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EDUCATION

B.S.	1980	Chinese Culture University (Taipei, Taiwan)	Botany
M.S.	1983	National Chun-Hsing University (Tai-Chung, Taiwan)	Botany
M.S.	1992	Colorado State University	Microbiology
Ph.D.	1997	University of Rhode Island	Biochemistry

POSTGRADUATE TRAINING

Postdoctoral Fellow — Center for Surgical Research, Department of Surgery, Rhode Island Hospital/Brown University

POSTGRADUATE HONORS AND AWARDS

Travel Grant Award, the 21st Annual Conference on Shock, San Antonio, TX, 1998.
Travel Grant Award, the 22nd Annual Conference on Shock, Philadelphia, PA, 1999.

ACADEMIC APPOINTMENTS

Research Assistant, Institute of Microbiology, Medicine College of National Taiwan University, Taipei, Taiwan. 1983-85
Research Assistant, Institute of Botany, Academia Sinica, Taipei, Taiwan. 1986-87
Graduate Teaching and Research Assistant (Microbiology), Colorado State University, 1988-91
Graduate Teaching and Research Assistant (Microbiology, Chemistry), University of Rhode Island, 1992-96
Research Associate, Department of Surgery, Rhode Island Hospital/Brown University, 1997-2002
Instructor, Department of Surgery, Rhode Island Hospital/Brown University, 2002-04
Assistant Professor, Department of Surgery, Rhode Island Hospital/Brown University, 2004-present

HOSPITAL APPOINTMENTS

Assistant Professor, Department of Surgery, Rhode Island Hospital/Brown University, 2004-present

HOSPITAL COMMITTEES

Executive Committee of Division of Surgical Research
Animal Welfare Committee

MEMBERSHIP IN SOCIETIES

Shock Society
The Society for Leukocyte Biology.

PUBLICATIONS LIST

ORIGINAL PUBLICATIONS IN PEER-REVIEWED JOURNALS

1. Pan, I.H., **Chung, C.S.** *et al.* 1985. Seroepidemiology of T-cell leukemia virus in Taiwan. *Jpn. J. Cancer Res. (Gann)* 76:9-11.

2. Tseng, T.C., **Chung, C.S.**, Li, I. 1990. Production of fusarin C Mycotoxin by *Fusarium moniliforme* isolates of Taiwan. *Bot. Bull. Academia Sinica* 31:169-174.

3. Tseng, T.C., **Chung, C.S.** 1990. A monoclonal antibody recognizing the specific epitope of aflatoxin analogs. *Bot. Bull. Academia Sinica* 31:279-284.

4. Marcom, K.A., Pearson, L.D., **Chung, C.S.**, Poulson, J.M., DeMartini, J.C. 1991. Epitope analysis of capsid and matrix proteins of North American ovine lentivirus field isolates. *J. Clin. Microbiol.* 29:1472-1479.

5. **Chung, C.S.**, Pearson, L.D., Ayers, V.K., Collins, J.K. 1994. Monoclonal antibodies that distinguish between encephalitogenic bovine herpesvirus type 1.3 and respiratory bovine herpesvirus type 1.1. *Clin. Diagn. Lab. Immnum.* 1:83-88.

6. Song, G.Y., **Chung, C.S.**, Chaudry, I.H., Ayala, A. 1998. Does necrotic tissue depress cell-mediated immune function in polymicrobial sepsis? *Surgical Forum* 49:22-23.

7. **Chung, C.S.**, Xu, Y.X., Chaudry, I.H., Ayala, A. 1998. Sepsis induces increased apoptosis in lamina propria mononuclear cells which is associated with altered cytokine gene expression. *J. Surg. Res.* 77:63-70.

8. **Chung, C.S.**, Xu, Y.X., Wang, W., Chaudry, I.H., Ayala, A. 1998. Is fas ligand or endotoxin responsible for mucosal lymphocyte apoptosis in septis? *Archives of Surgery* 133(11):1213-1220.

9. Ayala, A., **Chung, C.S.**, Xu, Y.X., Evans, T.A., Redmond, K.M., Chaudry, I.H. 1999. Increased inducible apoptosis in CD4+ T-lymphocytes during polymicrobial sepsis is mediated by Fas ligand (FasL) and not endotoxin. *Immunology* 97:45-55.

10. Song, G.Y., **Chung, C.S.**, Chaudry, I.H., Ayala, A. 1999. What is the role of interleukin 10 in polymicrobial sepsis: anti-inflammatory agent or immunosuppressant? *Surgery* 126:1-7.

11. Song, G.Y., **Chung, C.S.**, Schwacha, M.G., Jarrar, D., Chaudry, I.H., Ayala, A. 1999. Splenic immune suppression in sepsis: a role for IL-10-induced changes in p38 MAPK signaling. *J. Surg. Res.* 83:36-43.

12. Samy, T.S.A., Schwacha, M.G., **Chung, C.S.**, Cioffi, W.G., Bland, K.I., Chaundry, I.H. 1999. Proteasome participates in the alteration of signal transduction in T and B lymphocytes following trauma-hemorrhage. *Biochem. Biophys.Acta* 1453:92-104.

13. Ayala, A., Xu, Y.X., **Chung, C.S.**, Chaudry, I.H. 1999. Does Fas ligand or endotoxin contribute to thymic apoptosis during polymicrobial sepsis? *Shock* 11:211-217.

14. Song, G.Y., **Chung, C.S.**, Chaudry, I.H., Ayala, A. 2000. IL-4 induced activation of the STAT6 pathway contributes to the suppression of cell-mediated immunity and mortality in polymicrobial sepsis. *Surgery* 128:133-138.

15. **Chung, C.S.**, Song, G.Y., Moldawer, L.L., Chaudry, I.H., Ayala, A. 2000. Neither Fas ligand nor TLR-4 mediated endotoxin is responsible for inducible peritoneal phagocyte apoptosis during sepsis/peritonitis. *J. Surg. Res.* 91:147-153.

16. **Chung, C.S.**, Song, G.Y., Wang, W., Chaudry, I.H., Ayala, A. 2000. Septic mucosal intraepithelial lymphoid immune suppression: role for nitric oxide not IL-10 or TGF-β. *J. Trauma* 48:807-813.

17. Donnahoo, K.K., Meldrum, D.R., Shenkar, R., **Chung, C.S.**, Abraham, E., Karken, A.H. 2000. Early renal ischemia, with or without reperfusion, activates NF□B and increases TNF- bioactivity in the kidney. *J. Urology* 163:1328-1332.

18. Song, G.Y., **Chung, C.S.**, Chaudry, I.H. Ayala, A. 2000. Immune suppression in polymicrobial sepsis: differential regulation of Th1 and Th2 lymphocyte response by p38 MAPK. *J. Surg. Res.* 91:141-146.

19. Ayala, A., Song, G.Y., **Chung, C.S.**, Redmond, K.M., Chaudry, I.H. 2000. Immune hyporesponsiveness in polymicrobial sepsis: the role of necrotic (injured) tissue and endotoxin. *Crit. Care. Med*. 28:2949-2955.

20. Song, G.Y., **Chung, C.S.,** Jarrar, D., Chaudry, I.H., Ayala, A. 2001. Evolution of immune suppressive macrophage phenotype as a product of p38 MAPK activation of polymicrobial sepsis. *Shock* 15:42-48.

21. Ayala, A., **Chung, C.S.**, Song, G.Y., Chaudry, I.H. 2001. IL-10 mediation of activation induced Th2-cell apoptosis during polymicrobial sepsis. *Cytokine* 14:37-48.

22. **Chung, C.S.**, Wang, W., Chaudry, I.H., Ayala, A. 2001. Increased apoptosis in lamina propria B-cells during polymicrobial sepsis is a FasL but not an endotoxin mediated process. *Amer. J. Physiol.* 280:G812-G818.

23. Song, G.Y., **Chung, C.S.**, Chaudry, I.H., Ayala, A. 2001. A novel mechanism by which p38 MAPK antagonism improves survival following polymicrobial sepsis: attenuation of developing immune suppression but not early pro-inflammation. *Amer. J. Physiol.* 281:C662-C669.

24. **Chung, C.S.**, S.L. Yang, Song, G.Y., Lomas, J., Wang, P., Simms, H.H., Chaudry, I.H., Ayala, A. 2001. Inhibition of Fas signaling prevents hepatic injury and improves organ blood flow. *Surgery* 130:339-345.

25. Yang, S.L., **Chung, C.S.**, Ayala, A., Chaudry, I.H., Wang, P. 2002. Differential alterations in cardiovascular responses during the progression of polymicrobial sepsis in the mouse. *Shock* 17: 55-60.

26. Schwacha, M.G., **Chung, C.S.**, Ayala, A., Bland, K.I., Chaudry, I.H. 2002. Cyclooxygenase 2-mediated suppression of macrophage interleukin-12 production after thermal injury. *Amer. J. Physiol.* 282: C263-C270.

27. Song, G.Y., **Chung, C.S.**, Jarrar, D., Cioffi, W.G., Ayala, A. 2002. Mechanism of immune dysfunction in sepsis: inducible NO mediated alterations in P38 MAPK activation. *J. Trauma* 53:276-283.

