

Pilonidal Disease: Review of Recent Literature

Seyed Vahid Hosseini¹; Mohammad Rezazadehkermani^{2,*}; Reza Roshanravan¹; Khairallah Muzhir Gabash³; Mahmoud Aghaie-Afshar⁴

¹Colorectal Research Center, Shiraz University of Medical Sciences, Shiraz, IR Iran

²Department of General Surgery, School of Medicine, Shiraz University of Medical Sciences, Shiraz, IR Iran

³Department of Surgery, Al-Karama Teaching Hospital, College of Medicine, Wasit University, Kut, Iraq

⁴Department of General Surgery, School of Medicine, Kerman University of Medical Sciences, Kerman, IR Iran

*Corresponding author: Mohammad Rezazadehkermani, Department of General Surgery, School of Medicine, Shiraz University of Medical Sciences, Shiraz, IR Iran. Tel/Fax: +98-7112330724, E-mail: rezazadehkermani@yahoo.com

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Context: Sacrococcygeal pilonidal disease is a common cause of patient's referral to colorectal surgery services. Recently, numerous reports published about management of patients with pilonidal disease.

Evidence Acquisition: In this review, we gathered all the recent ten years evidences indexed in the PubMed database.

Results: Surgical management has been changed from invasive excision and secondary healing to minimal invasive and non-operative, primary closure methods and flap based techniques. Developing laser epililation had promising effects on reducing recurrence rate. Most of surgical techniques efficacy are shown with well-controlled studies.

Conclusions: Although recent evidences seems to describe current techniques efficacy but the absence of standardized pilonidal staging system made comparison of studies difficult and newer studies should be done regarding this issue.

Keywords: Pilonidal Sinus; Surgery; Review

1. Context

Pilonidal disease is a common surgical pathology. During the year 2011, pilonidal disease surgical managements were the eighth most common invasive procedure in Iran with the rate of 141 procedures per 100000 populations (1). A recent prospective study reports the prevalence of 9.4% based on evaluation of cadavers referred for autopsy (2). A Danish study report demonstrates suboptimal techniques in surgical management of pilonidal disease and proposed development of national guideline and protocols (3). In this study, authors review the published evidences during the last ten years with especial regards toward Middle Eastern published evidences.

2. Evidence Acquisition

PubMed database was searched using a wide coverage keyword, "Pilonidal". Since beginning of 2003 until the end of 2013, 590 records were found; non-English language, non-original articles and articles with sample sizes lesser than 50 cases were omitted. Albeit smaller studies enrolled in the review if a larger one was not found. Evidences, which investigate pilonidal disease in children and non sacrococcygeal pilonidal disease, were also excluded. In case of double published studies, only the later study was included.

3. Results

3.1. Risk Factors

The disease mostly involved young population. Obesity is an independent risk factor of disease and is associated with postoperative complication and recurrence (4). Regardless of BMI, sacrococcygeal subcutaneous fat thickness is associated with pilonidal disease (5). Regarding Karydakis opinion, in growing hair is the most common cause of pilonidal disease and one of the factors that contribute to ingrowing hair was the depth and narrowness of natal cleft. Akinci and colleagues report the deeper natal cleft in patients with pilonidal disease comparing with control group (6). This hypothesis leads to developing techniques for releasing coccyctaneous ligaments during surgery (7). An Iranian case-control study demonstrated obesity, driving or sitting for more than four hours per day, positive family history and taking bath less than three times per week as risk factors of developing pilonidal disease (8). Another study showed that hairy people who seat more than six hours per day and take bath two or less times per week had 219 fold increased risk of pilonidal disease than patients without these risk factors (9). Genetic is another risk factor for pilonidal disease as shown in a German study; patients with positive family history of pilonidal disease had earlier symptomatic disease as compared with pilonidal disease

patients without family history. Family history is also a risk factor for recurrence after surgery (10). Another finding - which may be in favor of genetic basis of disease - is extracellular matrix composition in pilonidal disease patients. Patients with recurrent disease have lower collagen I/III ratio and higher level of matrix metalloproteinase 1, 9 and 13. Such patients have higher rate of wound complication after their pilonidal surgery (11). A twenty year retrospective analysis of 1962 pilonidal disease patients showed lower number of sinuses in infective case and concluded that sinuses are not made by chronic infection. Prolonged disease also was not associated with increased number of sinuses. They also suggest that sinuses are acquired till certain age even if occupational, individual and environmental risk factors continue to present (12).

