The Results

Table (1) and fig. (1):-

Show mean ± standard deviation of age (in years) of the three groups of our study. Statistical analysis showed no significant difference between septic group and control group.

Table (2) and fig. (2):-

Show percentage (%) of sex distribution of the three groups. There was no statistical difference between the three groups.

Table (3) and fig. (3):-

Show percentage (%) of clinical manifestations in-patients of septic and aseptic groups. Neck stiffness was the most common presentation and coma was the least presentation

Table (4):

Shows C.S.F. picture of the three groups. All cases of septic meningitis show turbid aspect of C.S.F while C.S.F of a septic and control groups are clear. There was marked hypercellularity of C.F.F of septic and aseptic group with predominance of polymorphnuclear pleocytes in septic group and mononuclear pleocytes in aseptic group.

In contrast with aseptic and control groups, C.S.F of septic group shown significant increase in protein (mean = 215.79 ± SD = 83.89 mg%) and significant decrease in glucose (mean = 14.71 ± SD = 4.94 mg%).

Table (5):-

Shows blood picture of the three groups there is significant decrease of HB % (mean = 9.72 gm/ 100ml) and significant leucocytosis (mean = 9.60 thousands/mm^3) in septic group as compared to aseptic and control groups).

Table (6): and fig. (4): -

Shows the levels of NO in C.S.F of the three groups before starting treatment, there is significant elivation of NO level in C.S.F of septic group (Mean = 23.13 ± SD = 6.58 nmol/ml) as compared to its levels in aseptic (Mean = 7.55 ± SD = 2.99 nmol/ml) and control groups (Mean = 8.02 ± SD = 3.76 nmol/ml).

Table (7) and fig. (5):-

Shows the level of NO in serum of the three groups before starting treatement, there was significant elivation of NO level in septic group (mean = 83.23 ± SD = 17.60 nmol/ml) as compared to its levels in aseptic (mean = 66.41 ± SD = 26.90 nmol/ml) and control groups (mean = 42.31 ± SD = 6.22 nmol/ml).

Table (8):-

Shows correlation between NO and other variables in septic group, there was significant positive correlation between cells and protein in C.S.F and NO level in serum and C.S.F. Also, there was significant negative correlation between glucose and chloride in C.S.F and NO level in serum and C.S.F. However, there was no significant correlation between NO in serum and C.S.F. and other variables as fever, Hb, RBCs, WBCs, platelets.

Table (9):-

Shows correlation between age (in years) and NO (in nmol/ml) in control group, there was no significant correlation between age and NO.

Fig. (6):-

Shows the distribution of organisms in septic groups as shown by the result of culture and sensitivity of C.S.F of septic groups, the commonest organism was H. influenzae (65%), the other organisms was N. meningetidis (21%) and St. pneumonia (14%).

Table (10) and fig. (7):-

Shows the relation between caustive organisms and NO level (in nmol/ml) in serum and C.S.F of septic group. It was found that NO is more elivated in cases with H.influenzae than cases with St.pneumonia or N.meningetidis.

Table (11) and fig. (8):

Shows comparison between NO (in nmol/ml) pretreatment and posttreatment in septic group in both serum and C.S.F. There is significant decrease of NO level in both serum and C.S.F after treatment with antibiotics and dexamethasone.

Fig. (9):-

Shows prognosis in studied groups, About 20% of cases of septic group with bad prognosis and about 80% with good prognosis. 100% of cases of aseptic group with good prognosis.

Table (12) and fig. (10):-

Shows the relation between prognosis and NO (in nmol/ml) in septic group, there is significant increase in NO levels in cases with bad prognosis than cases with good prognosis.

microvascular damage, brain edema formation and C.S.F. pleocytosis *(Boje, 1995,* and *Buster et al., 1995).*

NO is a short-lived free radical produced by a variety of cell types and involved in physiologic processes, such as smooth muscle relaxation, neuronal signaling, inhibition of platelet aggregation and regulation of cell mediated cytotoxicity *(Anggard, 1994, Bredt et al., 1994, Lowenstein et al., 1994* and *Moncada et al., 1993).*

The cellular site of NO production in children with bacterial meningitis is unknown. However, NO can be generated by a variety of cell types, including neutrophils, microglia/macrophages, endothelial cells, astrocytes, neurons and vascular smooth muscle cells and by bacteria.

In the brain, NO has several important function and effects including neurotransmission, regulation of cerebral vascular tone and cerebral blood flow, and mediation of ischemic and excitotoxic neuronal injury *(Wang* and *Ferriereo et al., 1995).*

Intracisteranal inoculation of heat-killed bacteria induces an increase in C.S.F. nitrite comparable to that observed with living bacteria *(Koedel et al., 1995).*

Buster et al., 1995 demonstrated that inoculation of live bacteria (Hemophilus influenzae type b) or lipopolysaccharides intracisternally in rats resulted in a rise of C.S.F NO and increased the permeability of blood-C.S.F barrier. These alterations were inhibited by systemic adminestration of N-nitro-L-arginine methy ester, a non-selective NO synthase inhibitor.