28. Joshi, A.R.T., **Chung, C.S**., Song, G.Y., Lomas, J., Priester, R.A., Ayala, A. 2002. NF-κB activation has tissue specific effects on immune cell apoptosis during polymicrobial sepsis. *Shock* 18:380-386.

29. Ayala, A., **Chung, C.S.,** Lomas, J.L., Song, G.Y., Doughty, L.A., Gregory, S.H., Cioffi, W.G., LeBlanc, B.W., Reichner, J., Simms, H.H., Grutkoski, P.S. 2002. Shock induced neutrophil priming for acute lung injury in mice: divergent effects of TLR-4 and TLR-4/FasL deficiency. *Amer. J. Pathol.* 161:2283-2294.

30. **Chung, C.S.,** Song, G.Y., Lomas, J., Simms, H.H., Chaudry, I.H., Ayala, A. 2003. Inhibition of Fas/Fas ligand (FasL) signaling during sepsis has tissue specific effects on macrophage apoptotic and functional capacity. *J. Leukocyte Biol.* 74:344-351.

31. Lomas, J.L.,**Chung, C.S.,** Grutkoski, P.S., LeBlanc, B.W., Lavigne, L., Reichner, J., Gregory, S.H., Doughty, L.A., Cioffi, W.G., Ayala, A. 2003. Differential effects of MIP-2 and KC on hemorrhage induced neutrophil priming for lung inflammation: assessment by adoptive cell transfer in mice. *Shock* 19:358-365.

32. Grutkoski, P.S., Chen, Y., **Chung, C.S.** and Ayala, A. 2003. Sepsis-induced SOCS-3 expression is immunologically restricted to phagocytes. *J. Leukoc. Biol.* 74:916-922.

33. Grutkoski, P.S., Chen, Y., **Chung, C.S.**, Cioffi, W.G. and Ayala, A. 2004. Putative mechanism of hemorrhage-induced leukocyte hyporesponsiveness: induction of suppressor of cytokine signaling (SOCS)-3. *J. Trauma* 56:742-747.

34. Lomas-Neira, J.L., **Chung, C.S.**, Grutkoski, P.S., Miller, E.J., Ayala, A. 2004. CXCR2 inhibition suppresses hemorrhage induced priming for acute lung injury in mice. *J. Leukocyte Biol.* 76:58-64.

35. Ding, Y., **Chung, C.S.**, Bray, S., Chen, Y., Grutkoski, P.S., Carlton, S., Albina, J.E., Ayala, A. 2004. Polymicrobial sepsis induces divergent effects on splenic and peritoneal dendritic cell function in mice. *Shock* 22:137-144

36. Lomas-Neira, J.L., **Chung, C.S.**, Wesche, D.E., Perl, M., Ayala, A. 2005. In Vivo Gene Silencing (with siRNA) of pulmonary Expression of MIP-2 vs. KC Results in Divergent Effects on Hemorrhage Induced Neutrophil Mediated Septic Acute Lung Injury. *J. Leukocyte Biol.* 77:846-853.

37. Newton, S., Ding, Y., **Chung, C.S.**, Chen, Y., Lomas-Neira, J.L., Ayala, A. 2005. Sepsis induced changes in macrophage co-stimulatory molecule expression: CD86 as a regulator of anti-inflammatory IL-10 response. *Surg. Infect*. 5:375-383

38. Wesche-Soldato, D.E., **Chung, C.S.**, Lomas-Neira, J., Doughty, L.A., Gregory, S.H., Ayala, A. 2005. In vivo delivery of caspase-8 or Fas siRNA improves the survival of septic mice. *Blood* 106:2295-2301.

39. Lomas-Neira, J., **Chung, C.S.**, Grutkoski, P.S., Dunican, A., Simms, H.H., Cioffi, W.G., Ayala, A. 2005. Divergent roles of murine neutrophil chemokines in hemorrhage induced priming for acute lung injury. *Cytokine* 31:169-179.

40. Song, G.Y., **Chung, C.S.**, Rhee, R.J., Cioffi, W.G., Ayala, A. 2005. Loss of signal transducer and activator of transduction 4 or 6 signaling contributes to immune cell morbidity and mortality in sepsis. *Intensive Care Med.* 31:1564-1569.

41. Perl, M., **Chung, C.S.**, Lomas-Neira, J., Rachel, T.M., Biffl, W., Cioffi, W.G., Ayala, A. 2005. Silencing of Fas, but not caspase-8, in lung epithelial cells ameliorates pulmonary apoptosis, inflammation, and neutrophil influx after hemorrhagic shock and sepsis. *Am. J. Pathol.* 167:1545-1559.

42. Lomas-Neira, J., **Chung, C.S.**, Perl, M., Gregory, S.H., Biffl, W., Ayala, A. 2006. Role of alveolar macrophage and migrating neutrophils in hemorrhage-induced priming for ALI subsequent to septic challenge. *Am. J. Physiol. Lung Cell Mol. Physiol*. 290:L51-58.

43. Doughty, L.A., Carlton, S., Galen, B., Cooma-Ramberan, I., **Chung, C.S.**, Ayala, A. 2006. Activation of common antiviral pathways can potentiate inflammatory responses to septic shock. *Shock* 26:187-194.

44. **Chung, C.S.**, Watkins, L., Funches, A., Lomas-Neira, J., Cioffi, W.G., Ayala, A. 2006. Deficiency of gammadelta T lymphocytes contributes to mortality and immuno-suppression in sepsis. *Am. J. Physiol. Regul. Integr. Comp. Physiol*. 291:R1338-1343.

45. Wisnoski, N., **Chung, C.S.,** Chen, Y., Huang, X., Ayala, A. 2007. The contribution of $CD4^+CD25^+$ T-regulatory-cells to immune suppression in sepsis. *Shock* 27:251-257.

46. **Chung, C.S.,** Chen, Y., Grutkoski, P.S., Doughty, L., Ayala, A. 2007. SOCS-1 is a central mediator of steroid-increased thymocyte apoptosis and decreased survival following sepsis. *Apoptosis* 12:1143-1153.

47. Perl, M., **Chung, C.S.**, Perl, U., Biffle, W.L., Cioffi, W.G., Ayala, A. 2007. Beneficial versus detrimental effects of neutrophils are determined by the nature of the insult. *J Am Coll Surg.* 204:840-852; discussion 852-853.

48. Delano, M.J., Scumpia, P.O., Weinstein, J.S., Coco, D., Nagaraj, S., Kelly-Scumpia, K.M., O'Malley, K.A., Wynn, J.L., Antonenko, S., Al-Ouran, S.Z., Swan, R., **Chung, C.S.,** Atkinson, M.A., Ramphal, R., Gabrilovich, D.I., Reeves, W.H., Ayala, A., Philips, J., Laface, D., Heyworth, P.G., Clare-Salzler, M, Moldawer, L.L. 2007. MyD88-dependent expansion of an immature GR-1(+)CD11b(+) population induces T cell suppression and Th2 polarization in sepsis. *J Exp Med.* 204:1463-1474.

49. Wesche-Soldato, D.E., **Chung, C.S**., Gregory, S.H., Salazar-Mather, T.P., Ayala, C.A., Ayala, A. 2007. CD8+ T cells promote inflammation and apoptosis in the liver after sepsis: role of Fas-FasL. *Am J Pathol.* 171:87-96.

50. Scumpia, P.O., Delano, M.J., Kelly-Scumpia, K.M., Weinstein, J.S., Wynn, J.L., Winfield, R.D., Xia, C., **Chung, C.S.,** Ayala, A., Atkinson, M.A., Reeves, W.H., Clare-Salzler, M.J., Moldawer, L.L. 2007. Treatment with GITR agonistic antibody corrects adaptive immune dysfunction in sepsis. *Blood*. 110:3673-3681.

51. Swan, R., **Chung, C.S.**, Albina, J., Cioffi, W.G., Per, M., Ayala, A. 2007. Polymicrobial sepsis enhances clearance of apoptotic immune cells by splenic macrophages. *Surgery*. 142:253-261.

52. Perl, M., **Chung, C.S.**, Perl, U., Lomas-Neira, J., de Paepe, M., Cioffi, W.G., Ayala, A. 2007. Fas-induced pulmonary apoptosis and inflammation during indirect acute lung injury. *Am J Respir Crit Care Med.* 176:591-601.

53. **Chung, C.S.,** Wang, J., Wehman, M., Rhodes, D.E. 2008. Severity of alcohol withdrawal symptoms depends on developmental stage of Long-Evans rats. *Pharmacol. Biochem. Behav.* 89:137-144.

54. Venet, F., **Chung, C.S.,** Kherouf, H., Geeraert, A., Malcus, C., Poitevin, F., Bohe, J., Lepape, A., Ayala, A., Monneret, G. 2009. Increased circulating regulatory T cells [CD4(+) CD25 (+) CD127 (-)] contribute to lymphocyte anergy in septic shock patients. *Intensive Care Med.* 935:678-686.

55. Hu, C.K., Venet, F., Heffernan, D.S., Wang, Y.L., Horner, B., Huang, X., **Chung, C.S.,** Gregory, S.H., Ayala, A. 2009. The Role of Hepatic Invariant (i)NKT Cells in Systemic/Local Inflammation and Mortality During Polymicrobial Septic Shock. *J. Immunol.* 182:2467-2475.

