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Neurosurgical Wound Infection at a University Hospital in Egypt; Prospective Study of 1181 Patients for 2 Years

Mısır'da Bir Üniversite Hastanesinde Nöroşirürjikal Yara Enfeksiyonu; 2 Yılda 1181 Hastanın Prospektif Çalışması

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ABSTRACT

AIM: The aim of this study is to report the incidence rate of neurosurgical wound infection at our university as well as the predisposing risk factors.

MATERIAL and METHODS: A 2-year hospital prospective study was conducted and included 1110 patients underwent 1181 elective neurosurgical procedures, 50.3% were male. The ages ranged between 4 days and 80 year with mean age of 33.9±19.679. Instrumental spinal devices were applied in 189 (16%) of patients, and 114 (9.7%) underwent shunt surgery, while aneurysmal clips were used in 5 patients only. The mean duration of follow up was 17.46±3.49 months.

RESULTS: 41 patients suffered surgical wound infection representing 3.47 % of the patients. Staphylococcus aureus was the commonest organism in 10 (24.39%) patients followed by the E.coli in 5 (12.19%) patients, while the culture revealed no growth in 14 (34.14%) patients. 25 patients have one or more risk factors of wound infection. 28 cases were treated surgically and 13 patients received conservative treatment. 34 wound infections occurred early during hospitalization, while 7 patients had late wound infection. We have two death-related infection from meningitis and sever septicemia.

CONCLUSION: The neurosurgical wound infection rate is usually low even in developing countries and remains within the accepted rate.

KEYWORDS: Neurosurgery, Surgical site infection, Prophylactic antibiotic, Shunt

ÖZ

AMAÇ: Bu çalışmanın amacı, üniversitemizde nöroşirürjikal yara enfeksiyonunun insidansını ve ayrıca predispozan risk faktörlerini bildirmektir.

YÖNTEM ve GEREÇLER: 2 yıllık bir prospektif hastane çalışması yapılmış ve toplam 1181 elektif nöroşirürjikal işlem yapılmış ve %50,3'ü erkek olan 1110 hasta dahil edilmiştir. Yaş aralığı 4 gün ve 80 yaş ve ortalama yaş 33,9±19,679 yıldır. Hastaların 189'una (%16'sı) spinal enstrümentasyon uygulanmış, 114'üne (%9,7) şant cerrahisi yapılmış ve sadece beş hastada anevrizma klipleri kullanılmıştır. Ortalama takip süresi 17,46±3,49 aydır.

BULGULAR: 41 hastada (hastaların %3,47'si) cerrahi yara enfeksiyonu gelişmiştir. Staphylococcus aureus 10 (%24,39) hasta ile en sık görülen organizmayken E.coli 5 (%12,19) hastada görülmüş ve kültür 14 (%34,14) hastada herhangi bir üreme göstermemiştir. 25 hastada bir veya birkaç yara enfeksiyonu için risk faktörü bulunmuştur. 28 olgu cerrahi olarak tedavi edilmiş ve 13 hastaya konservatif tedavi uygulanmıştır. 34 yara enfeksiyonu hastaneye yatmanın erken döneminde oluşurken 7 hastada geç yara enfeksiyonu görülmüştür. Menenjit ve şiddetli septisemi nedeniyle iki adet ölümle ilişkili enfeksiyon görülmüştür.

SONUÇ: Nöroşirürjikal yara enfeksiyonu oranı genellikle gelişmekte olan ülkelerde bile düşüktür ve kabul edilen aralık dahilindedir.

ANAHTAR SÖZCÜKLER: Nöroşirürji, Cerrahi bölge enfeksiyonu, Profilaktik antibiyotik, Şant

INTRODUCTION

Neurosurgical wound infections are the most common and serious complications resulting in increased rates of morbidity and mortality (10). Several retrospective and prospective studies had been reported lower incidence of neurosurgical wound infection (12,17); however the consequences may carry high morbidity and mortality. Since the pioneering study of Mallis (11) who reported the beneficial effects of local and perioperative antibiotic prophylaxis in clean neurosurgical wound infection, many randomized and meta-analysis studies confirmed the benefit of antibiotic prophylaxis in reducing the incidence of surgical site infection (1,2,4,7,10). The protocol of antibiotic prophylaxis is different among centers and the majority of previous publications came from The United States or Europe and rarely from developing countries. To the best of our knowledge this is the first prospective study that reported neurosurgical wound infection in Egypt.

