

Research

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Etiology of Infection, Femoral Nerve and Splenic Injury by Abdominal Retractor

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ABSTRACT

The aim of this work is to identify the underlying factors of infections in surgical wounds, as well as injury to the femoral nerve and spleen. Medical literature dating between the years 2000 and 2013 was reviewed using PubMed's electronic service. The structure and shape of semi-automatic retractors used for abdominal surgical procedures were studied. The results we obtained showed that the etiology of infection in surgical wounds and injury to the femoral nerve and spleen are due to semi-automatic retractors. We conclude that prophylactic antibiotic therapy is not sufficient in eradicating these surgical wound infections or injury to the femoral nerve and spleen. This reorganization was based on the Institute of Medicine's (IOM) 2010 analysis of NCI clinical research. This report was highly critical of the inefficiency of the process by which the cooperative groups carry out their trials. Historically, relatively few U.S. oncologists have even participated in clinical research, mostly from academic institutions. Community oncologists, who see the great majority of American cancer patients, have generally been reluctant to participate in federal clinical research due to the bureaucratic burden and low reimbursement. As a result, more than half of the trials initiated by the NCI's cooperative groups do not meet their accrual goals and are closed, generating no data. Further, the attendant bureaucracy ensures that each new Phase III trial startup costs well over a million dollars, which becomes a total loss when a trial closes early. The IOM made a number of recommendations for improving and streamlining that process, including the consolidation of the groups.

KEYWORDS: Infection of surgical wounds; Abdominal-cutaneous nerve injury; Abdominal surgery; Surgical retractors.

METHODS AND LITERATURE

Medical literature dating between the years 2000 and 2013 was reviewed using PubMed's electronic service. The structure and shape of semi-automatic retractors used for abdominal surgical procedures were studied.

RESULTS

Infection of Surgical Wounds

This affection occurs in all hospitals around the world, but significantly more in developing countries. In research undertaken by Giri, it was observed that obesity, anemia, the duration of the surgical procedure and the surgeon's experience were all underlying factors of wound infections.¹

To reduce the incidence of infection in patients who underwent abdominal hysterectomies, Young implemented training programs for medical and nurse staff where they would use povidone-iodine or chlorhexidine gluconate as antiseptics, which reduced the incidence of infection from 10% to 2%.²

Machado noted that in patients suffering from obesity who underwent cesarean sections, the incidence of surgical wound infection has higher, when compared to patients whose weight was normal.³ Memon, in a comparative study, detected that prior to cesarean sections being practiced, asepsis and antisepsis of the vagina decreases infections.⁴ Kamyla communicated that the administration of antibiotics as a prophylactic reduced the incidence of infections.⁵

Próspero reported that when three doses of antibiotics were administered as prophylaxis for postoperative infection in a sample of 21,351 patients, 12,558 (58.8%) presented no infection. Statistically speaking, the difference was not significant.⁶

In a retrospective research, Khalifa analyzed reports from the 1970s through to 2011 regarding the resistance of bacteria to antibiotics. That work resulted in that *Staphylococcus aureus*, *Klebsiella*, *Pseudomonas* and *E. coli* are the most common bacteria found in infected surgical wounds. Ampicillin resistance reached 78% and amikacin resistance 2%.⁷ Hendricks emphasized that the lack of prophylaxis increased morbidity and mortality in surgical patients as well as the cost of care.⁸

The World Health Organization, based on research on the resistance of Gram-positive and Gram-negative bacteria to antibiotics, implemented programs to improve aseptic and antiseptic techniques in order to reduce their use.⁹

Femoral Nerve Injury

Femoral nerve injuries occur during abdominopelvic surgery due to the blade part of semi-automatic retractors being used to have a better view of the surgical area. The poor des-

ign and structural characteristics such as devices present make it prone to compress the nerves in the abdominal wall.

Infantino analyzed these injuries in patients who underwent surgical procedures and published that femoral nerve injuries can occur during obstetric, gynecologic or oncologic surgeries *via* the abdomen. In order to diagnose those injuries an electromyography of the pelvic limbs must be done.¹⁰

Moore reviewed medical literature on femoral nerve injury dating from 2000 through to 2010 and reported that symptoms of this neurological complication include paresthesia, decreased strength in the lower limbs, difficulty standing and walking, sometimes not being able to walk at all. These symptoms persist indefinitely, ranging from a few days to several months. Medical treatment is needed and the patient needs to follow physiotherapy for the rehabilitation aspect of this ailment.¹¹

On the other hand, Irving reviewed medical literature from 1960 to 2002 regarding the same type of injury and reported that the side blades on retractors, the intraoperative position of the patient and the radical dissection are all contributing factors to damage.¹²

The incidence of neurological injuries attributed to the use of semi-automatic retractors was underestimated due to information regarding this iatrogenic effect not being spread, perhaps due to forgetfulness or for fear of legal repercussions.

