

Subdural Hematoma In Childhood: Considerations About Twenty Cases And Review Of The Literature

C Pereira, J Monterio, E Santos, L Dias

Citation

C Pereira, J Monterio, E Santos, L Dias. *Subdural Hematoma In Childhood: Considerations About Twenty Cases And Review Of The Literature*. The Internet Journal of Pediatrics and Neonatology. 2004 Volume 4 Number 2.

Abstract

Background: Subdural hematoma is defined as blood collection between dura mater and arachnoid spaces due to trauma, infectious diseases or bleeding disorders. In infancy, subdural hematoma is a clinical syndrome which, although relatively constant in its overall features, is often unrecognized and its diagnosis is late. The subdural hematoma in childhood is more commonly seen in the child of the three weeks old or more. Clinical features depend on patient's age, the hematoma's site and its length. Computed tomography and magnetic resonance are the best methods.

Aim: 1) identify the sex, age, causes and computed tomography findings in patients with subdural hematoma; 2) to analyse the results of the treatment.

Material and Methods: This study is retrospective. Twenty children under fifteen years old were studied at João Alves Filho Hospital (Aracaju - Sergipe - Brazil). The period was 1995, may to 2004, june.

Results: Twelve (60%) children were male and eight (40%) female. Children's age range from two days to fourteen years old. The most common causes were fall, car collision, hit by a car, traumatic delivery and fight. Computed tomography was important for diagnosis and treatment. The clinical treatment was done in thirteen patients. There were fifteen (67%) patients that had good recovery and five (33%) died.

Conclusion: 1) the male children were more affected; 2) the principal age was 6 to 12 years-old; 3) the most common cause was fall; 4) the main localization in computed tomography was parieto-temporal and 5) 67% of the patients survived.

INTRODUCTION

The subdural hematoma (SDH) is an entity defined as a clot between the dura-mater and arachnoid space due to trauma, infectious diseases (empyema, meningitis) or coagulopathy.^{17, 34} In infancy, represents a clinical syndrome relatively constant with little identification.

The SDH is not common in children with head injury, exception the children with delivery trauma or non-accidental trauma as "WHIPLASH SHAKING INJURY".^{17,}

24, 43, 44, 50, 58

The SDH are usually classified as acute (until 03 days after the trauma), subacute (between 03 days and 06 weeks) and chronics (more than 06 weeks).^{22, 24, 33, 47} CHOUX et al²⁴ suggested that the acute SDH occur until 48 hours after the head trauma, the subacute between the third day and the

third week and the chronicle after the third week.

The acute SDH is usually associated with shock and brain contusion or severe brain damage, progressing to brain swelling and necrosis. In the other hand, the chronicle SDH, described as a complication of the acute SDH, is later, with few sings and symptoms. The principal etiology of the chronicle SDH is the light trauma.⁶¹

The SDH in childhood are more common in children with more than three week of life. The more frequents are the subacute and the chronicle.²⁵ These SDH present, on the whole, symptoms that are not characteristics.

Neuroimage exams show very utility to diagnostic the SDH. The X-ray of skull reveal fractures and diathesis of sutures. However, the most important exams are computerized tomography (CT) and magnetic resonance (MR).

The aim of this study is to describe twenty cases of SDH in childhood and discuss the diagnosis, physiopathology, treatment and prognosis.

PATIENTS AND METHODS

Had been studied, retrospectively, 20 children with SDH admitted at João Alves Filho Hospital (Aracaju – Sergipe – Brazil), and the period was 1995, May to 2004, June. This study was approved by the Ethical Committee of the Hospital, and a written informed consent was obtained from each patient. Were studied the sex, age, etiology, neuroimage findings (X-ray and CT), treatment and prognosis. The results are descriptive.

RESULTS

The male children were more affected (60%). The age ranged from two days to fourteen years old. The etiologies were fall in nine cases (45%), car accident in four cases (20%), trampling in three cases (15%), delivery trauma in three cases (15%) and aggression in one case (05%). The CT was the principal method to diagnosis. Was possible to diagnostic the stage, localization and extension of the SDH by CT in all cases.

The main localization of the SDH was parieto-temporal. The treatment of the SDH depends on the size and localization of the SDH. Over and above that, the clinical and neuroimage findings are precious to define the correct management of these patients. The conservative treatment (65%) was more done than surgery (35%). Analyzing the prognosis, fifteen patients survived (75%) and five died (25%). These results are resumed in table 1.