56. Huang, X., Venet, F., Wang, Y.L., Lepape, A., Yuan, Z., Wang, Y.L., Chen, Y., Swan, R., Kherouf, H., Monneret, G., **Chung, C.S.**, Ayala, A. 2009. PD-1 expression by macrophages plays a pathologic role in altering microbial clearance and the innate inflammatory response to sepsis. *P.N.A.S. USA* 106:6303-6308.

57. Stromberg, P.E., Woolsey, C.A., Clark, A.T., Clark, J.A., Turnbull, I.R., McConnell, K.W., Chang, K.C., **Chung, C.S.**, Ayala, A., Buchman, T.G., Hotchkiss, R.S., Coopersmith, C.M. 2009. CD4+ lymphocytes control gut epithelial apoptosis and mediate survival in sepsis. *FASEB J.* 23:1817-1825.

58. Venet, F., **Chung, C.S.**, Huang, X., Lomas-Neira, J., Chen, Y., Ayala, A. 2009. Lymphocytes in the development of lung inflammation: a role for regulatory $CD4^+$ T cells in indirect pulmonary lung injury. *J. Immunol.* 183:3472-3480.

59. Venet, F., Huang, X., **Chung, C.S.**, Chen, Y., Ayala, A. 2010. Plasmacytoid dendritic cells control lung inflammation and monocyte recruitment in indirect acute lung injury in mice. *Am. J. Pathol.* 176:764-773.

60. **Chung, C.S.,** Venet, F., Chen, Y., Jones, L.N., Wilson, D.C., Ayala, C.A., Ayala, A. 2010. Deficiency of bid protein reduces sepsis-induced apoptosis, inflammation and improves septic survival. *Shock* 34:150-161.

61. Perl, M., **Chung, C.S**., Perl, U., Thakkar, R., Lomas-Neira, J., Ayala, A. 2010. Therapeutic accessibility of caspase-3 activation as a key pathomechanism in indirect acute lung injury. *Crit Care Med*. 38:1179-1186.

62. McNeal, S.I., Legolvan, M.P., **Chung, C.S.**, Ayala, A. 2011. The Dual Functions of Rip1 in Fas-Induced Hepatocyte Death During Sepsis. *Shock* 35:499-505.

63. Thakkar, R.K., **Chung, C.S.**, Chen, Y., Monaghan, S.F., Lomas-Neira, J., Heffernan, D.S., Cioffi, W.G., Ayala, A. 2011. Local Tissue Expression of the Cell Death Ligand, FasL, Plays a Central Role in the Development of Extra-Pulmonary Acute Lung Injury. *Shock* 36:138-143.

64. Guan, Y.J., Zhang, Z., Yu, C., Ma, L., Hu, W., Xu, L., Gao, J.S., **Chung, C.S.**, Wang, L., Yang, Z.F., Fast, L.D., Chung, A,S., Kim, M., Ayala, A., Zhuang, S., Zheng, S., Chin, Y.E. 2011. Phospho-SXXE/D motif mediated TNF receptor 1-TRADD death domain complex formation for T cell activation and migration. *J Immunol*. 187:1289-1297.

65. Monaghan, S.F., Thakkar, R.K., Heffernan, D.S., Huang, X., **Chung, C.S.**, Lomas-Neira, J., Cioffi, W.G., Ayala, A. 2011. Mechanisms of Indirect Acute Lung Injury: A Novel Role for the Coinhibitory Receptor, Programmed Death-1. *Annals of Surgery (in press).*

REVIEWS, COMMENTARIES & BOOK CHAPTERS

1. Ayala, A., **Chung C.S.,** Chaudry, I.H. 1998. Lymphocyte apoptosis in sepsis. *Sepsis* 2:55-71.

2. Ayala, A., **Chung, C.S**., Song, G.Y. 1999. Lymphocyte anergy, apoptosis and cell activation in polymicrobial sepsis. In: Update in Intensive Care and Emergency Medicine, Vol. 31. Editors: Marshal, J.C., Cohen, J., Vincent, J.L. Springer-Verlag, Berlin, Germany, pp. 226-246

3. **Chung, C.S.,** Chaudry, I.H., Ayala, A. 2000. The apoptotic response of the lymphoid immune system to trauma, shock and sepsis. In: Yearbook of Intensive Care and Emergency Medicine-2000. Editors: Vincent, J.L. Springer-Verlag, Heidelberg, Germany pp. 27-40.

4. Ayala, A., **Chung, C.S.,** Song, G.Y., Grutkoski, P.S., Simms, H.H. 2002. Down-Regulation of the Immune Response. In: Molecular & Cellular Biology of Critical Care Medicine. Editors: Linden, P. and Doughty L.A. Kluwer Academic Publishers, Norwell, MA, pg 41-78.

5. Grutkoski, P.S., **Chung, C.S.**, Ayala, A. 2002. PMN and lymphocyte apoptosis in the critically ill: different means, similar outcome. *Crit. Care & Shock* 5:155-164.

6. Ayala, A., Lomas, J.L., Grutkoski, P.S., **Chung, C.S**. 2003. Pathological aspects of apoptosis in severe sepsis and septic shock. *Int. J. Biochem. & Cell Biol.* 35:7-15.

7. Ayala, A., **Chung, C.S.**, Grutkoski, P.S., Song, G.Y. 2003. Mechanisms of immune resolution. *Crit.Care Med*. 31(8 Suppl):S558-71.

8. Ayala, A., Ding, Y., Rhee, R.J., Doughty, L.A., Grutkoski, P.S., **Chung, C.S.** 2003. Pathological Aspects of the Anti-inflammatory/Immune suppressive Response to Sepsis and Shock. *Recent Res. Devel. Immunol.* 5:13-35.

9. Ayala, A., Lomas, J.L., Grutkoski, P.S., **Chung, C.S**. 2003. Fas-Ligand Mediated Apoptosis in Severe Sepsis and Shock. *Scand. J. Infect. Dis.* 35:593-600

10. Grutkoski, P.S., **Chung, C.S.**, Albina, J.E., Biffl, W.L., Ayala, A. 2004. Chapter: Apoptosis In the Critically Ill. In: Textbook of Critical Care, 5th Edition. Editors: Abraham, E.W.B. Saunders Publishers, Philadelphia, PA.

11. Lomas-Neira, J.L., Perl, M., **Chung, C.S.**, Ayala, A. 2004. Shocks and Hemorrhage. *Shock* 24:Suppl 1:33-39

12. Wesche, D.E., Lomas-Neira, J.L., Perl, M., Jones, L., **Chung, C.S.**, Ayala, A. 2005. The Role and Regulation of Apoptosis in Sepsis. *J. Endotoxin Res.* 11:375-382.

13. Wesche, D.E., Lomas-Neira, J.L., Perl, M., **Chung, C.S.**, Ayala, A. 2005. Leukocyte Apoptosis and its Significance in Sepsis and Shock. *J. Leukocyte Biol.* 78:325-337.

14. Perl, M., **Chung, C.S.**, Ayala, A. 2005. Apoptosis. *Crit. Care Med.* 33(12 Suppl):S526-9.

15. Perl, M., **Chung, C.S.**, Garber, M., Huang, X., Ayala, A. 2006. Contribution of anti-inflammatory/immune suppressive processes to the pathology of sepsis. *Front Biosci.* 11:272-299.

16. Wesche-Soldato, D.E, Swan, R.Z., **Chung, C.S.**, Ayala, A. 2007. The apoptotic pathway as a therapeutic target in sepsis. *Current Drug Targets* 8:493-500.

17. Ayala, A., Wesche-Soldato, D.E., Perl,M., Lomas-Neira, J., Swan, R., **Chung, C.S.** 2007. Blockade of apoptosis as a rational therapeutic strategy for the treatment of sepsis. *Novartis Found Symp.* 280:37-49; discussion 49-52, 160-4.

18. Huang, X., Venet, F., **Chung, C.S.**, Lomas-Neira, J., Ayala, A. 2007. Changes in dendritic cell function in the immune response to sepsis. Cell- & tissue-based therapy. *Expert Opin Biol Ther.* 7:929-38.

19. Lomas-Neira, J., **Chung C.S.**, Ayala, A. 2008. RNA interference as a potential therapeutic treatment for inflammation associated lung injury. Int J Clin Exp Med. 1:154-60.

20. Venet, F., **Chung, C.S.**, Monneret, G., Huang, X., Horner, B., Garber, M., Ayala, A. 2008. Regulatory T cell populations in sepsis and trauma. *J Leukoc Biol.* 83:523-35.

21. Wesche, D.E., Lomas-Neira, J.L., Perl, M., **Chung, C.S.**, Ayala, A. 2008. Hydrodynamic delivery of siRNA in a mouse model of sepsis. *Methods Mol Biol.* 442:67-73.

22. Perl, M., Lomas-Neira, J.L., **Chung, C.S.**, Ayala, A. 2008. Epithelial cell apoptosis and neutrophil recruitment in acute lung injury-a unifying hypothesis? What we have learned from small interfering RNAs. *Mol Med.* 14:465-75.