In 2013, Clarke-Pearson reported that in the United States 600,000 hysterectomies are performed yearly, of which 12,000 patients suffered femoral nerve injury.¹³

Many studies on femoral nerve injury agree in that it is due to the side blades on retractors.^{10,11,12,13}

Abdominal Cutaneous Nerve Injury

Some of Ehler's research focused on clinical manifestations of other post-surgery (*via* the abdomen or vagina) neurological iatrogenic effects and published that injury inflicted on the genitofemoral nerves produce pain in the crural and vulvar areas; injury to the lateral femoral cutaneous nerve causes paresthesia on the antelateral thigh; and injury to the obturator nerve is due to the weakening of thigh muscles, with a decrease in strength of the foot and while walking. When the injury affects the pudendal nerve, functional anatomical changes include urinary and fecal incontinence as well as pain the perineum. These injuries are produced with the compress-

-ion of the hooks and side blades of retractors. In order to decrease this type of injury, blades should not exert excessive pressure on the abdominal wall. Electromyography is used to diagnose injuries, and in some cases CT scans or MRIs are used.¹⁴

Tonneti studied the mechanism through which abdominal-cutaneous nerves are damaged on corpses. He identified that these injuries are caused by the compression of nerves from the use of retractor hooks.¹⁵

Splenic Injury

Cassar reviewed literature on iatrogenic splenic injury and reported that 40% of splenectomies are performed for this type of injury, an injury caused by compression from side blades in semi-automatic retractors.¹⁶ Mettke published that in 42,802 patients who underwent colorectal surgery, 640 (1.40%) suffered splenic injury.¹⁷ The Bookwalter retractor also causes injuries to the spleen; its use in surgery requires ten joint movements which promotes infection.¹⁸

Retractor features and design, operating time and excessive traction force used to ensure optimal surgery area visibility are all factors associated to infection in surgical wounds, abdominopelvic nerve compression and splenic injury.

Semi-automatic Retractors

The most frequently used retractors in gynecologic surgery are O’Sullivan-O’Connor, Balfour and Collins. All of these have permanent hooks, and blades that can be used if so wished. The hooks are curved and “fit” into the inner part of the abdominal wall, exerting pressure on abdominal-cutaneous nerves.

These retractors need bolts, screws and an opening system. The complete cleaning of these areas is very difficult and asepsis of the opening system is impossible. When retractors are dismantled, blood detritus and secretions are found on the screws, bolts and openings. Rust can also be found there. Detritus is an underlying factor in surgical wound infections.

Infection begins at the center and ends of incision sites, where there is direct contact with the retractor and where hooks and blades exert pressure. Table 1 shows surgical procedures with information regarding retractors, joints, screws and bolts used, all of these on which detritus is lodged.

SITES WHERE BLOOD, DETRITUS AND PATHOGEN MICROORGANISMS ARE LODGED

Name	Type of Surgery	Joints Spaces	Screws	Bolts	P.D.L.S.
O’Sullivan	Gynecological	43 in each	4	4	13
Balfour	Cesarean	23	3	3	6
Collins	Cesarean	32	3	3	6
Soriano	Cesarean	22	0	0	4
	Vaginal-gynecological	11	0	0	1

P.D.L.S. = Potential Detritus Lodging Sites

Table 1: Surgical procedures using retractors with joints, screws and bolts where detritus is lodged

O’Sullivan-O’Connor Retractor

The retractor’s opening and closing system is a rack that uses a metal band or spring. Its semi-hermetic characteristic makes it difficult to access as well as the parts contained therein. This retractor’s upper and lower blades are hinged, see Figure 1. For an image of detritus in the rack, see Figure 2. Spaces between the joint and curved side blade are shown in Figure 3.