{image:1}

DISCUSSION

SDH is a pathological entity defined as a sanguineous collection located between the dura-máter and arachnoid, due to infectious diseases, trauma, and coagulopathy. In infancy, it represents a clinical syndrome that, even so relatively constant, is generally not identified, being many times diagnosed delayed. In the clinical practice, some times is difficult to differentiate the SDH caused for accident or abuse, probably due to the lack of technological resources and of the ignorance of this clinical entity for the doctor.

The head injury in any age is more common in the male children. In our patients, it had predominance of the male, twelve cases (60%) and eight of the female (40%), and this fact had been observed for other authors.

The SDH has multiple etiology. The post-traumatic SDH, due to fall of surface mainly raised, are the most frequent in infancy, being majority of them diagnosed when the trauma history is disregarded, forgotten or unknown. In new-born (NB) the SDH is uncommon, being, in the majority of the times, related to delivery-trauma, prematurity, fetal presentation, untimely obstetrics maneuvers.^{16, 38, 45, 64} The clinical manifestations are multiform, and the child be able without symptom or to evolve for the death. When without symptom, the SDH disappears spontaneously or evolves to the chronicle state that can be reflected of a nutrition state compromised of the child and a precarious physical and mental development.^{25, 34, 58, 61}

About 14% of the NB with serious trauma of childbirth died in the first week of life mainly which had to the SDH.⁵² However, with the improvement of the assistance in nurseries and the use of transfontanel ultrasound,^{24, 46} it has the precocious recognition and frequent of the intracranial bleeds, in way to improve the prognostic significantly.²⁹ The clinical diagnosis of SDH in the NB, after the difficult childbirth, must be suspected when it will have low activity, convulsive crises, motor deficits, pupillary alterations, ocular shunting lines and tumefaction of fontanels.⁵⁸ Retinal hemorrhages are gifts in up to 30-50% of the cases. Some times, the initial symptoms are apparently light in the first 16-72 hours.^{24, 58}

The SDH for not accidental trauma summarize the term infantile abuse, originally described by TARDIEU,⁶³ in 1886, and that currently they include the abandonment, recklessness, sexual, emotional or physical abuse (strangulation, shaken the child, to shoot it against the wall or the window and shot).^{34, 39} It is difficult to quantify the frequency of the not accidental traumas in infancy, a time that depends on an adequate monitoring and of minute physical examination for the diagnosis of child abuse.^{12, 20, 23, 63} The SDH only occurs in 8% of all cases of child abuse, but, with a more rigorous election of the cases, its frequency can be greater.⁶⁷ The SMITHS and HANSON⁶⁰ had found 134 cases of child abuse, where 50 (35%) had non-accidental trauma, of which 32 (64%) had SDH. This type of SDH wide affects the lesser children of three years old, and the neurological findings are not specific and can not suggest the child abuse.¹⁷

The shaken baby syndrome (SBC) is the typical injury of the child abuse.^{2, 22, 31, 32, 37, 57} The complete clinical picture was described by Caffey^{20, 21, 22} and GUTHKELCH³⁶,

understanding: SDH, brain swelling, hemorrhagic retinopathy, breaking of ribs. Its classic picture occurs without any skull breaking, wound in scalp, edema or direct evidence of trauma. However, these last findings can be gifts in case that history of head trauma against surface.⁹ To cause the injury in whip, the required force must be enough to surpass the force of the cervical muscles and to allow the head into front and back. Had been described that the repeated events can cause a cumulative effect. Of this form, the SBC is more commonly observed around the fifth month of age, when the child has the head relatively wider than the body, the muscles of the neck are weaker, with small control of the head. The measure that the child grows, has increase of the corporeal weight in relation to the head and the muscles of the neck becomes stronger; in this way, the head moves with the body as an only block. The increase of the corporal weight implies greater force to put into motion the child. The SDH, in this way, are rarer in bigger children of two years.