3.2. Pre-Operative Measures

Wound infection is one of the causes of recurrence and primary closure failure. Culture of infected wounds demonstrate mostly endogenous colonic flora as accusing agents. Thus, pre-operative colon preparation proposed to reduce the load of feces and endoluminal flora would reduce the risk of infection. However, a Turkish randomized controlled trial reported that pre-operative colon preparation would not decrease wound infection, wound dehiscence and recurrence. Duration of wound healing also did not change (13). As the aim of surgical management of pilonidal disease is to excise all tracts and extensions, it is essential to understand the anatomy of the cyst and sinus. Ultrasonography can detect tracts that cannot be found in examination (14).

3.3. Anesthesia

The procedure could be done both with local and general anesthesia; as some authors believe local anesthesia is associated with lower postoperative pain and need for analgesics (15). In order to reduce the pain of local anesthesia, it is recommended to instill the agent in the abscess cavity (16), but very limited evidences support this method and more studies is needed for approve its use in routine practice. Comparing local anesthesia and sedation with spinal anesthesia showed the superiority of local anesthesia with sedation over spinal anesthesia in cost, complication rate and hospital stay length (17).

3.4. Primary Surgical Interventions

Choosing an appropriate surgical approach toward pilonidal disease is always challenging, Table 1 describes studies that compare different surgical options for treating pilonidal disease. However, multiple meta-analyses describe the efficacy of different approaches. An updated in Cochrane Systematic Review and Meta-analysis suggested the lower rate of recurrence with open healing compare with primary closure; but rate of infection did not differ. This study also demonstrated the benefit of off-midline closure compared with midline closure technique (18, 19). Systematic review

and meta-analysis of trials showed no difference in wound complication with primary closure or laying wound open to heal secondarily. This study also demonstrated the superiority of off-midline closure, which was associated with lower rate of recurrence and wound complications (20). In acute pilonidal abscess patients secondary wound healing is generally recommended and there are authors reports using curettage associates with lower rate of recurrence (21, 22). Local injection of adrenaline reduces bleeding during operation and operation time, but this method did not change postoperative bleeding volume (23).

Using Electrocautery during operation is discouraged and is associated with higher incidence of wound infection and dehiscence, hematoma formation and prolonged healing time, compared with tissue sealing cutting devices (24). However, a prospective randomized trial which compared using monopolar diathermy excision with knife excision report lower operation time and patient postoperative pain in diathermy group and no difference in wound healing time between groups, but rate of recurrence was not investigated in this study (25). Risk of recurrence is decreased significantly by combination of using preoperative antibiotics, excision with scalpel and early removal of tie dressing in contrast with not using preoperative antibiotic, excision with Electrocautery and removal of tie dressing after seven days (26). Applying subcutaneous sutures to approximate deep tissues did not reduce wound complications for simple primary closure of pilonidal wounds (27); as using drain after excision with primary closure seemed to reduce infection and recurrence but this resultswere not statistically significant (28).

3.5. Platelet Derive Products for Pilonidal Wound Management

Once the decision made to leave the wound open, multiple options are currently available for facilitating wound closure. Topical application of platelet rich plasma (PRP) showed to be associated with earlier wound healing and better patient satisfaction; possibly due to platelet derived growth wound enhancing factors (29). Applying auto logouscryo-platelet gel, while primary closure of pilonidal wound, was associated with lower rate of wound complication and recurrence (30). Since concentration of platelet varies between individuals, some standardization protocols and methods have been developed and using these methods are reported to reduce wound complication in contrast with traditional way of using platelet products (31). However, most of these studies supported by developer companies and the result of these studies should be mentioned regarding this bias.

3.6. Application of Tissue Adhesives

The reduced tissue damage and atraumatic wound closure properties of tissue adhesives proposed them for closure of pilonidal wound; but a study, which compared using Histoacryl with not using Histoacryl showed that