23. Ayala, A., Perl, M., Venet, F., Lomas-Neira, J., Swan, R., **Chung, C.S.** 2008. Apoptosis in sepsis: mechanisms, clinical impact and potential therapeutic targets. *Curr Pharm Des.* 14:1853-9.

24. **Chung, C.S.,** Swan, R., Perl, M., Wesche-Soldato, D., Ayala, A. 2008. Apoptosis: a potential therapeutic target in sepsis and non-infectious systemic inflammation. In: "Sepsis And Non-Infectious Systemic Inflammation". Editors: Cavaillon, J-M. Wiley-VCH Verlag Publishers, Weinheim, Germany. pp. 199-223.

25. Perl, M., Lomas-Neira, J., Venet, F., **Chung, C.S.**, Ayala, A. 2011. Pathogenesis of indirect (secondary) acute lung injury. *Expert Rev Respir Med.* 5:115-26.

PUBLICATIONS SUBMITTED OR IN PREPARATION

1. Monaghan, S.F., Chung, C.S., Chen, Y., Thakkar, R.K., Heffernan, D.S., Cioffi, W.G., Ayala, A. Novel Anti-inflammatory Mechanism in Acute Lung Injury: Soluble Programmed Cell Death Receptor-1 (sPD-1). (In preparation)

2. Chung, C.S., Chen, Y., Perl, M., Ayala, A. Silencing of SOCS-3 reduces lung inflammation, neutrophil inflex and injury after hemorrhagic shock (HEM) and sepsis. (In preparation)

3. Chung, C.S., Chen, Y., Ayala, A. Role of socs-1 and socs-3 proteins in cardiac inflammation after shock. (In preparation)

4. Chung, C.S., Chen, Y., Doughty, L.A., Ayala, A. JAK/STAT and TLR pathways differentially regulate SOCS-3 protein expression during sepsis. (In preparation)

5. Chung, C.S., Chen, Y., Ayala, A. The role of Myd88-independent, TRIF pathway in polymicrobial sepsis. (In preparation)

ABSTRACTS

1. Pearson, L.D., Marcom, K.A., **Chung, C.S.** 1989. Production and characterization of monoclonal antibodies to vine lentiviruses. *The Seventh Conference of Research Workers in Animal Disease,* Chicago, IL.

2. Collins, J.K., Ayers, V.K., **Chung, C.S.**, Pearson, L.D. 1991. Characterization of the glycoproteins of bovine encephalitis herpesvirus, BHV 1.3. *The Seventy-Second Conference of Research Workers in Animal Disease,* Chicago, IL.

3. **Chung, C.S.**, Pearson, L.D., Ayers, V.K., Collins, J.K. 1991. Monoclonal antibodies that distinguish between bovine encephalitogenic herpes virus (BHV 1.3) and bovine herpes virus 1.1. *The 72nd Conference of Research Workers in Animal Disease*, Chicago, IL.

4. **Chung, C.S.**, Rhoads, D.E. 1994. A rat brain proteolipid fraction may mediate alcohol sensitive Na, K-ATPase activity. *New England Pharmacologists, the 23rd Annual Meeting*, Mystic, CT.

5. **Chung, C.S.**, Xu, X.Y., Chaudry, I.H., Ayala, A. 1997. Sepsis induces increased apoptosis in lamina propria mononuclear cells which is associated with altered cytokine gene expression. *Association for Academic Surgery, the 31st Annual Meeting,* Dallas, TX.

6. **Chung, C.S.**, Xu, Y.X., Chaudry, I.H., Ayala, A. 1998. Sepsis induces increased apoptosis in lamina propria mononuclear cells which is associated with altered cytokine gene expression. *FASEB J*. 12:A881.

7. **Chung, C.S.**, Wang, W., Chaudry, I.H., Ayala, A. 1998. Is Fas/Fas Ligand involved in B-cell apoptosis in intestinal lamina propria during sepsis? *Shock* 9:21S.

8. Redmond, K.M., **Chung, C.S.**, Chaudry, I.H., Ayala, A. 1998. Immune cell hyporesponsiveness in sepsis: altered IL-10/IL-12 release as a response to necrotic (injured) tissue but not endotoxin (ETX). *Shock* 9:35S.

9. Ayala, A., **Chung, C.S.**, Redmond, K.M., Chaudry, I.H. 1998. Factors responsible for immune cell hypo-responsiveness in sepsis: role of endotoxin (ETX) and necrotic tissue. *Shock* 9:23S.

10. Xu, Y.X., **Chung, C.S.**, Chaudry, I.H., Ayala, A. 1998. Neither Fas ligand (FasL) nor endotoxin (ETX) contributes to thymocyte apoptosis during polymicrobial sepsis. *Shock* 9:37S.

11. Song, G.Y., **Chung, C.S.**, Jarrar, D., Chaudry, I.H., Ayala, A. 1998. Increased p38 MAP kinase expression contributes to lymphocyte immune suppression seen in late sepsis. *J. Leukocyte Biol*. 64:28S.

12. Song, G.Y., **Chung, C.S.**, Jarrar, D., Chaudry, I.H., Ayala, A. 1999. P38 MAP kinase activation contributes to macrophage immune dysfunction in sepsis. *FASEB J.* 13:A1152.

13. Ayala, A., **Chung, C.S.**, Song, G.Y., Chaudry, I.H. 1999. IL-10 as a mediator of activation induced lymphocyte apoptosis in sepsis. *Shock* 11:60S.

14. Song, G.Y., **Chung, C.S.**, Jarrar, D., Chaudry, I.H., Ayala, A. 1999. Inhibition of p38 MAPK attenuates immunosuppression and improves survival in polymicrobial sepsis. *Shock* 11:43S.

15. **Chung, C.S.**, Song, G.Y., Moldawer, L.L., Chaudry, I.H., Ayala, A. 1999. The role of caspases in macrophage cell dysfunction and apoptosis during sepsis. *Shock* 11:63:S.

16. Joshi, A.R.T., **Chung, C.S.**, Song, G.Y., Ayala, A. 1999. Inhibition of NF-kB reduces apoptosis in peyer's patch B-cells during polymicrobial sepsis. *Shock* 11:29S.

17. **Chung, C.S.**, Song, G.Y., Chaudry, I.H., Ayala, A. 1999. Septic mucosal intraepithelial lymphocyte lymphoid immune suppression is not IL-10 mediated. *J. Trauma* 47:218.

18. Ayala, A., **Chung, C.S.**, Song, G.Y., Chaudry, I.H. 2000. The physiology and cellular biology of acute illness: apoptosis. *Shock* 13:(Suplt 1) 3.

19. Ayala, A., **Chung, C.S.**, Chaudry, I.H. 2000. The gut mucosal lymphocyte response to polymicrobial infection. *Shock* 13:(Suplt 1) 18.

20. Ayala, A., Song, G.Y., **Chung, C.S.**, Chaudry, I.H. 2000. TH1, TH2 cell reponse under stressful conditions: the anti-inflammatory mediator response. *Shock* 13:(Suplt 1) 93.

21. Song, G.Y., **Chung, C.S.**, Chaudry, I.H., Ayala, A. 2000. Pathways of TH2 cell-mediated immune suppression in polymicrobial sepsis: IL-4 induced activation of STAT-6. *Shock* 13:(Suplt 1) 93.

22. Ayala, A., **Chung, C.S.**, Song, G.Y., Lomas, J., Chaudry, I.H. 2000. Apoptosis in polymicrobial sepsis: dysregulation of activation induced apoptotic response. *Shock* 13:(Suplt 1) 111.

23. **Chung, C.S.**, Song, G.Y., Chaudry, I.H., Ayala, A. 2000. Does Fas ligand contribute to pro-inflammatory responses during polymicrobial sepsis? *FASEB J* 14:A1111.

24. **Chung, C.S.**, Song, G.Y., Lomas, J., Simms, H.H., Chaudry, I.H., Ayala, A. 2000. Delayed blockade of FasL restores lymphoid immune function, suppresses apoptosis and improves survival in sepsis. *Shock* 13:(Suplt 2) 29.

25. Cahoone, E.V., **Chung, C.S.**, Lomas, J., Ayala, A. 2000. Deficiency in CD8 T-lymphocytes compromises the ability of mice to survive sepsis. *Shock* 13:(Suplt. 2) 11.

26. Watkins, L., **Chung, C.S.**, Song, G.Y., Ivanova, S., Tracey, K.J., Ayala, A. 2000. Does 3-aminopropanal affect splenocyte apoptosis and/or function? *Shock* 13:(Suplt 2) 18.

27. Song, G.Y., **Chung, C.S.**, Chaudry, I.H., Ayala, A. 2000. Does deficient STAT4 signaling contribute to morbidity and mortality seen in polymicrobial sepsis? *J. Leukocyte Biol.* 68:30 (suplt).

28. Ayala, A., Watkins, L., Song, G.Y., **Chung, C.S.**, Al-Abed, Y., Ivanova, S., Tracey, K.J. 2000. Inhibitor of 3-aminopropanal toxicity, PICVA-13, preserves immune responsiveness during sepsis. *J. Leukocyte Biol.* 68:28 (suplt).