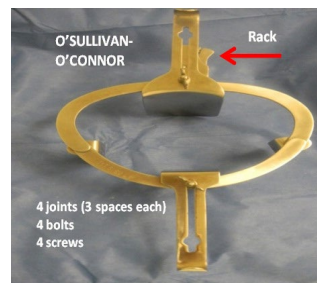


Figure 1: O’Sullivan-O’Connor retractor: showing rack

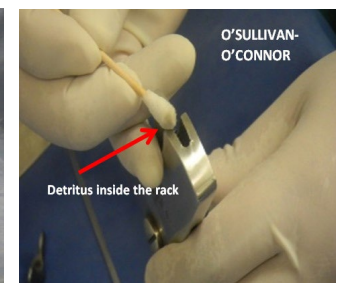


Figure 2: O’Sullivan-O’Connor retractor: showing detritus inside the rack

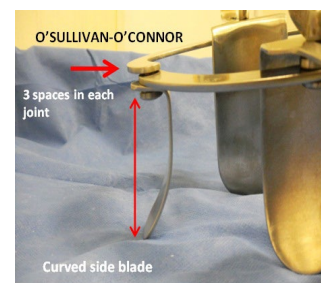


Figure 3: O’Sullivan-O’Connor retractor: showing curved side blade

Balfour Retractor

Two screws are placed at the ends of the two rods that are inserted in the openings, each one measuring 5 mm. The “slider” is rectangular and measures 28 x 30 x 10 mm; with two openings each with a length of 28 mm and diameter of 8 mm.

The “slider” glides along the length of the each rod (28 cm), see Figure 4. There is a screw fixed on one end of the slider. Detritus is lodged both in the openings and this fixed screw, as seen in Figure 5.

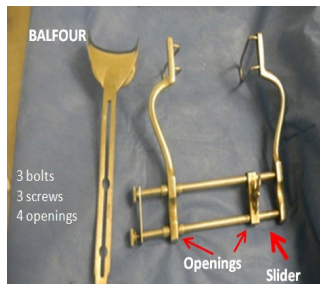


Figure 4: Balfour retractor showing openings and slider



Figure 5: Balfour retractor showing detritus in the slider's openings and screw

Collins Retractor

In this retractor biological agents can be lodged in three permanent joints, two side blades and in one site where arms bend.

Soriano Retractor

The Soriano retractor’s use was tested on female patients and the results showed no postsurgical infections and no femoral nerve injury thanks to the structure and design of the instrument as a whole and its individual parts. The suprapubic or deep blades are a complementary part of this retractor. This instrument does not need screws or bolts and can be used in abdominal and/or vaginal surgeries on patients with normal weight or who are morbidly obese.¹⁹ The dismantled instrument is composed of the following parts: the main part; four deep blades; and three suprapubic blades. The articulation system requires no screws or bolts (Figure 6). Detritus can be lodged - in this instrument - in two sites, the joint of the Main Part and that of the Complementary Part.

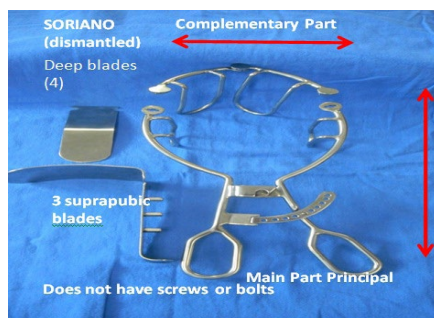


Figure 6: Soriano retractor

Viral Infections

Hepatitis is a viral diseases transmitted through blood be it orally, *via* blood transfusion, the use of contamin

ated needles and sex. Preventive measures are intended to prevent contact with blood from patient to patient, patient to doctor or nurse, or *vice versa*.

In spite of programs created by the World Health Organization, the number of patients with hepatitis worldwide is increasing gradually. The morbidity and mortality rate was determined in pregnant women.^{20,21} Forty percent of patients with Hepatitis C (HC) have no history of blood transfusions or drug addiction, but rather the infection was acquired through surgical instruments used on them. Hospital-acquired infection is the most important underlying factor in HC transmission.²²

Another deadly disease is AIDS, a major public health problem worldwide. Obstetric patients are not exempt from this disease and transmission to the fetus is inevitable.²³ In research about AIDS-transmission mechanisms conducted by Onuga, it was stated that the virus survives several days in dry conditions, and up to four weeks in a humid environment.²⁴ Compared with men, there is a higher incidence of hepatitis or AIDS from abdominal surgical procedures in women. This type of infection includes hospital-acquired infections.

CONCLUSIONS

The WHO’s preventive programs focusing on reducing the incidence if infection in surgical wounds have lowered this rate. However, hospital-acquired infections persist and are a constant threat.

Femoral nerve and abdominal-cutaneous nerve injury along with splenic injury are caused by the structure and shape of semi-automatic retractors.

To help reduce infections and neurological injuries, retractors must be anatomically designed and joints must not have spaces in order to prevent detritus from lodging there.

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