution methods for measuring blood flow, volume, and other properties of biological systems: a brief history and memoir. Ann Biomed Eng 2000; 28(8): 836-848.

## 6.2 Tabellenverzeichnis

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### 6.3 Abkürzungsverzeichnis

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#### Abkürzung Erläuterung

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BCO	Bolusthermodilution, „bolus cardiac output determination“
Bias	Mittelwert der Differenzen; Maß für den systematischen Fehler
CCO	kontinuierliche Thermodilution, „continuous cardiac output determination“
CI	Herzzeitvolumen-Index, „cardiac index“
CO	Herzzeitvolumen, „cardiac output“
CPB	Kardiopulmonaler Bypass
EF	Ejektionsfraktion
F	Faraday-Konstante ( $9,648 \times 10^4 \text{ A s mol}^{-1}$ )
h	Stunde
Hb	Hämoglobinkonzentration in g· dl <sup>-1</sup>
HLM	Herz-Lungen-Maschine
Hz	Hertz
HZV	Herzzeitvolumen
LiDCO	Lithiumdilutions-Herzzeitvolumen, „Lithium dilution cardiac output“
mA	Milliampere
MAP	mittlerer arterieller Blutdruck
min.	Minute
ml	Milliliter
mM	millimolar, mmol· l <sup>-1</sup>
mm Hg	Millimeter Quecksilbersäule
mmol	Millimol
mosm	Milliosmol (1 Osmol=6,06 x 10 <sup>23</sup> Teilchen)

**Abkürzung Erläuterung**

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ms	Millisekunde
mV	Millivolt
Na <sup>+</sup>	Natriumionenkonzentration in mmol· l <sup>-1</sup>
OP	Operationssaal
PAK	Pulmonalarterienkatheter
precision	zweifache Standardabweichung des → Bias
R	universelle Gaskonstante ( $8,314 \text{ V A s mol}^{-1} \text{ K}^{-1}$ )
SD	Standardabweichung
SEM	Standardfehler der Mittelwerte, „standard error of the mean“
SV	Schlagvolumen
SVR	systemischer vaskulärer Widerstand
SVRI	systemischer vaskulärer Widerstandsindex
T	Temperatur (absolut)
W	Watt
Z	Ionenzahl

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## 6.5 Lebenslauf

### Persönliche Daten

Name: Marcus Gründel

Geburtsdatum: 05. Dezember 1971

Geburtsort: Berlin

Eltern: Dr. Georg Gründel, Arzt und  
Gerda Gründel, geb. Beier, gest. im September 1989

### Ausbildung

1978– 1988 17. Polytechnische Oberschule Berlin-Lichtenberg

1988 – 1989 Erweiterte Oberschule "Immanuel Kant" in Berlin-Lichtenberg

1992 – 1999 Medizinstudium an der Freien Universität Berlin und der  
Humboldt-Universität zu Berlin

6/99-7/00 Planung und Durchführung des experimentellen Teils der  
Dissertation

8/00 – 1/02 AiP im Deutsches Herzzentrum Berlin

### Zeugnisse

1989 Abitur

1994 Ärztliche Vorprüfung

1996 Erstes Staatsexamen Medizin

1998 Zweites Staatsexamen Medizin

1999 Drittes Staatsexamen Medizin

### Praktisches Jahr

Chirurgie: Deutsches Herzzentrum Berlin

Innere Medizin: DRK-Kliniken Westend, Akademisches Lehrkrankenhaus des  
Universitätsklinikums Charité, Berlin

Anästhesie: Universitätsklinikum Charité Berlin