29. Ayala, A., **Chung, C.S.**, Lomas, J., Grutkoski, P.S., Doughty, L.A., Cahoone, E.V., Simms, H.H. 2001. Hemorrhagic (HEM) shock serves as a Apriming stimulus for acute lung injury but is not sufficient to Atrigger it alone. *FASEB J* 15:A244

30. **Chung, C.S.**, Song, G.Y., Lomas, J., Wang, W., Ayala, A. 2001. Blockade of Fas/FasL signaling prevents increased intestinal permeability during sepsis. *Shock* 15:(Suplt 1)70.

31. Ayala, A., **Chung, C.S.**, Lomas, J., Grutkoski, P.S., Doughty, L.A., Simms, H.H. 2001. A mouse model of priming for acute lung injury following shock. *Shock* 15:(Suplt 1)82.

32. Doughty, L., **Chung, C.S.**, Lomas, J., Nguyen, K., Biron, C., Ayala, A. 2001. Mechanism of viral potentiation of inflammation: IFN-alpha modulation of the cytokine response to sepsis. *Shock* 15:(Suplt 1)35.

33. Song, G.Y., **Chung, C.S.**, Cioffi, W.G., Chaudry, I.H., Ayala, A. 2001. Insights into the contribution of STAT4 and STAT6 signaling to the morbidity and mortality seen in sepsis. *Shock* 15:(Suplt 1)61.

34. Lomas, J.L., **Chung, C.S.**, Song, G.Y., Grutkoski, P.S., Dunican, A.L., Simms, H.H., Ayala, A. 2001. Role of MIP-2 in suppression of neutrophil apoptosis. *Shock* 15:(Suplt 1)74.

35. Lomas, J.L., **Chung, C.S.,** Grutkoski, P.S., Carlton, S., Dunican, A.L., Simms, H.H., Cioffi, W.G., Ayala, A. 2002. Divergent roles of the murine homologues of IL-8 in the pathogenesis of acute lung injury. *Surg. Infect.* 3:78.

36. Rhee, R.J., Carlton, S., **Chung, C.S.,** Lomas, J.L., Ayala, A. 2002. Immune dysfunction in sepsis: the contribution of CD1d mediated NK-T cell activation. *Shock* 17: 44S.

37. Grutkoski, P.S., Chen, Y., Chung, C.S., Ayala, A. 2002. Suppressor of cytokine signaling (SOCS)-3 expression is upregulated in polymicrobial sepsis. *Shock* 17:8S.

38. Lomas, J.L., **Chung, C.S.,** Grutkoski, P.S., Doughty, L., Ayala, A. 2002. Differential effects of MIP-2 and KC on hemorrhage induced neutrophil priming for lung inflammation. *Shock* 17:21S.

39. **Chung, C.S.,** Song, G.Y., Lomas, J., Grutkoski, P.S., Doughty, L., Ayala, A. 2002. Neutrophil sequestration in lung is a transient event during polymicrobial sepsis. *Shock* 17:30S.

40. Doughty, L., **Chung, C.,** Carlton, S., Grutkoski, P., Lomas, J., Ayala, A. 2002. dsRNA-activated protein kinase (PKR) mediates viral priming of lethality in polymicrobial sepsis. *Shock* 17:30S.

41. Rhee, R.J., Carlton, S., **Chung, C.**, Lomas, J.L., Cioffi, W.G., Ayala, A. 2002. Inhibition of CD1d activation suppresses septic mortality: a role for NK-T cells in septic immune dysfunction. *J. Surg. Res.* 107:268.

42. Ding, Y.L., **Chung, C.S**., Bray, S., Chen, Y., Grutkoski, P.S., Carlton, S., Ayala, A. 2003. Polymicrobial sepsis induces divergent effects on dendritic cell function in mice. *Surg. Infect.* 4:95.

43. **Chung, C.S.,** Watkins, L., Song, G.Y., Lomas, J.L., Grutkoski, P.S., Cioffi, W.G., Ayala, A. 2003. Role of gamma-delta T-cells in immunoregulatory effects in sepsis. *Surg. Infect.* 4:97.

44. Lomas, J.L., **Chung, C.S**., Grutkoski, P.S., Gregory, S.H., Doughty, L.A. Biffl, W.L., Ayala, A. 2003. Hemorrhage induced priming for acute lung injury resultant from subsequent septic challenge: what is the neutrophil's contribution? *Faseb J.* 17:A245.

45. Ayala, A., Lomas, J.L., **Chung, C.S.**, Gregory, S.H., Doughty, L.A., Grutkoski, P.S. 2003. FasL or Fas gene deficiency potentiates PMN priming for lung inflammation resultant from sequential shock and sepsis. *Faseb J.* 17:A655.

46. Doughty, L., Carlton, S., Grutkoski, P., **Chung, C.S**., Ayala, A. 2003. NFκB activation is required for IFNγ-mediated potentiation of inflammatory responsiveness. *Faseb J.*

47. **Chung, C.S.,** Watkins, L., Song, G.Y., Lomas, J., Grutkoski, P.S., W.G.Cioffi, Ayala, A. 2003. Immunoregulatory effects of gamma-delta T-cells in response to sepsis. *Faseb J.*

48. Lomas, J.L., **Chung, C.S.,** Grutkoski, P.S., Gregory, S.H., Biffl, W.L., Ayala, A. 2003. PMN depletion attenuates lung injury resultant from combined insults of hemorrhage followed by sepsis independent of ICAM-1 expression. *Shock* 19:67A.

49. Grutkoski, P.S., Chen, Y., **Chung, C.S.,** Ayala, A. 2003. Factors responsible for suppressors of cytokine signaling (SOCS)-3 upregulation in polymicrobial sepsis is site-specific. *Shock* 19:2A.

50. Ayala, A. **Chung, C.S**., Grutkoski, P.S., Rhee, R. 2003. Myd88 deficiency abrogates aspects of splenic lymphoid immune dysfunction seen in response to tissue injury. *Shock* 19:13A.

51. Rhee, R., **Chung, C.S**., Carlton, S., Ayala, A. 2003. Divergent effects of CD1d gene deficiency vs. CD1d antibody blockade on septic survival. *Shock* 19:62A

52. Grutkoski, P.S., Chen, Y., **Chung, C.S**., Cioffi, W.G., Ayala, A. 2003. Putative mechanism of hemorrhage-induced leukocyte hyporesponsiveness: induction of suppressor of cytokine signaling (SOCS)-3. *J. Trauma* 55:206.

53. Lomas-Neira, J.L., **Chung, C.S**., Grutkoski, P.S., Miller, E.J., Ayala, A. 2003. CXCR2 inhibition suppresses hemorrhage induced priming for ALI. *J. Leuko. Biol.* 74:133 suplt.

54. Grutkoski, P.S., Chen, Y., **Chung, C.S.**, Ayala, A. 2003. Differential regulation of SOCS proteins during sepsis. *J. Leuko. Biol.* 74:47 suplt.

55. Ayala, A., Ding, Y., **Chung, C.S.,** Grutkoski, P.S., Carlton,S., Albina, J.E. 2004. Divergent effects of sepsis on dendritic cells. Shock 21:19A

56. **Chung, C.S.,** Grutkoski, P.S., Chen, Y., Ayala, A. 2004. Mechanisms of induction of the suppressor of cytokine signaling (SOCS) upregulation following trauma and sepsis. Shock 21:44A

57. Ayala, A., Rhee, R.B., **Chung,C.S**. 2004. Inhibition of CD1d activation suppresses septic mortality: a possible role for NK-T-cells. Shock 21:52A.

58. Ayala, A., **Chung, C.S.,** Wesche, D., Lomas-Niera, J.L. 2004. Extrinsic events in the apoptotic response to sepsis/shock. Shock 21:53A.

59. Lomas-Neira, J., **Chung, C.S.,** Wesche, D., Albina, J., Ayala, A. 2004. Hemorrhage induced priming for acute lung injury is abrogated by TNF gene deficiency. *FASEB J.*, Suplt.

60. Wesche, D.E., **Chung, C.S.,** Gregory, S.H., Ayala, A. 2004. 'Hydrodynamic' administration of Fas siRNA prevents liver damage and improves survival of septic mice. *FASEB J.*, suplt.

61. **Chung, C.S.,** Grutkoski, P., Chen, Y., Ayala, A. 2004. Inhibition of MyD88 signaling or NF-κB activation by pyrrolidine dithiocarbamate (PDTC) reduced SOCS3 expression during sepsis. *FASEB J.*, suplt.

62. **Chung, C.S.,** Grutkoski, P., Chen, Y., Ayala, A. 2004. Blockade of TLR-NFκB signaling downregulate SOCS-3 expression during sepsis.*Shock* 21:80 Supplt. 2.

63. Wesche, D.E., **Chung, C.S**., Lomas-Neira, J., Gregory, S.H., Ayala, A. 2004. In vivo delivery of caspase 8 siRNA improves survival of septic mice. *Shock* 21:23 Supplt. 2.

64. Lomas-Neira, J., **Chung, C.S.,** Wesche, D.E., Ayala, A. 2004. Local chemokine suppression reduces shock induced lung injury: in vivo siRNA silencing of pulmonary MIP-2. *Shock* 21:78 Supplt. 2.

65. Garber, M.E., **Chung, C.S.,** Chen, Y., Ayala, A. 2004. Altered interleukin 16 expression during polymicrobial sepsis. *Shock* 21:17 Supplt. 2.