Other causes of non-traumatic SDH in infancy are associates to the anticoagulating therapy, rupture of aneurysm of calosomarginal artery and ventricle-peritoneal derivation.^{38, 40}

The coagulopathy must be thought always associates to the non-traumatic SDH as differential diagnostic of the traumatic, since such exist many similarities between the injuries as ecchymosis in different periods of evolution. This was boarded by O'HARE et al⁵⁵ that had observed, for a period of two years, fifty children with suspicion of accidental skull injuries, of which 16% had presented concomitant coagulopathy to the wounds. The association between coagulopathy and child abuse is not uncommon and, for in such a way, is important:⁶⁴

1. To investigate behaviors and abnormal attitudes of the parents, antecedents, factors of stress, financial or marriage problems, use of alcohol, whose unsatisfied acts are unloaded in the children as child abuse;
2. To evaluated the possible and impossible cause for the injury of the child and physical characteristics of the injury.

To diagnosis the coagulopathy, beyond the history of familiar antecedents, bleed for minimum traumas, use of medication that intervenes with the coagulation, must be carried through by coagulation tests.⁴

The chronic SDH in infancy generally is a complication of the acute form, when this is not treated adequately, and the main causes are intracranial hemorrhage in the perinatal period, delivery trauma, child abuse, post meningitis, coagulopatias including leukemia, haemophilia and vitamin K deficiency.^{6, 10, 11, 13, 47, 54} This last disease is very rare, having been described in literature only 16 cases, being mortality very high.^{42, 45, 49, 54, 56} Other circumstances that can result in SDH of secondary bleed the low vitamin K concentrations are the diarrhea, antibiotics, syndrome of cystic, deficiency of α -1-antitripsina, and others.^{3, 14, 15, 19, 26, 45}

The causes most frequent of SDH in this study had been accidental fall in nine cases (45%), automobile accidents in four cases (20%), trampling in three cases (15%), delivery trauma in three cases (15%) and physical aggression in one case (5%).

Although the head injury history can help the diagnosis, it is not frequent to get a clear description of had really happened. However, with the clinical signs, the SDH possibility must be suspected, same in the absence of trauma.^{58, 61} Some children with acute SDH for physical abuse not submitted to adjusted evaluations, probably due to lack of technological resources and of the ignorance of this clinical entity for the doctor.^{34, 62}

The inquiry must include a multidiscipline team, neuro-ophthalmologic examination, neuroimage exams as x-ray of skull, CT scan, MR and, on NB, transfontanel ultrasound.^{24, 39} Some authors based on the CT findings, decide the adjusted treatment.^{8, 10, 47}

The skull CT is the examination of choice for the diagnosis of SDH, having as advantages rapidity, trustworthiness for the diagnosis and identification of injuries associates and complications.^{1, 6, 16, 28, 30, 40, 52, 46, 53} The possibility of osseous evaluation through appropriate windows, together with the capacity to visualize the blood in acute state is the main factors that concur for its efficiency on the other examinations of image. The SDH and brain edema are frequently situated in the cerebral convexity⁴⁷, mainly on the form of swelling of the ipsilateral hemisphere. About 75-90% are supratentorials and 10% are infratentorials. In non-accidental trauma, the preferential localization is in posterior fossa, parieto-occipital region and interhemispheric, considered areas of neurological emergency in NB.^{24, 59, 68} How much to the distribution of the SDH in this study, the parieto-temporal region was more

frequently reached, followed of the fronto-parietal, parietal region and finally fossa posterior.⁶⁸

The treatment of the SDH in infancy depends on the extension and localization of the hematoma, in such way that the clinical evolution and the studies of image are basic to define a therapeutical behavior to be instituted. The specific treatment of the acute SDH, had been emphasized the importance of the precocious draining for the removal of hematoma.^{7, 35, 58} Associated to the specific treatment that aims to diminish the intracranial pressure, must even though be kept general good condition of the child through conservatives measures.⁶¹ In the SDH due to coagulopathy is very important the prophylactic treatment, that involves the routine administration of 01 mg of vitamin K, after delivery.²⁶ The surgical treatment consists of the draining way suture.^{16, 47, 48} Had been considered for the chronic SDH, procedures less invasive than to control the intracranial pressure, as the subdural puncture, subdural draining.^{8, 10, 47} The repeated subdural puncture are important in the treatment of SDH due to meningitis or repeated traumas.⁷ The conservative treatment was carried through in thirteen cases (65%) and the surgical treatment in seven (35%) cases. The fast diagnosis for the CT scan, followed by the surgical draining of the hematoma is essential conditions for a good prognostic.^{18, 24, 35, 48, 51, 66} In this study, fifteen patients had discharged and five died.