Bernatowicz et al., 1995 demonestrated that Co-incubation of rat astrocytes, microglial cells and neurons in primary cultures with heat killed uncapsulated streptococcus pneumoniae stimulates NO production, aporcess inhibited by NO synthase inhibitors (including aminoguanidine), cycloheximide and dexamethazone.

Our study was carried out on (40) childrens from Benha fever hospital, they were divided into three groups:

Group (A): included 14 childrens with septic meningitis. Their ages ranged from 6 months to 9 years. They were proved to be septic meningitis by clinical picture of meningitis (e.g. fever, convulsions, vomiting, bulging anterior fantanelle, necks and back stiffiness, kerning's sign, Brudziniski's signs, drowsiness or coma). **(Table 3 and fig. 3)**. The presence of higly elivated C.R.P, polymorphnuclear pleocytosis in C.S.F and positive C.S.F bacterial cultures where H.influenzae was commonest organism (65%), the other organisms were Niesseria meningetdis (21%) and St. pneumonia (14% of cases).

Group (B) Included 16 children with aseptic meningitis their ages ranged from 6 months to 8 years. They were proved to be aseptic meningitis by clinical picture of meningitis. **(Table 3 and fig. 3),** negative or slightly elivated C.R.P., pleocytosis in C.S.F. and the presence of negative bacterial cultures of C.S.F.

Group (C) Included 10 children as a control group, their ages ranged from 6 months to 10 years they were admited to Benha fever hospital presented with fever and required C.S.F analysis to exclude meningited, they were later found to be free of meningitis as evidanced by the results of C.S.F examination and negative bacteriological culture of C.S.F. and negative clinical findings of meningitis during follow up.

All studied groups and neurological examination, C.B.C, C.R.P and C.S.F. analysis (physical, cellular, chemical, culture and sensitivity), the results of C.S.F analysis revealed significant elivation of cells in cases of meningitis with predominance of polymorphnuclear pleocytes in septic meningis and predominance of mononuclear pleocyte in cases of aseptic meningitis, also there was significant increased protein and decreased C.S.F glucose in cases of septic meningitis. As regard aspect there was turbidity of C.S.F in cases of septic meningitis as compared to clear C.S.F in cases of aseptic meningitis and control group.

In the present study we measured the level of NO in serum and C.S.F in the three groups before treatment, and also its level after

treatment in septic group. There was a significant increase in level of NO in both serum and C.S.F in children with septic meningitis as compared with those of a septic and control groups. These results provide evidance of an enhanced production of NO in C.S.F and serum of children with septic meningitis.

Our results are in agreement with those of ***Pfister et al., (1995)*** who reported that there was increased C.S.F levels of NO metabolites in patients with bacterial meningitis. Also, in agreement with the results of ***Furth et al., (1995)*** and ***Kornelisse et al., (1996)*** who decumented a significant elivation of C.S.F NO in children with bacterial meningitis cause by H.influenzae, N.meningitidis or St. pneumoniae.

Our results did not show any significant correlation between age and NO level in serum and C.S.F among the control group as show in table (9) also, we found a significant correlation between serum and C.S.F levels of NO and glucose and protein levels in C.S.F among patients with bacterial meingitis as shown in table (8).

NO may inhibit the mitocondrial respiration that enhances anaerobic glycolysis. This mechanism may contribute to the decrease glucose concentration in C.S.F compartment in patients with bacterial meningitis ***(Albina JE, et al., 1993*** and ***Welsh N, et al., 1992).***

Alternatively, low glucose level may also be explained by inhibition of carrier-mediated transport across B.B.B. ***(Cooper A, et al., 1968*** and ***Prockop L, et al., 1966).***

As regard organism in C.S.F of septic group in our study the result of the culture of C.S.F revealed three types of bacteria; H.influenze (65%), N.meningetidis (21%) and St. pneumonia (14%) **(fig. 6).**

There was a significant increase in C.S.F and serum NO in H.influenzae meningitis as compared with those of meningitis caused by St.pneumoniae and by N.meningitidis thus, H.influenzae may be a more potent inducer of inducible NO synthase than N.meningetidis and St.penumania, these results agreed with those of ***Tsukahara et al., (1988).***

In our study, two patients with meningitis caused by H.influenzae died during treatment and follow up and a third child with H.influenzae meningitis developed neurological complication. It was noted that NO was more elivated in C.S.F and serum in those patients than other children with meningitis. This suggests that NO has a role in the prognosis of these cases and the higher the NO serum and C.S.F the more bad of prognosis **(table 12 and fig. 10).**

Tsukahara et al., (1998) reported that a higher proportion of patients with C.S.F nitrite above the normal range had neurologic or

audiologic sequelae (or both) in contrast to the patients with normal levels and this suggests that NO may be responsible for neurologic damage in human.

In our study the children with septic meningitis were treated with intravenous ceftazidime (150 mg/kg in two divided doses) for 10 days and dexamethasone (0.6 mg/kg/day) for 4 days. The levels of NO in serum and C.S.F of those children were estimated before and after treatment. The result was significant decrease of NO levels in C.S.F and serum after treatment of those cases with antibiotics and dexamethasone.

These results are in agreement with ***Jafari et al., (1994)*** who reported that adminestration of dexamethasone with the commencement of antibiotic treatment is often recommended to improve the outcome of septic meningitis.