66. Chen, Y., **Chung, C.S.,** Jones, L., Ayala, A. 2004. Deficiency of BID, a pro-apoptotic member of the Bcl2 family activated by death receptors, improves septic survival. *Shock* 21:30 Supplt. 2.

67. Ayala, A., Wesche, D.E., Lomas-Neira, J.L., Perl, M., **Chung, C.S.** 2004. Leukocyte apoptosis and its significance during sepsis. *J. Leukocyte Biol.* 76:20 Supplt.

68. Lomas-Neira, J.L., **Chung C.S.**, Wesche D.E., Perl M., Ayala A. 2004. In vivo gene silencing (with siRNA) of pulmonary expression of MIP-2 vs. KC results in divergent effects on hemorrhage induced neutrophil mediated septic acute lung injury. *J. Leukocyte Biol.* 76:61 Supplt.

69. Ayala, A., Wesche, D.E., Loma-Neira, J.L., Perl, M., Jones, L., **Chung, C.S.** 2004. The role and regulation of apoptosis in sepsis. *J. Endotoxin Res. 10:304.*

70. **Chung, C.S.**, Chen, Y., Doughty, L., Ayala, A. 2004. Differential induction of SOCS3 by JAK/STAT-dependent and independent pathways during sepsis. *J. Endotoxin Res. 10:366*

71. Doughty, L.A., Galen, B., Carlton, S., **Chung, C.S.**, Ayala, A. 2004. Upregulation of scavenger receptor expression during inflammation. *Shock* 21:27 Supplt. 2.

72. Perl, M., **Chung, C.S.**, Lomas-Neira, J., Rachel, T.M., Biffl, W., Cioffi, W.G., Ayala, A. 2005. Pulmonary instillation of Fas- but not caspase-8 small interfering RNA (siRNA) into lung epithelial cells ameliorates acute lung injury. *Shock* 23:3 Supplt. 3.

73. Garber, M.E., **Chung, C.S.,** Chen, Y., Ayala, A. 2005. Expression of interleukin 16 is altered in murine model of hemorrhagic shock. *Shock* 23:38 Supplt. 3.

74. Lomas-Neira, J.L., **Chung C.S.**, Wesche D.E., Perl M., Ayala A. 2005. MIP-2 and KC differentially contribute to the neutrophil activational/phosphoprotein status resultant from hemorrhage. *Shock* 23:40 Supplt. 3.

75. Chen, Y., **Chung, C.S.**, Wilson, D., Jones, L., Ayala, A. 2005. The role of BID protein in sepsis-induced apoptosis. *Shock* 23:47 Supplt. 3.

76. Wesche, D.E., Galen, B., Garber, M.E. **Chung, C.S**., Ayala, A. 2005. In vivo delivery of Fas siRNA differentially regulates the expression of Fas in teh liver non-parenchyma and spleen following CLP. *Shock* 23:49 Supplt. 3.

77. Rachel, T.M., Perl, M., **Chung, C.S.**, Chen, Y., Ayala, A. 2005. Involvement of endoplasmic reticular (ER) stress and caspase-12 activation in leukocyte apoptosis in the early course of polymicrobial sepsis. *Shock* 23:50 Supplt. 3.

78. Huang, X., **Chung, C.S.**, Chen, Y., Ayala, A. 2005. Sepsis induces differential expression of ITIM receptors on $CD4^+$ T cells. *Shock* 23:61 Supplt. 3.

79. Perl, M., Lomas-Neira, J., Perl, U., **Chung, C.S.**, Ayala, A. 2006. Contribution of non-apoptotic and apoptotic Fas signaling to the pathology of extrapulmonary acute lung injury. *Shock* 25:1 Supplt. 1.

80. Wesche, D.E., **Chung, C.S**., Ayala, A. 2006. $CD8^+$ T cells promote inflammation in the liver after sepsis. *Shock* 25:4 Supplt. 1.

81. Lomas-Neira, J.L., **Chung C.S.**, Perl M., Chen, Y., Ayala A. 2006. Neutralization of KC and MIP-2; divergent effects on activation pathways in mouse PMN cell line-consistent with mouse blood PMN. *Shock* 25:29 Supplt. 1.

82. Huang, X., **Chung, C.S.**, Chen, Y., Ayala, A. 2006. Sepsis induces elevated expression of inhibitory receptor PD-1 and its ligand PD-L1 on immune cells. *Shock* 25:46 Supplt. 1.

83. **Chung, C.S.**, Chen, Y., Ayala, A. 2006. Hemorrhagic shock induces differential expression of SOCS-1 and SOCS-3 proteins. *Shock* 25:61 Supplt. 1.

84. Chen, Y., **Chung, C.S.**, Ayala, A. 2006. The role of Myd88-independent, TRIF pathway in polymicrobial sepsis. *Shock* 25:74 Supplt. 1.

85. Swan, R., **Chung, C.S.**, Ayala, A. 2006. Sepsis differentially affects macrophage ($M\phi$) clearance of apoptotic thymocytes. *Shock* 25:77 Supplt. 1.

86. Swan, R., **Chung, C.S.**, Perl, M., Cioffi, W., Ayala , A. 2006. The effects of polymicrobial sepsis on murine macrophage clearance of apoptotic thymocytes. *American College of Surgeons 92nd Annual Clinical Congress*, Chicago IL, Oct. 8-12.

87. Swan, R., Albina, J., **Chung, C.S.**, Cioffi, W., Gregory, S., Perl, M., Ayala, A. 2007. Poly-microbial sepsis enhances clearance of apoptotic immune cells by splenic macrophages. *Society of University Surgeons 2nd Annual Academic Surgical Congress*, Phoenix AZ, February 6-9.

88. **Chung, C.S.**, Horner, B., Chen, Y., Ayala, A. 2007. Role of NKT cells in the immune dysfunction and injury in sepsis. *Shock* 27: 52 Supplt.1.

89. Perl, M., **Chung, C.S.**, Perl, U., Lomas-Neira, J., Ayala, A. 2007. In vivo silencing of caspase-3 in lung epithelial cells ameliorates extrapulmonary acute lung injury (ALI) induced by hemorrhagic shock & sepsis. *Shock* 27: 6 Supplt.1.

90. Venet, F., Lomas-Neira, J., **Chung, C.S**., Ayala, A. 2007. Lymphocytes as an anti-poptotic/anti-inflammatory regulator of extrapulmonary acute lung injury? *Shock* 27: 6 Supplt.1.

91. Huang, X., **Chung, C.S.**, Chen, Y., Ayala, A. 2007. Antigen presenting cells contribute to impared Th1 response through upregulating PD-1/B7-H1 expression. *Shock* 27: 62 Supplt.1.

92. Venet, F., Lomas-Neira, J., **Chung, C.S**., Ayala, A. 2007. Mechanisms of extrapulmonary acute lung injury: lymphocytes as anti-apoptotic/anti-inflammatory regulators. *40th Annual Meeting of the Society for Leukocyte Biology, Cambridge, MA, October 11-13.*

93. Lomas-Neira, J., Perl, M., Soldato, D., Venet, F., **Chung, C.S**., Ayala, A. 2007. TNF-α priming for the development of shock induced acute lung injury (ALI) is mediated by local tissue not circulating cells. *40th Annual Meeting of the Society for Leukocyte Biology, Cambridge, MA, October 11-13.*

94. **Chung, C.S.**, Chen, Y.P., Perl, M., Ayala, A. 2007. Silencing of SOCS-3 reduces lung inflammation, neutrophil inflex and injury after hemorrhagic shock (HEM) and sepsis. *40th Annual Meeting of the Society for Leukocyte Biology, Cambridge, MA, Oct. 11-13.*

95. **Chung, C.S.**, Chen, Y.P., Ayala, A. 2008. Suppressor of cytokine signaling (SOCS)-1 but not SOCS-3 inhibits MCP-1 production in mouse lung epithelial cells. *FASEB J.*, suplt.

96. Venet, F., Lomas-Neira, J., Huang, X., Chen, Y., **Chung, C.S.**, Ayala, A. 2008. Mechanisms of extra-pulmonary acute lung injury: the dendritic cell as a regulator of the macrophage's inflammatory response. *31th Annual Conference on Shock (US Society) and 6th Congress of the International Federation of Shock Societies*, Cologne, Germany.

97. Venet, F., Lomas-Neira, J., Chen, Y., **Chung, C.S.**, Ayala, A. 2008. Dendritic cells as anti-inflammatory regulators of extra-pulmonary acute lung injury. *American Society for Investigative Pathology*, San Diego, CA.

98. Venet, F., **Chung, C.S.**, Lepape, A., Ayala, A., Monneret, G. 2008. Anergy in septic patients : correlating the increased percentage of circulating CD4+CD25+CD127- regulatory T cells with a decline in lymphocyte proliferation. *American Society for Investigative Pathology,* San Diego, CA.

99. Huang, X., Venet, F., Wang, Y.L., Lepape, A., Swan, R., Chen, Y., **Chung, C.S.**, Monneret, G., Ayala, A. 2008. PD-1 deficiency protects mice from the lethality of sepsis by balancing efficient pathogen clearance and inflammatory cytokine production. *FASEB J.*, suplt.