CONCLUSIONS

These data suggest that:

1. The male children were more affected;
2. The main age was between six and twelve years old;
3. The most common cause was the fall;
4. The main localization of the SDH was parieto-temporal;
5. 67% of the patients survived.

CORRESPONDENCE TO

Dr. Carlos Umberto Pereira, M.D., PhD. Av. Augusto Maynard, 245/404 49015-380 Aracaju – Sergipe – Brazil. e-mail: umberto@infonet.com.br

References

1. Aicardi J, Goutieres F, Hodebour Verbois A. Multicystic encephalomalacia of infants and its relation to abnormal

- gestation and hydranecephaly. *J Neurol Sci* 15:357-373, 1972.
2. Alexander R, Crabbe L, Sato Y, Smith W, Bennet T. Serial abuse in children who are shaken. *Am J Dis Child* 144:58-60, 1990.
3. Allen RW, Ogden B, Bentley FL, Jung AL. Fetal hydantoin syndrome, neuroblastoma and hemorrhagic disease in a neonate. *JAMA* 224: 1464-1465, 1980.
4. Altemier WA, O'connor S, Vietze PM, Howard MS, Sherrod KB. Antecedents of child abuse. *J Pediatr* 100:823-828, 1982.
5. Alvarez-garijo JA, Gomila DT, Aytesca P, Menguaal MA, Marin AA. Subdural hematomas in neonates. *Surgical treatment. Childs Brain* 8:31-38, 1981.
6. Aoki N, Masuzawa H. Infantile chronic subdural hematoma. Etiologic significance of infantile subdural hematoma. *Neuro Med Chir* 22:595-599, 1981.
7. Aoki N, Masuzawa H. Infantile acute subdural hematoma. Clinical analysis of 26 cases. *J Neurosurg* 61:273-280, 1984.
8. Aoki N, Mizutani H, Masuzawa H. Unilateral subdural-peritoneal shunting for bilateral chronic subdural hematomas in infancy. Report of three cases. *J Neurosurg* 63:134-137, 1985.
9. Aoki N, Masuzawa H. Subdural hematomas in abused children: report of six cases from Japan. *Neurosurgery* 18:475-477, 1986.
10. Aoki N, Masuzawa H. Bilateral chronic subdural hematomas without communications between hematomas cavities: treatment with unilateral subdural-paritoneal shunt. *Neurosurgery* 22:911-913, 1988.
11. Aoki N. Chronic subdural hematoma in infancy - Clinical analysis of 30 cases in the CT era. *J Neurosurg* 73:201-205, 1990.
12. Billmire ME, Dyers PA. Serious head injury in infants: accident or abuse. *Pediatrics* 85:34, 1985.
13. Bleyer WA, Hakami N, Shepard TH. The development of the hemostasis and in the human fetus and newborn infant. *J Pediatr* 97:838-853, 1971.
14. Bleyer WA, Skinner AL. Fetal neonatal hemorrhage after maternal anticonvulsant therapy. *JAMA* 235:626-627, 1976.
15. Bonnar J. Warfarin anticoagulant and pregnancy. *Lancet* 1:862-863, 1971.
16. Brill CB, Jarrah V, Black P. Occipital interhemispheric acute subdural hematoma treated by lambdoid suture tap. *Neurosurgery* 16:247-250, 1985.
17. Brown JK, Minns RA. Non-accidental head injury with particular reference to whiplash shaking injury and medico-legal aspects. *Dev Med Child Neurol* 35:849-869, 1993.
18. Bruce DA, Schut L, Sutton LN. Pediatric head injury. In: Wilkins RH, Rengachary SS. *Neurosurgery*. (ed) McGraw-Hill, New York, 1985, pp. 1600-1604.
19. Caballero FN, Buchanan GR. Abetalipoproteinemia presenting as severe vitamin K deficiency. *Pediatrics* 65:161-162, 1980.
20. Caffey J. Multiple fractures of long bones of children suffering from subdural haematomas. *Am J Roentgenol* 56:163-167, 1946.
21. Caffey J. On the theory and practice of shaking infants. Its potential residual effects of permanent brain damage and mental retardation. *Am J Dis Child* 124:161-169, 1972.
22. Caffey J. The whiplash shaken infant syndrome. *Pediatrics* 74:396-403, 1974.
23. Carty H, Ratcliffe J. The shaken infant syndrome. *BMJ* 310:344-345, 1995.
24. Choux M, Lena G, Genitori L. Intracranial hematomas. In: Raimondi AJ, Choux M, Di Rocco C. *Head injuries in the newborn and infancy. Principles of Pediatric*