Kitteler et al., (1994) reported that corticosteroids are known to supress NO synthase induction. Thesefore, early dexamethasone therapy may be partly responsible for attenuation of increased NO production during recovery in patients with septic meningitis.

So we can conclude that, NO production in enhanced in the C.S.F and serum in cases of septic meningitis and support the hypothesis that NO contributes to the pathophysiology of septic meningitis. So NO can be used as simple and significant diagnostic and prognostic monitor of cases with septic meningitis but this needs further study in wider scale.

Bell, E. and McCormick, F. (1981): Bacterial meningitis. In: Neurological infections in children. 2nd edition. C.V. Mosby Company, London, 21-69.

Berkowitz ID, Hayden WR, Traystman RJ, Jones MD et al., (1993): Haemophilus influenzae type b impairment of pial vessel autoregulation in rats pediatr. res., 33: 48-51.

Bernard, H. (1984): CSF and other body fluids. In: Clinical diagnosis and management. 17th. Edition. W.B. Saunders Company, London, 1070-4.

Bernatowicz. A. Ködel U, Fontana A, Pfister HW (1995): Production of nitrite by primary rat astrocytes in response to penumococci. J Neuro-immunol 60: 53-61.

Biver, Y., Averbuch, Heller, L., Weinberger, M., et al. (1994): J. Neural. Neurosutg. Psychiatry., Jun., 57 (4): 705-8.

Boctor, N., Girgis, N., and Farid, Z., (1986): Trichinosis meningoencephalitis: a case report; ELISA serodiagnosis J. Egypt. Soc. Parasit., vol (16) 2 727-32.

Boje KM (1995): Inhibition of nitric oxide synthase partially attenuates alterations in the blood-cerebrospinal fluid barrier during experimental meningitis in the rat. Eur J Pharmacol 272: 297-300.

Bolotina V.M., Najibi S., Palacino J.J., Pagano P.J., and Cohen R.A. (1994): Nitric oxide directly activates calcuim-dependent potassium channels in vascular smooth muscle. Nature, 368: 850-853.

Brandtzaeg, P.; Joe, G.; Brusletto, B. et al., (1990): Plasminogen activator inhibitor 1 and 2, alpha 2-antiplasmin. Plasminogen, and endotoxin levels in systemic meningococcal disease. Thromb. Res. 57:271-78.

Bredt D.S., and Snyder S.H. (1989): Nitric oxide mediates glutamate-linked enhancement of cGMP levels in the cerebellum. Proc. Natl. Acad. Sci. USA, 86: 9030-9033.

Bredt Ds, Snyder SH et al., (1994): Nitric oxide a physiologic messenger molecule. Annu Rev Biochem 63: 175-95.

Bucala R., Tracey K.J., and Cerami A. (1991): Advanced Glycosylation products quench nitric oxide and mediate defective endothelium dependent vasodilation in J. Clin. Invest., 87-438.

Buster BL. Weintrob AC. Townsend GC, Scheld WM. (1995): Potential role of nitric oxide in the patho-physiology of experimental bacterial meningitis in rats. Infect Immun 693: 3835-9.

Cambell, A.G.M. and McIntosh, N. (1992): Infection of the nervous system in the newborn. Forfar and Arneil's texbook of pediatrics, 272.

Chance B., Seis H., and Boweries A. (1978): Hydroperoxide metabolism in mammalian organs. Physiol. Rev., 59: 527.

Cheees Brough, M., (1984): Medical Laboratory, Manual for Trepical cuntries. Vol. 11: Microbiology, El BS; 160-65.

Christie, A. (1987): Acute Bacterial or Pyogenic Meningitis. In: Infect. Dis. Epidemiology and Clinical practice, 4th.ed. Edited by Christie, A. Churchil Livingston, 857-913.

Compos, J., Medlman, P., and Sako, M. (1987): Detection of relatively pencilline G.resistant N. meningitidis by disk susceptibility testing. Antinicrob., Chemother; 31-1982.

Connor J.R. Manning P.T., and Settle S.L. (1995): Suppression of adjuvant-induced arthritis by selective inhibition of inducible nitric oxide synthase. Eur. J. Pharmacol., 273: 15-24.

Cooper A, Beaty H, Openheimer S, Goodner R, Petersdorf R. (1968): Studies on the pathogenesis of meningitis. Glucose transport and spinal fluid production in experimental pneumococcal meningitis. J Lab Clin Med 71:473-83.

Curzen N.P., Griffiths M.J.D., and Evans T.W. (1994): Role of the endothelium in modulating the vascular response to sepsis. Clin. Sci., 86: 359-374.

Daci, S.J. and Lewis, S.M., (1991): Practical Haematology 7th edition, Churchill Livengstone, Edinburgh, London, Melbourne and New York, 37-58.

Dajani, A.S.; Asmar, B.I.; Thiiumoorthi, M.C. (1979): Systemic haemophilus influenza disease an overview J. Pediatric, 94, 355.

Davey, D., Gruikshank, K., and McManus, I. (1982): Bacterial Meningitis: Ten Years Experience. J.Hyg., 88 (3) 383-441.