100. Lomas-Neira, J., Perl, M., Soldato, D., Venet, F., **Chung, C.S.**, Ayala, A. 2008. Endothelial not epithelial-cell expression of TNF-a is critical for the development of shock-induced acute lung injury: IT vs. IV. *American Society for Investigative Pathology,* San Diego, CA.

101. Venet, F., Lomas-Neira, J., Huang, X., Chen, Y., **Chung, C.S.**, Ayala, A. 2008. Mechanisms of extra-pulmonary acute lung injury: the dendritic cell as a regulator of macrophage's recruitment and inflammatory response. *Annual Meeting of The Society of Leukocyte Biology*, Denver, CO.

102. Huang, X., Venet, F., Lepape, A., Yuan, Z., Chen, Y., Monneret, G., **Chung, C.S.**, Ayala, A. 2009. A pathological role for PD-1 in sepsis induced lethality: dysregulating the balance between efficient monocyte/macrophage mediated pathogen clearance, cell death and the innate inflammatory response. *Shock* 31: 58. Supplt.1.

103. **Chung, C.S.**, Chen, Y.P., Ayala, A. 2009. Role of socs-1 and socs-3 proteins in cardiac inflammation after shock. *Shock* 31: 16. Supplt.1.

104. Heffernan, D.S., **Chung, C.S.**, Venet, F., Ravindran, R., Tran, M., Cioffi, W.G., Alfred Ayala, A. 2009. A divergent response of innate regulatory T-cells to sepsis in humans. Circulating invariant natural killer T-cells are preserved. *The 90th annual meeting of the New England Surgical Society*, Newport, RI.

105. Thakkar, R.K., Chen, Y., **Chung, C.S.**, Monaghan, S.F., Cioffi, W.G., Ayala, A. 2010. Local Tissue Expression of the Cell Death Ligand, FasL, Plays a Central Role in the Development of Acute Lung Injury. *Surgical Forum*, Washington, DC.

106. Monaghan, S.F., Thakkar, R.K., **Chung, C.S.**, Chen, Y., Huang, X., Heffernan, D.S., Cioffi, W.G., Ayala, A. 2010. Lack of Programmed Cell Death Receptor (PD)-1 Leads to Improved Survival in a Murine Model of Indirect Acute Lung Injury. *Surgical Forum*, Washington, DC.

107. Hutchins, N., **Chung, C.S**., Ayala, A. 2010. CD8+ T cells instigate endothelial cell injury ad liver organ damage during sepsis through the Fas-FasL system. *Trauma, Shock, Inflammation and Sepsis,* Munich, Germany.

108. Shubin, N., **Chung, C.S**., Ayala, A. 2010. B and T lymphocyte attenuator (BTLA) is a contributor to the pathological progression of sepsis. *Trauma, Shock, Inflammation and Sepsis, Munich,* Germany.

109. Patel, S., Shubin, N., A. Ayala, A., **Chung, C.S.** 2010. Sepsis induces changes in intestinal expression of PD-1:PD-L1. *The 33rd Annual Congress on Shock*, Portland, Oregon.

110. **Chung, C.S.**, Chen, Y.P., Ayala, A. 2010. Silencing of SOCS genes increases cardiac inflammation and reduces cardiac function after hemorrhagic shock (hem). *Annual Meeting of Joint Meeting between the Society for Leukocyte Biology & the International Endotoxin and Innate Immunity Society*, Vancouver, BC, Canada.

111. **Chung, C.S.**, Chen, Y.P., Monaghan, S.F., Heffernan, D.S., Ayala, A. 2011. Sepsis-induced upregulation of CD39 and CD73 in the intestine is associated with developing gut inflammation and dysfunction. *The 34th Annual Congress on Shock*, Norfolk, Virginia.

112. Hutchins, N., Borgerding, J., **Chung, C.S.**, Ayala, A. 2011. Lymphocytes induce changes to liver sinusoidal endothelial cell function during sepsis. *The 34th Annual Congress on Shock*, Norfolk, Virginia.

113. Huang, X., Chen, Y., **Chung, C.S.**, Ayala, A. 2011. B7-H1 gene deficiency mediated protection of mice from the lethality of sepsis associated with suppression of inflammatory cytokine response, but not improved bacterial clearance. *The 34th Annual Congress on Shock*, Norfolk, Virginia.

114. Shubin, N.J., **Chung, C.S.**, Monaghan, S.F., Heffernan, D.S., Ayala, A. 2011. BTLA expression contributes to sepsis progression by globally suppressing leukocyte activation and growth. *The 34th Annual Congress on Shock*, Norfolk, Virginia.

115. Shubin, N.J., Monaghan, S.F., Irwin, L.R., Heffernan, D.S., **Chung, C.S.**, Ayala, A. 2011. Myeloid cell dysfunction in septic shock: a novel regulatory role for B and T lymphocyte attenuator. *Annual Meeting of the Society for Leukocyte Biology,* Kansa City, Mo.

116. Ayala, A., Kim, Y.S., Carreria, A., Elphick, G., Shubin, N., **Chung, C.S.** 2011. Sepsis induced potentiation of peritoneal macrophages migration is mitigated by PD-1 gene deficiency. *Annual Meeting of the Society for Leukocyte Biology,* Kansa City, Mo.

INVITED PRESENTATIONS

1. **Chung, C.S.**, Xu, Y.X., Chaudry, I.H., Ayala, A. Sepsis induces increased apoptosis in lamina propria mononuclear cells, which is associated with altered cytokine gene expression. *31st Annual Meeting of the Association of for Academic Surgery*. Dallas, TX, November 6-8, 1997.

2. **Chung, C.S.,** XU, Y.X., Wang, W., Chaudry, I.H., Ayala, A. Is Fas ligand or endotoxin responsible for mucosal lymphocyte apoptosis in sepsis? *Surgical Infection Society* the *18th Annual Meeting*, New York, NY, April 30-May 2, 1998.

3. **Chung, C.S.**, Wang, W., Chaudry, I.H., Ayala, A. Is Fas/Fas Ligand involved in B-cell apoptosis in intestinal lamina propria during sepsis? *21st Annual Meeting on Shock*, San Antonio, TX, June 14-17, 1998.

4. **Chung, C.S.,** Song, G.Y., Wang, W., Chaudry, I.H., Ayala, A. Septic mucosal intraepithelial lymphoid immune suppression: role for nitric oxide not IL-10 or TGF-β *American Association for the Surgery of Trauma*, the *59th Annual Meeting*, Boston, MA, September 16-18, 1999.

5. **Chung, C.S.,** Song, G.Y., Moldawer, L.L., Chaudry, I.H., Ayala, A. Neither Fas ligand nor TRL-4 mediated endotoxin sensitivity is solely responsible for inducible peritoneal phagocyte apoptosis- during sepsis/peritonitis. *Association for Academic Surgery,* the *33rd Annual Meeting*, Philadelphia, PA, November 17-20, 1999.

6. **Chung, C.S.,** Song, G.Y., Lomas, J., Simms, H.H., Chaudry, I.H., Ayala, A. Delayed blockade of FasL restores lymphoid immune function, suppresses apoptosis and improves survival in sepsis. *The 23rd Annual Meeting on Shock*, Snowbird, UT, June 3-6, 2000.

7. **Chung, C.S.** Gut-Associated Lymphoid Tissue Apoptosis in Sepsis. *Rhode Island Hospital-Basic Research Seminar Series*, June 13, 2000.

8. **Chung, C.S.**,Yang, S.L., Song, G.Y., Lomas, J., Wang, P., Simms, H.H., Chaudry, I.H., Ayala, A. Inhibition of Fas signaling prevents hepatic injury and improves organ blood flow. *The 62nd Annual Meeting of the Society of University Surgeons*, Chicago, IL, February 8-10, 2001.

9. **Chung, C.S.**, Song, G.Y., Lomas, J., Simms, H.H., Chaudry, I.H., Ayala, A. Inhibition of Fas/Fas ligand signaling during sepsis has tissue specific effects on macrophage apoptotic and functional capacity. *Surgical Infection Society, the 21st Annual Meeting,* Snowbird, UT, May 3-7, 2001.

10. **Chung, C.S.** Lymphocyte Cell Death as a Pathological Process in Shock and Sepsis. *Surgical Research Seminar Series of Div. of Surgical Research- Rhode Island Hospital*, May 22, 2001.

11. **Chung, C.S.** Lymphocyte Cell Death as a Pathological Process in Shock and Sepsis. Part of Symposium I- Necrosis, Apoptosis, Senescence: What have we learned from how cell die. *The 24th Annual Conference on Shock*, Marco Island, FL, June 10, 2001.

12. **Chung, C.S.**, Song, G.Y., Lomas, J., Simms, H.H., Chaudry, I.H., Ayala, A. Blockade of FAS signaling prevents organ injury and improves organ blood flow during sepsis. *The 9th Annual Research Celebration at Rhode Island Hospital*, October 25, 2001.