METHODS

This prospective study included 1110 patients underwent 1181 neurosurgical procedures at the Neurosurgery Department, Zagazig University between January 1, 2009 and January 1, 2011. Age ranged between 4 days to 80 years with mean of 33.9±19.679 years. All patients underwent elective neurosurgical operations during the study period were included. The duration of follow up ranged from 12 and 24 months with mean of 17.46±3.49 months. Emergency cases as traumatic induced brain pathology such as extradural hematoma, subdural hematoma, etc. that operated at the traumatology unit were excluded from the study. Patients with early mortality shortly after surgery were not included in the study. 594 patients were male representing 50.3% of the patients while the remaining 587 patients were female representing 49.7% of the patients. The details of the surgical procedures were reported in Table I. They included 256 craniotomies for brain tumors or arachnoid cysts; another 5 craniotomies were performed for patients with ruptured cerebral aneurysms and 8 patients with intracranial suppurations. The majority of our work included 644 patients with spinal pathology representing 54.5% of the patients operated at the department. Metallic instrumental fusion was used in 189 patients with unstable fracture spines, or degenerative disorders. Aneursymal clips were used in 5 patients with ruptured cerebral aneurysms, while 114 shunt surgeries were performed including 9 cases with thecoperitoneal shunt, 2 cystoperitoneal shunt for arachnoid cysts, 1 subdural –peritoneal shunt, 2 external ventricular drainage, and the remaining 98 cases received ventriculoperitoneal shunt. 11 patients were adults and the remaining 87 patients were children. They included 47 new shunts and 40 shunt revisions. Antiseptic procedures include evening shaving of the head and surgical site in spine surgery, disinfecting with povidine-iodine solution with no draping of the surgical site with adhesive plastic surgical drape. The irrigation solution contained crystalline

Table I: Frequency of Procedures and the Incidence of Infection

	Frequency	%	No of infection	%
Craniotomy	272	23.03	9	3.3%
Brain tumor and arachnoid cyst	256	94.1	7	2.73%
supuration	7	2.57	0	0%
Cerebral aneurysm	5	1.83	1	20%
cranioplasty	4	1.47	1	25%
Spine	644	54.5	17	2.63%
Instrumentation	189	29.34	6	3.17%
No instrumentation	455	70.66	11	2.41%
Primary	615	95.49	14	2.27%
Recurent	29	4.51	3	10.34%
Congenital	23	1.94	4	17.4%
Meningocele and	17	73.9	4	23.5%
myelomeningcele		8.69	0	0%
encephalocele	2	8.69	0	0%
tethered cord	2	8.69	0	0%
craniocynstosis	2			
CSF diversion	114	9.65	11	9.64%
V-P shunt	98	85.96	11	11.22%
adult	11	9.6	0	0%
pediatric	87	76.3	11	12.64%
L-P shunt	9	7.89	0	0%
Cystoperitoneal shunt	2	1.75	0	0%
Subdural peritoneal shunt	1	0.8	0	0%
EVD	2	1.75	0	0%
3rd ventriculostomy	2	1.75	0	0%
Peripheral nerve	112	9.48	0	0%
Entrapment syndrome	87	77.7		
injury	25	22.3		
Stereotaxy and functional	16	1.4	0	0%
Total	**1181**	**100.0**	**41**	**3.47%**