Davis L., (1992): Viral meningitis and encephalitis. In: Conn's current therapy. 10th edition, ed. Rbert, R. W.B. saunders company, London, 853-7.

Davis, L. (1992): Viral meningitis and encephalitis. In: Conn's current therapy. 10th. edition. Edited by Robert, R. W.B. Saunders Company, London, 853-7.

Del Maestro R.F. (1980): An approach to free radical in mediciene and biology. Acta Physiol. Scand., 492: 153.

Dinerman J.L., lowenstein C.J., and Snyder S.H. (1993): Molecular mechanisms of nitric oxide regulation, potential relevance to cardiovascular diseases. Circ. Res., 73: 217-222.

Dizdaroglu M., Dirken M.L., Jiang H., and Robbins J.H. (1987): Ionizing radiation induced damage in DNA of cultured human cell. Biochem. J., 241:929.

Donald, P., Starcha, A., and Schoeman, J. (1989): Cerebrospinal Fluid C-reactive Protein in Meningitis in Children. J.Lab-Clin. Method., 106 (4): 429-438.

El-Akkad, A. (1969): Epidmiology of cerebropinal meningitis in Egypt during the last 50 years. J. Egypt. Pub. Health. Assoc, 44 (4): 261-79.

Faidas A; Shopard, D.L. and James, L (1993): Magnetic resonance immaging listria brain stem encephalitis. Clinical Infection Diseases, 16: 186.

Feigin, R. (1987): Bacterial meningitis beyond the neonatal period. In: Textbook of pediatric Infectious Diseases. 2nd . edition, edited by Feigin, R. And Cherry, J.W.B. Saunders Company, Philadelphia, 439-61.

Feigin, R.; Me Craken, G. and Klein, J. (1992): Dragnosis and management of meningitis Pediatr Infect Dis J (11) 785-814.

Feigin, R.D., and Sinder, R. (1992): Meningococcal Infections. In: Nelson Textbook of Pediatrics, 14th.ed. Edited by Richard E. Behrman. W.B. Saunders. Company. Phladelphia, 713-716.

Ferriero DM, Sheldon RA, Black SM, et al., (1995): Selective destruction of nitric oxide synthase with quisqualate reduces damage after hypoxia-ischaemia in neonatal rat. Pediatr. Res. 38: 912-8.

Figueroa, J. and Densen, P. (1991): Infectious diseases associated with complement deficiencies Chn Microbrol Rev 4: 35-395.

Filice, G.; Hayes, P.; Counts, G. et al., (1985): Risk of group A meningococcal disease bacterial mterference and cross reactive bacteria among mucosal flora J Chmic Microbiol 22: 156.

Fishman, R. (1975): Brain edema. N. Engl. J. Med 293: 706-12.

Flaegstad, T.; Guttegerg, T. and Kristiansen, B. (1990): Antibodies to meningococci in children with meningococcal diseases Scand J. Infect Dis. 22: 547-51.

Fothergill, L. and Wright, J. (1933): Influenzal meningitis: relation of age incidence to the bacterial power of the blood against the causative organism.

Frasch. G. (1989): Vaccines for prevention of meningococcal disease. Chnical Microbol Rev. 2: 139.

Fujino A., Nakaya S., and Wakatsuki T. (1991): Effects of nitroglycerine on ATP-induced Ca^{++}-mobiliation, Ca^{++} activated K channels and contraction of cultured smooth muscle cells of porcine coronary artery. J. Pharmacol. Exp. Ther., 256: 371-377.

Furchgott R.F., and Zawadzki J.V. (1980): The biological role of endothelial cells in the relaxation of arterial smooth muscle by acetyl choline. Nature, 288: 373-376.

Furchott R.F., and Vanhoutte P.M. (1989): Endothelium derived relaxing and contractor factors. FASEBJ, 3: 2007-2018.

Furth AM. Seijmonsbergen EM. Groeneveld PHP, van Furth R. Langermans JAM (1996): Levels of nitric oxide correlate with high levels of tumor necrosis factor alpha in cerebrospinal fluid samples from children with bacterial meningitis. Clin Infect Dis 22: 876-8.

Gaston B., Drazen J.M. Loscalzo J., and Stamler J.S. (1994): The biology of nitrogen oxides in the airways. Am. J. Respir, Crit, Care Med., 149: 538-551.

Gerald, J., Tortora., Berdell R., Funke., Christine L. Case (1990): Structure and function of the nervous. Inmicrobiology, Fourth edition. The Benjamin/Cunming publishing company, California, 539-40.

Girgis, N.; Fairid, Z. and Mikail, I (1989): Dexamethasone treatment for bacterial meningitis in children and adults. Pediatr. Inf. Dis. J., (8): 848-51.

Girgis, N.; Fairid, Z. and Yossef, H. (1985): Fatal cryptococcal meningitis in 4 Egyptian patients. Ain Shams Med. J. (36) 4: 586-93.

Golde, M.; Danum, R. and Halsey, N. (1983): Rifampicin alone and in combination with trimethoprim in chemoprophylaxis for infections due to H.influenzae type "B". Rev. Infect. Dis., 5:549.