- Neurosurgery. (ed) Springer-Verlag, USA, 1986, pp. 203-216.
25. Collins WF Jr. Subdural hematomas of infancy. *Clin Neurosurg* 15:394-404, 1986.
26. Committee On Nutrition: Vitamin K supplementation for infants receiving mild substitute infant formulas and for those with fat malabsorption. *Pediatrics* 48:483-486, 1971.
27. Craig WS. Intracranial hemorrhage in the newborn. *Arch Dis Child* 13:89-124, 1938.
28. Daum F, Silverberg M. Effect of congenital anomalies of the gastrointestinal tract on infant nutrition. In: Lenbenthal E: *Textbook of Gastroenterology and Nutrition in Infancy*. (ed) Raven Press, New York: 1981, pp. 579.
29. Dewbury KC, Bates RI. Neonatal intracranial hemorrhage: cause of ultrasound appearances. *Brit J Radiol* 56:783-789, 1983.
30. Dias LAA. Hematoma Subdural Agudo. In: Pereira CU: *Neurotraumatologia*. (ed) Revinter. Rio de Janeiro: 2000, pp. 135-152.
31. Duhaime AC, Gennarelli TA, Thibault LE, Bruce DA, Margulies SS, Wiser R. The shaken baby syndrome. *J Neurosurg* 66:409-415, 1987.
32. Duhaime AC, Alario AJ, Lewander WJ, Schut L, Sutton LN, Seidl TS, Nudelman S, Budenz D, Hertle R, Tsiaras W. Head injury in very young children: mechanism injury types, ophthalmologic findings 100 hospitalized patients younger than two years of age. *Pediatrics* 20:179-185, 1992.
33. Echlin FA, Sordillo SVR, Garvey TQJ. Acute, subacute and chronic subdural hematoma. *JAMA* 161:1345, 1956.
34. FeNBandes YB, Maciel Jr JA, Guedes C, Davoli A, Facure NO. Shaken baby syndrome (síndrome do bebê chacoalhado). Relato de caso. *Arq Neuropasiquiatr* 53:649-653, 1995.
35. Gutierrez FA, Raimondi AJ. Acute subdural hematoma in infancy and children. *Childs Brain* 1:269-290, 1975.
36. Guthkelch AN. Infantile subdural haematoma and its relationship to whiplash injuries. *BMJ* 2:430-431, 1971.
37. Hadley MN, Volkes K, Sonnet H, Rekate HL, Murphy A. The infant whiplash shaken injury syndrome: a clinical and pathological study. *Neurosurgery* 24:536-540, 1989.
38. Ho Su, Spehlmann R, Ho ET. CT scan in interhemispheric subdural hematoma: clinical and pathological correlation. *Neurology* 27:1097-1098, 1977.
39. Jayawant S, Rawlinson A, Gibbon F, Price J, Schulte J, Sharples P, Sibert JR, Kemp AM. Subdural hemorrhages in infants: population based study. *BMJ* 17:1558-1561, 1998.
40. Kasdon DL, Magruder MR, Steveas EA, Paullus WS. Bilateral interhemispheric subdural hematomas. *Neurosurgery* 5:57-59, 1979.
41. Konhu K, Horie Y, Hirashima Y, Endo S, Takaku A. CT findings in neonatal acute subdural hematoma. *Neurosurgery* 21:223-225, 1981.
42. Latimer JS, Shrp HL. -1-antitrypsin deficit in children. *Curr Probl Pediatr* 11:1-36, 1980.
43. Lin TH, Cook AW, Browder EJ. Intracranial hemorrhage of traumatic origin. *Med Clin North Am* 43:603, 1958.
44. Lindgren SO. Acute severe head injuries. Clinical diagnosis and classification with respect to early prognosis and treatment. *Acta Chir Scand* 254:1, 1960.
45. Lorber J, Lilleyman JS, Peile EB. Acute infantile thrombocytosis and vitamin K deficiency associated with intracranial hemorrhage. *Arch Dis Child* 54:471-472, 1979.
46. McDonald RL, Hoffman HJ, Kestle JRW, Rutka JT, Weinstein G. Needle aspiration of acute subdural hematomas in infancy. *Pediatr Neurosurg* 20:73-77, 1994.
47. MacLaurin RL. Subdural hematomas and effusions in children. In: Wilkins RH, Rengachary SS. *Neurosurgery*. (ed) McGraw-Hill. New York, 1985, pp. 2211-2214.