penicillin for extradural procedures only. Absorbable gelatin sterile sponge (Gelfoam) and/ or absorbable oxycellulose (surgicel) were used routinely for hemostasis. 2 gm of third generation cephalosporin (Cefotriaxone, or Cefotaxime) were used intravenously at the introduction of anesthesia and continued for 4 to 7 days. The antibiotic is given in a dose of 50-100mg/kg in pediatric patients. Oral antibiotic is usually administered till removal of the sutures (Amoxicillin-sulbactam or amoxicillin–clavulanic acid). All drains were removed within 48 days. Closed drains were applied in all cases with negative suction while simple closed drains were applied in patients with incidental dural injury during spine surgery. We do not use a drainage system in patients with peripheral nerve lesions or with CSF diversion procedures. All procedures were performed in 3 designated neurosurgical theaters at our institution. If any signs of infection were suspected, a swab was taken for culture and sensitivity and appropriate antibiotic was given. Surgical site infections included both superficial and deep incisional infections. Organ space infections as intracranial, osteomyelitis, discitis, meningitis, ventriculitis, were included. Hyperemia and local warming at surgical site are also included. The patients' demographic characteristics were recorded for each patient and the cases were classified according to the procedures. Statistical analysis was performed using SPSS (version 14).

RESULTS

A total of 41 patients with postoperative surgical wound infections were identified among the 1181 patients included in the study with a resulting infection rate of 3.47%. The age ranged between 4 days and 60 years with mean age of 26.88 years. 16 (39.02%) patients were below one year, and 10 cases were above 50 years. Culture and sensitivity from the wound revealed Staphylococcus aureus in 10 patients representing 24.39% of the patients as shown in Table II. 14 patients (34.14%) revealed no growth. All the patients with shunt infection were pediatric patients who had received a ventriculoperitoneal shunt, and we did not have any infections in adult patients with hydrocephalus or lumboperitoneal shunts. 34 wound infections occurred early during hospitalization, while 7 patients had late wound infection. 25 patients have one or more risk factors while 16 patients have no predisposing risk factor as shown in Table III. The neurosurgical wound infection in craniotomies manifested as meningitis (2 cases), brain abscess (2 cases), subdural empyema (1 case), subgaleal serosanguineous collection (1 case), and the remaining (3 cases) were superficial wound infections. 28 patients required surgical intervention with exposure of the wound where foreign body was identified in 5 cases. Foreign body is more common in patients with late infection (3/7). Removal of instrumental fusion after wound exploration was done in two patients due to bone rarefaction. The remaining 13 patients treated conservatively with antibiotic and daily dressing only. 17 cases (41.46%) were operated in winter time (October-March). We have two infection related death from fatal meningitis and sever septicemia with end organ failure.

Table II: Causative Organisms of Wound Infection

Causative organism	No of cases	%
Sterile	14	34.14%
Staphylococcus aureus	10	24.39%
Escherichia coli	5	12.19%
Klebsilla	4	9.75%
Proteus	3	7.31%
Pseudomonas	3	7.31%
Mixed organisms	2	4.87%
Total	41	100%

Table III: Risk Factors in Patients with Wound Infection

Risk factor	Number of patients
Immune compromised patients	
Diabetes mellitus	5 (12.2%)
Leukaemia	1 (2.4%)
Corticosteroids administration	19 (46.3%)
Distant infection	3 (7.3%)
CSF leak	7 (17.07%)
Foreign instrumentations	17 (41.46%)
No risk factors	16 (39.02%)

DISCUSSION

Antibiotic prophylaxis in neurosurgery began with the use of the antiseptic hexamine in 1925 and has continued till present with the introduction of new drugs from penicillin to vancomycin (15). Although clean neurosurgical procedures without implantation of foreign devices carry a low risk of postoperative infection, yet the application of prophylactic antibiotic is now a routine in neurosurgery. This fact was supported by the results of multiple published studies (5, 6). Clinical symptoms after neurosurgical infections usually vary and including pain, sense of malaise, fever but spontaneous drainage from the wound is more common (3). The devastating effects of postoperative infection in the nervous system requested continuous interest in factors leading to postoperative infections (4). A variety of risk factors had been reported. Immunocompromised patients as those with diabetes mellitus, hypertension, distant infection, other malignancies, male patients and extremity of age are considered as patients' risk factors. The duration, surgical diagnosis, surgeon, complexity of surgery, early reoperation, intraoperative hypothermia, use of drains, paranasal sinus entry, CSF leak, seasonal variation and even the timing of surgery are previously reported as risk factors (1, 2, 4, 6,7,10, 17-19, 21). Choux et al. proposed performing operations with high risk of wound infection earlier in the morning to avoid the potential decrease in sterility of the operating rooms (5). Although the low number of overall wound infection cases in this series and the heterogeneous group of patients limits the

ability of our study to detect statistical significant risk factors, yet with reading of risk factors in table 3 in our patients, we found that 25/41 of the patients had one or more risk factors as diabetes mellitus, leukemia, or CSF leak.