Greenwood, B.M. (1991): Bacterial meningitis: In: Hunter's Tropical Medicine. 7th. Ed. Edited by G. Thomas Strickland. W.B. Saunders Company, Philadelphia, 385-399.

Griffis, J.M. (1991): Meningococcal Infection. In: Harison's Principles of Internal Medicine 12th. Ed. Edited by Kurt, J. Isselbacher, Eugene Braunwald, Jean D. Wilson et al., MC Graw-Hill, Inc. USA., Vol. 5:590-593.

Grifiss, M. (1982): Epidemic meningococcal disease: Synthesis of a hypothetical immunoepidemiologic model. Rev. Infect. Dis. 4: 159-172.

Grossman, M.; Jawetz, E. and Tierney, L. (1993): Viral and Rickettsial. Inf. Dis. In: Current Medical Diagnosis and Treatment 31st .ed Edited by Schroeder, A.; Krupp, A.; Tierney, M. et al. Appeleton and Lange, California, (II), 951-74.

Guiloff, R. (1992): Neurological manifestations of AIDS. Medicine International, (98): 4114-9.

Guy, P., Philip, Y., AND Herpert, M. (1975): Cerebrospinal Meningitis. In: Biologic and Clinical Basis of Inf. Dis. 2nd. Ed. W.B. Saunders Company, London, 532-561.

Hambleton, G., and Davies, P.A. (1975): Bacterial Meningitis. Some Aspects of Diagnosis and Treatment. Arch. Dis. Child., 50: 674-684.

Hanna, L.; Girgis, N. and Yassin, M. (1981): Incidence of papilloedema and optic atrophy in meningitis. Jap. J. Ophth. (25): 69-73.

Hare J.M., and Colucci W.S. (1995): Role of nitric oxide in the regulation of myocardial function. Prog. Cardiovasc. Dis., Sep-Oct., 38 (2): 155-166.

Hassan Elwan (1985): Meningismus In: Introduction to nerology, Cairo Unicersity, 129.

Hemet, C., Chassagne, P., Levade MH., et al. (1994): Aseptic Meningitis secondary to carbamazepine treatment of

mannic-depressive illness. Am. J. Psychiatry. 1994 Sep., 515 (9): 1393.

Heyderman, R.; Klein, N.; Shannan, G. et al., (1991): Deficiency of prostacycline production in meningococcal shock Arch Dis Child 66: 1296-1299.

Hibbs Jr. J.B. (1991): Synthesis of nitric oxide from L-arginine: a recently discovered pathway induced by cytokines with antitumor and antimicrobial activities.

Hogg N., Darley-Usmer V.M., Wilson M.T., and Moncada S. (1992): Production of hydroxyl radicals from the simulataneous generation of superoxide and nitric oxide. Biochem. J., 281: 419-424.

Hollander, H. and Halde, C. (1993): Infect. Dis.: Mycotic. In: Current Medical Diagnosis and Treatment. 31st. ed: edited by Schroeder, A., Krupp, A., Tierney, M. et al. Appeleton and Lange, California, Vol. II: 1080-8.

Issekutz, T.; Lee, S. and Bortolussi, A. (1986): Immune response to listeria mnocytogenes. In: Manual of clin immunology. 3rd. edition. Edited by Ross, N.: Friedman, H. and Fahey, J. Am. Soc. For Microbiol., Washington, 86-93.

Jacobs, R. (1993): Infect. Dis.: Spirochaetal In: Current Medical Diagnosis and Treatment. 31st. ed edited by Schroeder, A; Drupp, A., Tierney, M. et al. Appeleton and Lange, California, Vol. III: 1080-22.

Jacobs, R. (1993): Spirochetal. Inf. Dis. In: Current medical diagnosis and treamtent. 31st. ed. Edited by Schroder, A.; Krupp, A.; Tierney, M. et al. Appeleton and Lange, California, (II): 1008-22.

Jafari HS. McCracken GH Jr (1994): Dexamethasone therapy in bacterial meningitis. Pediatr Ann 23: 82-8.

James, D. (1989): Sarcoidosis. In:infectious diseases. 4th edition, edited by Hoeprick, P. and Jordan, M.J.B. Lippicott Company, London (108): 1477-83.

Jevon, Gp, Dunne, Wm Jr, Howkins, Hk, et al (1994): Fatal group A streptococcal meningitis and toxic shock-like syndrome. Clin. Infect. Dis. 1994, 18 (1): 91-3.

Jia L., Bonaventura C., Bonaventura J., and Stamler J. (1996): S-nitrosohaemoglobin: a dynamic activity of blood involved in vascular control. Nature, 380: 221-226.

Jones E.A. (1984): The neurobiology of hepatic encephalopathy. Hepatology, 4: 1235.

Jones, D. (1991): Chemoprophylaxis of meningitis. Tran. Roy. Soc. Trop. Med. Hyg. (Suppl. 1), 85: 44-5.

Kanner J., Harel S., and Graint R. (1991): Nitric oxide as antioxidant. Arch. Biochem. Biophys., 289: 130-136.

Kaplan, L. (1989): Dexamethasone for children with bacterial meningits. A.J.D.C., (143): 290-2.