48. McLaurin RL, Towbin R. Post-traumatic hematomas. In: McLaurin RL, Venes JL, Epstein F. *Pediatric Neurosurgery: Surgery of the developing nervous system*. (ed) WB Saunders. Philadelphia, 1989, pp. 277-289.
49. McNinch AW, Orme RLE, Tripp LH. Hemorrhagic disease of the newborn. *Lancet* 1:1080-1090, 1983.
50. Moloy HC. Studies on head molding during labor. *Am Obstet Gynecol* 44:762-782, 1942.
51. Nagao T, Nobuhiko A, Mizutani H, Kitamura K. Acute subdural hematoma with rapid resolution in infancy - case report. *Neurosurgery* 3:465-467, 1986.
52. Nataelson SE, Sayers MP. The fate of children sustaining severe head trauma during birth. *Pediatrics* 51:169-174, 1973.
53. Obajimi MO, Jumah KB, Iddrisu M. CT evaluation of intracranial subdural haematoma: an Accra experience. *Afr J Med Med Sci*. 31:321-4, 2002.
54. O'connor ME, Linvingston DS, Hannah J, Wilkins D. Vitamin K deficiency and breast feeding. *Am J Dis Child* 137:601-602, 1983.
55. O'hare AE, Eden OB. Bleeding disorders and non-accidental injury. *Arch Dis Child* 59:860-864, 1984.
56. Payne NR, Hasegawn DK. Vitamin K deficiency in newborns: a case report -1-antitrypsin deficiencies and a review of factors predisposing to hemorrhage. *Pediatrics* 73:712-716, 1984.
57. Salman M, Crouchman M. What can cause subdural hemorrhage in a term infant? *Pediatr Today* 5:42-45, 1997.
58. Salmon JH. Subdural hematoma in infancy - suggestions for diagnosis and management. *Clin Pediatr* 10:597-599, 1971.
59. Schwartz P. Birth injuries of the newborn. *Arch Pediatr* 73:729-750, 1956.
60. Smith SM, Hanson R. 134 battered children, a medical and psychological study. *BMJ* 3:666-670, 1974.
61. Sparaccio RR, Khatib R, Cook AW. Acute subdural hematoma in infancy. *N Y State J Med* 71:212-213, 1971.
62. Starling SP, Patel S, Burke BL, Sirotiak AP, Stronks S, Rosquist P. Analysis of perpetrator admissions to inflicted traumatic brain injury in children. *Arch Pediatr Adolesc Med*. 158:454-8, 2004.
63. Tardieu A. Etude medico-legal sur les services et mauvais traitements exerces sur des enfants. *Annal Hygiene Publ Med Legal* 13:361-398, 1886.
64. Teixeira WRG, Mori SS, Morrone ZJ, Arias HS, Queiroz SM, Teixeira CMP. Síndrome do bebê espancado. *Rev Paul Med* 102:237-243, 1984.
65. Volpe JJ. Intracranial hemorrhage: subdural, primary subarachnoid, intracerebellar, miscellaneous. In: Volpe JJ. *Neurology of the newborn*. (ed) WB Saunders: Philadelphia, 1981, pp. 239-261.
66. Welch K, Strand R. Traumatic parturitional intracranial hemorrhage. *Dev Med Child Neurol* 28:156-164, 1986.
67. Wilkins B. Head injury - abuse or accident. *Arch Dis Child* 76:393-397, 1997.
68. Young RSK, Zalneraits EL. Retroauricular cephalohematoma as a sign of posterior fossa subdural hematoma. *Clin Pediatr* 9:631-632, 1980.

Author Information

Carlos Umberto Pereira

Department of Medicine, Division of Neurosurgery, João Alves Filho Hospital, Federal University of Sergipe

João Tiago Silva Monterio

Department of Medicine, Division of Neurosurgery, João Alves Filho Hospital, Federal University of Sergipe

Egmond Alves Silva Santos

Department of Medicine, Division of Neurosurgery, João Alves Filho Hospital, Federal University of Sergipe

Luiz Antônio Araújo Dias

Division of Neurosurgery, Santa Casa de Ribeirão Preto