The incidence of wound infection varied among different centers. In a consecutive series of 1747 patients treated with elective neurosurgical procedures, Valentini and his colleagues reported an incidence of 0.7% of his patients with a higher incidence (1.52%) in craniotomies than 0.15% in spinal surgery (17). McClelland and Hall in their series of 2111 patients reported 0.8% incidence of infection. They have higher incidence of infection in cranial operations than spinal surgery. The incidence was 0.8% and 0.4% respectively (12). Our results showed also lower incidence of wound infection in spinal procedures than craniotomies. They were 2.63% and 3.3% respectively. Although, the incidence of infection is higher in our center than reported in USA and Italy, yet it is compared favorably to that reported by Korinek and his colleague in their series of 4578 craniotomies, the overall incidence of infection was 6.6%. The introduction of prophylactic antibiotic decreased the infection rate from 9.7% to 5.8% (9). Our results showed that the incidence of wound infection is procedure dependant; the highest incidence was in meningocele and myelomeningocele repair. 4/17 of our patients representing 23.52% had surgical wound infection. This incidence is slightly higher than reported by Schroeder et al (16), in their study 7/60 of their patients representing 11.7% had wound infection. However, we reported a lower incidence of shunt infection 12.64% vs. 19.6% in their series. McClelland and Hall in their series reported higher incidence in CSF shunting (1.6%) followed by Ommaya reservoir placement (1.4%) than spinal surgery and craniotomies (12). Surgery of peripheral nerve injury and entrapment is usually clean with low or no reported incidence of infection. Our result matched that of Valeniti et al. (17), McClelland and Hall (12), who reported no infection in their patients with peripheral nerve surgery. Our study showed that the mean age of patients with wound infection was younger than the mean age of the all patients. The mean age was 26.88 vs. 33. 9 years. McClelland and Hall also reported a younger mean age of patients with wound infection. The age was 37.8 years compared to 44.8 years of the remaining patients (12). This may be attributed to the higher incidence of infection in the pediatric group with CSF shunting and meningocele repair. Staphylococcus aureus was the most common offending organism in our study representing 24.39% of cases, which is in concert with previous reports. McClelland and Hall (12) reported 50 % of their infections due to Staphylococcus aureus. Korinek et al reported both methicillin resistant and coagulase negative staphylococcus aureus as the most common pathogen. The incidence was 23% and 21% respectively (8). Our study showed higher incidence of wound infection in winter time. 17 cases (41.46%) were operated in winter time (October-March). seasonal variation was previously reported as a significant risk factor. Yamamoto and his colleagues reported higher incidence in summer (21), Ingham et al. (7) reported the highest rate of postoperative wound infection in February, Wright found high rates in April and October (20).

The protocol of antibiotic administration for long time in our center is a little beyond the definition of prophylaxis which is usually used for the application of antibiotics for short period. Majorities of recent reports clarified that multiple- dose antibiotic prophylaxis is not superior to single preoperative dose in clean surgical procedures. Petignat and his collaborators in their series proved that a single preoperative dose of cefuroxime significantly reduces the risk of organ-space infection, especially spondylodiscitis, after surgery for herniated disc. The overall incidence of surgical site infection is 1.3% (16). Moorthy and his colleagues in their conservative antibiotic policy in patients undergoing non-trauma cranial surgery, bacterial meningitis was diagnosed in 0.8% only of their patients (13). They used a one-day course of intravenous chloramphenicol or a single dose of ceftriaxone as antibiotic prophylaxis.

The results from our series showed that the incidence of neurosurgical wound infection is usually low even in developing counties. The application of prophylactic antibiotics is of great importance to have these results.

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