Keitch, A. and Kenneth, C. (1992): Acute bacterial meningitis. In: Conn's current therapy. 10th. ed Edited by Rober, R. W.B. Saunders Co. London, 88-91.

Kennedy, W., Hoyt, M. and MaeCracken, G. (1991): The role of corticosteroid therapy in patients with penumococcal meningitis. A.J.D.C. (145): 1374-8.

Ketteler M. Border WA. Noble NA (1994): Cytokines and L-arginine in renal injury and repair. Am J Physiol 267: F197-F207.

Klein, J.O., Feigin, R.R., and McCraden, G.H. (1986): Report on the Task Force on Diagnosis Management of Meningitis. Pediatries, 785: 959-982.

Kornelisse RF, Hoekman K, Visser JJ, et al (1996): The role of nitric oxide in bacterial meningitis in children. J Infect Dis 174: 120-6.

Kumar, J. and Clark, L.(1990): H. influenzae infection In: Clinical Medicine. 2nd edition. Bailliere Tindall 30-2.

Levin, M. and Hyderman, R. (1982): Bacterial meningitis. In: Recent Advance in Paediatrics. 9th. Edition, edited by T.J. David, 1-17.

Lockshin, m. and Kagen, L. (1972): Meningitis reaction after azathioprine. E.Eng. J. Med. (186): 1321-2.

Lowenstein CJ, Dinerman JL, Synder SH, (1994): Nitric oxide: a physiologic messenger. Ann Intern Med, 120: 227-37.

Lukehart, S.; Hook, E. and Baker-Zander, S. (1988): Invasion of the CNS by Treponema pallidum: implication for diagnosis and treatment. Ann. Int. Med. (109): 855-62.

Lundberg J.O., Weizberg E., Lundberg J.M., and Alving K. (1994): Intragastric nitric oxide production in humans: measurements in expelled air. Gut, 35: 1543-1546.

Lundberg J.O.N., Hellstrom P.M., Lundberg J.M., and Alving K. (1994): Greatly increased luminal nitric oxide in ulecrative colitis. Lancet, 344: 1673-1674.

MacDonald P.B., Read M.A., and Dusting G.J. (1988): Synergistic inhibition of platelet aggregation prostacyclin. Thromb. Res., 49: 437-449.

Machlin L.J., and bendich A. (1987): Free raidcal tissue damage, protective role of antioxidant nutrients. FASEBJ, 1:441.

Mahmoud, A., Kenneth, S. and Michael, W. (1990): Meningococcal diseases. In: Tropical and Geographical Medicine. 2nd.ed. edited by Kenneth and Mahmoud. W.B. Saunders Company, London, 789-814.

Martin, W. (1983): Rapid and reliable techniques for of bacterial meningitis. Am. J. Med. (28): 119-23.

Martin, W. (1992): CNS Infections. In: The Practitioner (3): 199-201.

McCracken, G. (1984): Management of bacterial meningitis. Current status and future prospects. Am J. Med. (79): 215-23.

Mercier, J.; Beaufils, F.; hartman, J. et al., (1988): Haemodynamic patterns of meningeal shock in children Crit Care Med 16:27-33.

Minns, R.A.; Engleman, H.M. and Stirling, H. (1989): Cerebrospinal fluid pressrue in pyogenic meningitis. Arch. Dis. Child., 64: 814.

Moncada S., and Higgs A. (1993): Mechanism of diseasc: Thc L-arginine nitric oxide pathway. N.Engl. J. Med., 329: 2002-2012.

Moncada S., Palmer R.M.J., AND Higgs E.A. (1991): Nitric oxide: Physiology, pathophysiology and pharmacology. Pharmacol. Rev., 43: 109-142.

Moore. S.; Herholzer, J.; Dewitl, H. et al., (1990): Respiratory virsuses and mvcoplasma as cofactors for epidemic group A meningococal meningitis. JAMA 264 1271-1275.

Morris, J., Stanley, L. and Vinay, K. (1987): The nervous system. In: Basic patholoyg, 4th edition. W.B. Saunders Company London, 723-57.

Mupanenaunda R.H., and Edwards A.D. (1995): Treatment of newborn infants with inhaled nitric oxide. Arch. Dis. Child, 72: F 131-F134.

Ni, H.Knight, AI., Cartwright, K., Palmer, WH., et al. (1992): Polymerase chain reaction for diagnosis of meningococcal meningitis. Lancet, Dec 12., 340 (8833): 1432-4.

Osterud. B. and Flaegstad. T. (1983): Increased tissue thromboplastine activity in monocytes of patients with meningeal infection related to unfavorable prognosis. Thromb Haemost 49: 5-7.

Overturf, G. (1989): Bacterial meningitis. In: Infectious diseases. 4th ed. Edited by Hoeprich, P. and Jordan, M. J.B. Lippincott Company, Phildrlphia, 1114-32.

Overturf, G. and Hoeprich, P. (1983): Bacterial meningitis. In: Infectious diseases. 3rd ed. Edited by Overturf, G. and Hoeprich, P. Harper and Row, 1035-52.

Palim, R.A. and Ditmar, M.F. (1989): Acute disseminated staphylococcal disease in childhood. From Ped. Secrets textbook. The C.V. Mosby Co., St. Louis, Torento, London.