13. **Chung, C.S.,** Watkins, L., Song, G.Y., Lomas, J.L., Grutkoski, P.S., Cioffi, W.G. Ayala, A. Role of gamma-delta T-cells in immunoregulatory effects in sepsis. *The 20th annual meeting of the Surgical Infection Society*, San Antonio, TX, April 10, 2003

14. **Chung, C.S.,** Grutkoski, P., Chen, Y., Ayala, A. Inhibition of MyD88 signaling or NF-□B activation by pyrrolidine dithiocarbamate (PDTC) reduced SOCS3 expression during sepsis. *The 27th Annual Conference on Shock*. Halifax, Nova Scotia, Canada, June 8, 2004. *(Mini-Symposia).*

15. **Chung, C.S.**, Chen, Y., Doughty, L., Ayala, A. JAK/STAT and TLR pathways differentially regulate SOCS-3 protein expression during sepsis. *The 28th Annual Conference on Shock*. Marco Island, Florida, June 4, 2005. *(Mini-Symposia).*

16. Wisnoski, N., **Chung, C.S.,** Chen, Y., Huang, X., Ayala, A. The contribution of CD4+CD25+ T-regulatory-cells to immune suppression in sepsis. *The 1st Academic Surgical Congress*, San Diego, California, Feb. 7-10, 2006.

17. **Chung, C.S.** Hemorrhagic shock induces differential expression of SOCS-1 and SOCS-3 proteins. *Novo Nordisk Inc.* North Brunswick, New Jersey. August 24, 2006.

18. **Chung, C.S.** Immune hyporesponsiveness in shock: role of SOCS-1 and SOCS-3 proteins. *The 12th Congress of the European Shock Society*, Ulm, Germany. Sept. 14-16, 2006.

19. **Chung, C.S.** SOCS in shock. *The 30th Annual Congress on Shock*, Baltimore, Maryland. June 9-12, 2007.

20. **Chung, C.S.** role of socs-1 and socs-3 proteins in cardiac inflammation after shock. *The 32nd Annual Congress on Shock*, San Atonio, Texas. June 6-9, 2009.

GRANTS

1. AtoxBio, Ltd.
P.I.: Chun-Shiang Chung
Project: Mechanism of the beneficial effects of AB103 on sepsis-induced inflammation/mortality.
Direct: $ 28,000. 2011, May-August

2. The US Shock Society/Novo Nordisk Grant
P.I.: Chun-Shiang Chung
Project: "Immune Hypo-Responsiveness in Shock: Role of SOCS-1 & SOCS-3 Proteins."
2009-2010

3. NIH Research Grant R01-GM46354-11
P.I.: Alfred Ayala
Project: "Differential Effects of Sepsis on Macrophage Function."
Award: $1,562,905. 2008-2012

4. NIH Research Grant R01-HL63898-01
P.I.: Alfred Ayala
Project: "Regulatory Mechanisms of Acute Lung Injury: Phagocyte Apoptosis."
Award: $1,413,967. 2008-2012

5. NIH Research Grant R01-GM53209-10
P.I.: Alfred Ayala
Project: "Programmed Cell Death: Role In Septic Immune Suppression."
Award: $1,106,943. 2004-2009

6. Lifespan Developmental Grant
P.I.: Chun-Shiang Chung
Project: "Mechanisms of Immune Hypo-responsiveness in Shock."
Award: $28,490. 2004-2005

6. Rhode Island Foundation Grant
P.I.: Chun-Shiang Chung
Project: "Mechanisms of Immune Hypo-responsiveness in Shock."
Award: $10,000. 2005-2005

HOSPITAL TEACHING ROLES

Served as co-trainer for the following surgical residents/students:
Amit R.T. Joshi, B.A.: Summer Medical Student Research Assistantship Award: Project: The role of NF-kB in the onset of immune cell apoptosis subsequent to polymicrobial sepsis. June-September 1998.

Grace Y. Song, B.A.: Medical Student: The role of IL-10 and altered signal transduction events in the induction of immune suppression in polymicrobial sepsis. January, 1998-present. Role of p38 MAPK in the immune dysfunction seen in polymicrobial sepsis. September 2000-January 2001.

Lara Watkins: Undergraduate from Providence College: Determination of the contribution of CD8 and/or γ/δ-T-cells in the induction of immune dysfunction seen septic mice. June 2000-May 2002.

Rory A. Priester, B.A.: Medical Student: The role PKC in the regulation of increased activation induced apoptosis encounter in sepsis. June-December 1999.

Joanne A. Lomas, M.S.: Graduate Student- project entitled: "The role of chemokines in the regulation of acute lung injury in response to hemorrhagic shock and sepsis." September 2000-May 2006.

Rebecca Rhee: Undergraduate from Brown University/Laboratory Aide: The contribution of NK-T-cells to immune suppression seen in sepsis. January-August 2001.

Shayla M Toombs: Summer undergraduate student in the *NIH Short Term Training for Minority Students Program/ Leadership Alliance:* Project: Assessment of the Mode of Action of FasL mediated Septic Mortality. June-August 2002.

Sara M. Bray: Summer-Undergraduate student - Project: Do alterations in co-stimulant receptors take place in septic mice and does it enhance or suppress survival of septic challenge. June 2002-June 2003

Leslie Jones: Summer undergraduate student in the *NIH Short Term Training for Minority Students Program/ Leadership Alliance:* Project 1: "Intracellular Localization of Specific Pro-/Anti-apoptotic Bcl-family Proteins (e.g., BID) in Response Death Receptor (FasL) Driven Apoptosis seen in Polymicrobial Sepsis." June-August, 2003. Project 2: "Assessment of BID gene deficiency and/or gene silencing (BID siRNA) apacity to suppress apoptosis and improve survival seen following polymicrobial sepsis". June-August, 2004.

Nicholas Wisnoski: Summer-Undergraduate student - Project: The Contribution of $CD4^+CD25^+$ T-regulatory-cells to Immune Suppression in Sepsis. June-Dec. 2003; Sept. 2004-May, 2005.

Doreen E. Wesche, B.S.: Graduate Student- project entitled: "Assessment of the capacity of anti-Fas and/or anti-FasL siRNA to reverse liver and GI morbidity and mortality seen with polymicrobial sepsis." June 2003-May 2007**.**

Megan Garber, B.S.: Graduate Student- project entitled: "The role of IL-16 in the development of immune dysfunction and apoptotic changes seen in sepsis." September 2003-Sept. 2007.

Antonio Funches: Summer undergraduate student in the *NIH Short Term Training for Minority Students Program/ Leadership Alliance:* Project: Determination of the extent $\gamma\delta$ T-cells residing in the intra-epithelial lymphoid cell compartment of the gut induced to undergo apoptosis during sepsis and the degree to this is death receptor (Fas-FasL) mediated. June-August 2005.

Caroline Hu: Summer-Undergraduate student - Project: The Role of liver NK-T-cells in the development of immune/heptic dysfunction and injury in septic mice. June 2005- Aug. 2006.

Mario Perl: Surgical resident from Ulm, Germany: Role of Fas in the indirect ALI induced by hemorrhage and sepsis. April 2005-August 2007.

Ryan Swan: Surgical resident from RIH: Polymicrobial Sepsis Enhances Clearance of Apoptotic Immune Cells by Splenic Macrophages. June 2005-June 2007.

Leia Foster: Summer undergraduate student in the *NIH Short Term Training for Minority Students Program/ Leadership Alliance:* Project: Assessment of cross-linked Strept-Avidin/protamine to serve in targeted siRNA delivery. June-August, 2006.

Yvvone Wong: Summer-Undergraduate student - Project: Role of CD1d+ Antigen Presenting Cells in the Development of Immune/Hepatic Dysfunction in Septic Mice. Feb. 2006- May 2008.

Stacy-Ann A. Allen: Graduate Student (rotation)- Project: The contribution of NKT-cells to the development of cell-mediated immune dysfunction seen in response sepsis in the liver as compared to the spleen. Septemer-December, 2007.

Ana Moreno: Undergraduate student - Project: Determination of the Effect of Intra-peritoneally Delivered Caspase-12 siRNA to the Development of not only Local Leukocyte Activation/Apoptosis but Overall Mortality during Sepsis. September 2007-May 2008.

Sam McNeal: Graduate Student- Project: Role of RIP-1 in caspase-3 independent apoptosis after sepsis. January 2007- present.

Rajan Thakkar: Surgical resident from RIH: Role of cell death ligand, FasL, in the development of acute lung injury. June 2008- June 2010.

Noelle Hutchins: Graduate Student- Project: Can T Cells Mediate Liver Sinusoidal Endothelial Cell (LSEC) Inflammation, Apoptosis or Injury during Sepsis through the Fas-FasL System? July 2008- present.

Nicholas Shubin: Graduate Student- Project: Role of B & T lymphocyte attenuator (BTLA) and its ligand herpes virus entry mediator (HVEM) pathway in sepsis. Jan. 2009- present.

Sean Monaghan: Surgical resident from RIH: Role of PD-1 and its ligands PD-L1 or PD-L2 in the development of acute lung injury. June 2009- June 2011.

Sima Patel: Undergraduate student - Project: Determination of the Role of PD-1:PD-L1 in the Induction of Small Intestine Inflammation/Injury during Sepsis**.** June 2009- May 2010.

Ye Sul Kim: Undergraduate student - Project: Does the expression of Programmed Cell Death Receptor (PD)-1 and/or its ligand PD-L1, contribute to changes in macrophage migratory function seen during sepsis via cytoskeletal alterations? January 2010- May 2011.