Palmer R.M.J., Ashton D.S., and Moncada S. (1988): Vascular endothelial cell synthesize nitric oxide from L-arginine. Nature, 333: 664-666.

Pfister HW. Bernatowicz A, Koedel U. Wick M (1995): Nitric oxide production in bacterial meningitis. J Neurol Neurosurg Psychiatry 58: 384-5.

Pmeroy, S.L., Holmes, S.J. and Fodge, P.R. (1990): Aprospective Evaluation of the Neurologic Sequelae of Bacterial Meningitis in Children with Special Emphasis on late Seizure. N. Engl. J. Med., 323: 1651-1657.

Prockop L, Fishman, R (1966): Pathophysiology of the cerebrospinal fluid changes in experimental pneumococcal meningitis. Trans Am Neurol Assoc 91: 126-31.

Quagtiarello, V. and Scheld, W. (1992): Bacterial meningitis: pathogenesis, phathophysiology and progress N Engl J. Med (327) 864-872.

Radomski M.W., Palmer R.M.J., and Moncada S. (1987): The anti-aggregating properties of vascular endothelium: interactions between prostacyclin and nitric oxide. Br. J. Pharmacol., 92: 639-646.

Ralph, D.; Feigin, M.D.; Greorge, H. et al. (1992): Diagnosis and management of meningitis. Pediatr., Inf. Dis., J. 11 (9): 785-810.

Ramilo, O.; Saez, L.; Lorens, X. et al., (1990): Tumour necrsis factor alpha and interleukin-beta initiate meningial inflammation J. Exp Med (172) 497-507.

Rand M.J. (1992): Nitrergic transmission: nitric oxide as a mediator of non-adrenergic, non-cholinergic neuro - effector transmission. Clin. Exp. Pharmacol. Physiol., 19: 147-169.

Richard, E. and Robert, M. (1992): Meningococcal infections. In: Nelson textbook of pediatrics. 14th ed. Edited by Victor, C.; James, R. and Richard, E. W.B. Saunders, London, 713-6.

Richard, F. and Tabor, D. (1990): The immunology of sepsis meningitis; Cytokines biology. Scand. J. Infect. Dis. Supp. (73): 7-15.

Roos, N. (1993): New treatment of bacterial meningitis. Clin. Neuropharmacol. 1993 Oct., 16 (5): 373-86.

Rubbo H., Raid R., Trujillo M., Telleri R., Kalyanaraman B., Barines S., Kirk M., and Freeman B.A. (1994): Nitric oxide regulation of superoxide and peroxynitrite-dependent lipid peroxidation: formation of novel nitrogen-containing oxidized lipid derivatives. J. Biol. Chem., 269: 26066-26075.

Sabbour, M. and Farid, Z. (1978): Bacterial meningitis. In Infectious Diseases. 1st ed. Edited by Sabbour, M. and Fairid, Z. Dar El-Maarif, 261-70.

Saif, El-Din, S. and Abdel-Wahab, M.F. (1991): Central nervous system infections. In: A guide book of tropical medicine and infections diseases. Tropical Medicine Department, Ain-Shams, University, Cairo, 179-201.

Saif, El-Din, S,. and Abde-Wahab, M.F. (1995): Central Nervous System Infection. In: A Gudie Book of Tropical Medicine and Infectius Diseases. 2nd.ed. Tropica mediciene Department-Ain-Shams, University Cairo, 155-166.

Scheld, W.M. (1994): Bacterial meningitis and Brain Abscess. In: Harrison's Principles of Internal Medicine 13rd.ed. Edited

by Kurt, J. Eugene, B, and Jean, D. R.R. Donnelly USA Vol. 5:2296-2302.

Schmidt H.H.H.W., and Watter U. (1994): NO at work. Cell, 78: 919-925.

Schwartz, J., and balentine, J. (1983): Recurrent Meningitis due to intracranial epidermoid cyst. Neurology, 28-124.

Sell, S. (1983): Long-term sequelae of bacterial meningitis in children. Pediatr. Infect. Dis., 2:90-3.

Siegel, J.D.; McCraken, G.H. and Threlkeid, N. (1980): Single dose penicillin prophylaxis against neonatal group B streptococcal infection. N. Engl. J. Med., 303:769.

Singer, J.I., (1992): An a septic meningitis picture from incipient brain abscess. Paediatr. Emerg. Caré. Aug., 8 (4): 238-40.

Sippel, J., Girgis, N., Kilpatriek, M. (1991): Laboratory dingnosis of bacterial meningitis. Trans. Roy. Soc. Trop. Med. Hyg. (suppl 1) 85L 6-8.

Spitzer, P.; Hammer, S. and Karchmer, A. (1986): Treatment of listeria monocytogenes infection with trimethoprim-sulfamethoxazole: a case report and review of the literature. Rev. Infect. Dis. (8): 427-30.

Sprangue R., Thiemermann C., and Varve J.R. (1992): Endogenous endothelium derived relaxing factor opposes hypoxic pulmonary vasoconstriction and supports blood flow to hypoxic alveoli in anaesthetised rabbits. Proc. Natl. Acad. Sci. USA, 89: 8711-8715.

Springer, T.T. (1990): Adhesion receptors of the immune system Nature (346) 425-434.

Stamm, A.; Dismikes, W. and Simmons, B. (1982): Listeriosis in renal transplant recipients. Rev. Infect. Dis. (4): 665-82.

Stephen, J. and Anthony, H. (1991): Practical management of bacterial meningitis in tropics. Postgraduate Doctor, (14): 6, 248-54.

Stephens, D.S. and Farley, M.M. (1991): Pathogenic events during infections of the human nosopharynx with N meningitidis and H influenzae Rev. Infect Dis 12: 22-23.

Stephens, D.S. and McGee, Z.A. (1981): Attachment of neisseria meningitidis to human mucosal surfaces: influence of pili and type of receptor cell. J. Infect. Dis., 143:525-32.

Stuart, M.; Cartwright, K.; Robinson, M et al., (1989): Effects of smoking on meningococcal carriage. Lancet 2: 723-725.

Swartz, N. (1985): Bacterial meningitis. In: Cecil textbook of medicine, 17th edition edited by Wyngarden, J.B. and Smith, L.H.W.B. Saunders Company, Philadelphia, 1552.

Swartz, N. (1992): Bacterial Meningitis. In: Cecil Textbook of Medicine, 19th. ed. Edited by James B. Wyngarden, Loyd H. Smith and J. Claude Bennett. W.B. Saunders Company, Philadelphia, 1604-1611.

Syrogiannopoulos, G.A.; Hansen, E.J. and Erwin, A.L. (1988): Haemophilus influenza type b lipooligosaccharide induces meningeal inflammation. J. Infect. Dis., 157: 247.

Taeusch, W.H.; Ballard, A.R. and Avery, E.M. (1991): Bacterial infections of the newborn in Diseases of the newborn. Schaffer and Avery's sixth (ed). W.B. Saunders Co., Philadelphia, 37, 350: 366.

Tauber. M.; Borschberg. V. and Sand, M. (1988): Influence of granulocyle on brain edema. Interacranial pressure and CSF cocentration of lactate and protein in experimental meningits J. Infect Dis (157) 456-464.

Thiemermann C., Szabo C., Mitchell J.A., and Vane J.R. (1993): Vascular hyperactivity to vasoconstrictor agents and haemodynamic decompensation in haemorrhagic shock is mediated by nitric oxide. Proc. Natl. Acad. Sci. USA, 90: 267-271.

Topley, W.W.C. and Wilson, G.S. (1964): Principles of bacteriology and immunity. Arnold, London.

Tsukahara-H; Haruta-T, Hata-I et al., (1998): Ritric oxide in septic and aseptic meningitis in children Scand-J-Clinc-Lab-Invest. Feb; 58 (1): 73-9.

Vallance P., and Moncada S. (1993): Role of endogenous nitric oxide in septic shock. New Howrizons, 1: 77-87.

Vallance P., and Moncada S. (1994): Nitric oxide from mediator to medicines. J. Coll. Phys. Lon., 28: 209-219.

Visser JJ, Scholten RJPM, Hoekmank, et al., (1994): Nitric oxide synthesis in meningococcal meningitis Ann Intern Med; 120: 345-6.

Volpe, J.J. (1987): Neurology of the newborn, bacterial and fungal intracanial infections. 2nd edit. W.B. Saundets Co. Philadelphie, 20-596-630.

Waage A, Halstensen A, Shalaby R, Brandtzaeg P, Kierulf P, Espevik T, et al., (1989): Local production of tumor necrosis factor-α, intesleukin-1, and interleukin-6 in meningococcal meningitis. J.Exp Med, 170: 1859-67.

Walsh, J. (1990): Abnormal laboratory results: C.S.F. microscopy and biochemistry. In: Medicine Digest. (16), 5:22-4.

Wang Q, pelligrino DA, Baughman YL, et al., (1995): The role of neuronal nitric oxide synthase in regulation of cerebral blood flow in normocapnia and hyper capnia in rats. J Cereb Blood Flow Metab; 15: 774-8.

Welsh N, Sandler S. (1992): Interleukin-1 β induces nitric oxide production and inhibits the activity of aconitase without decreasing glucose oxidation rates in isolated mouse pancreatic islets. Biochem Biophys Res commun 182: 333-40.

Welshimer, H. (1981): The genus listeria and related organisms. In: The Prokaryotes: A Handbook on Habitats, Isolation and Identification of Bacteria. Edited by Starr, M. Spring Virlag. New York (2): 168-87.

Yassin, W., Walten, H., and Girgis, N. (1983): Epdiemiology of Bacterial Meningitis in Egypt. J Gypt Publ. Health. Assoc. L. VIII No. 5,6: 322-330.

Zell, M. and Richard, I. (1990): Acute meningitis. In: Principles and Practice of infect. Dis., 3rd ed. Edited by Mandel, Douglas and Bennett John Wilfy and Sons, 741-55.

Ziai, M., Haggerty, RJ. (1985): Neonatal meningitis. N.Engl. J. Med. 259-314.

Zoritch B. (1995): Nitric oxide in asthma. Arch. Dia. Child, 72:259-262.