Table 1. Primary Surgical Intervention

First author, Year	Patients and methods	Intervention	Outcome
Dalenback, 2004 (38)	Prospective 41 months follow up of 125 patents with pilonidal disease	Excision with primary closure with ambulatory base with local anesthesia	6.4% infection; 5.6% wound dehiscence; 8% Recurrence
Cihan, 2004 (39)	Prospective randomized trial with 162 non infected pilonidal disease with median 4.2 years follow-up	Compare primary closure with Limberg and modified Limberg Flap	Modified Limberg flap had lower recurrence rate; Higher rate of infection and wound dehiscence in primary closure group
Ciccolo, 2004 (40)	Retrospective evaluation of 312 multiple types of Pilonidal disease with 12 months follow-up	Excision and primary closure with interrupted silk suture that comprehending cutis, subcutis and presacral band	4% Seroma collection; 3% Recurrence
Al-Naami, 2005 (41)	Retrospectively reviewed 100 case of pilonidal disease with three months follow-up	Patients undergone simple sinotomy	10% delayed wound healing; 2% recurrence within three months follow-up
Akca, 2005 (42)	Prospective randomized trial with 200 cases of pilonidal disease with median 28 months follow-up	Compare primary closure with Limberg flap	Primary closure was associated with higher rate of infection, dehiscence and recurrence
Ertan, 2005 (43)	Prospective randomized study with 100 chronic pilonidal disease with mean 19 months follow-up; Infected cases were omitted	Compare Limberg flap with Primary excision and closure	Limberg flap was associated with lower wound infection, dehiscence and recurrence; Time to walk without pain and time to sit on toilet without pain was longer with primary closure
Vahedian, 2005 (22)	Prospective study with 275 acute infected pilonidal patients	Compare drainage with drainage-curettage of pilonidal abscess	Lower rate of recurrence in curettage group
Gencosmanoglu, 2005 (44)	Prospective randomized trial with 142 non-acute pilonidal disease with median 47 months follow-up	Compare incision, curettage, partial lateral wall excision and marsupialization with total excision and primary closure	Lower rate of wound complication and recurrence with incision, curettage, partial lateral excision and marsupialization
Kareem, 2006 (45)	Prospective randomized study of 77 patients with chronic pilonidal disease with mean four years follow up	Compare wide excision and secondary healing with excision and primary closure	Recurrence rate was not different in both groups; Lower rate of time off work, hospitalization and time to complete healing in primary closure group
Hosseini, 2006 (46)	Prospective randomized study with 80 infected pilonidal patients with one year follow up	Compare drainage-delayed excision-primary closure with excision and secondary healing	Excision and secondary healing had lower rate of postoperative infection and recurrence
Ersoy, 2007 (47)	Retrospective study with 175 non-randomly grouped patients	Compare simple unroofing, Marsupialization, Primary closure and Limberg flap reconstruction	Primary closure has greater complications than other methods.
Al-Salamah, 2007 (48)	Prospective randomized trial with 380 non-infected chronic pilonidal disease patients with mean 35 months follow up	Compare excision and primary midline closure with excision without closure	Wound infection and recurrence rate was not different in two groups
Tocaceli, 2008 (49)	Retrospective analysis of 229 patients with one year follow-up	Patients undergone Excision and primary closure	91% complete primary healing; 1% recurrence in one year follow-up; 7% develop wound dehiscence; 2% develop subcutaneous collection
Tocchi, 2008 (50)	Prospective randomized trial with 103 non-recurrent quiescent pilonidal disease with five years follow-up	Patients undergone excision and simple closure and drain insertion compared in two groups	Suction drain was associated with lower rate of major and minor wound dehiscence, wound infection and hematoma formation.
Karakayali, 2009 (51)	Prospective Randomized study with 140 Non-infected and non-recurrent pilonidal disease with mean 15 months follow up	Compare Unroofing-Marsupialization with Rhomboid excision- Limberg flap	Unroofing and marsupialization had lesser postoperative complication and more patient comfort
Hossini, 2009 (52)	Prospective randomized trial with 90 uncomplicated and non-recurrent pilonidal disease with median 12 months follow-up	Compare excision and primary closure with excision and rhomboid flap	Rhomboid flap was associated with lower rate of infection and recurrence

Nordon, 2009 (53)	Prospective Randomized trial with 55 cases of moderate severe pilonidal disease with median 36 months follow up; Also review 259 case of chronic pilonidal disease retrospectively	Compare simple Bascom's technique with cleft lift operation.	Retrospectively simple Bascom's technique had higher rate of recurrence and re-operation; Prospective result showed the same results
Can, 2009 (54)	Retrospective analysis of 200 patients with 14-18 months follow up	Compare excision and primary closure with excision and closure with cleft lift flap	Lower rate of recurrence and wound complication in cleft lift flap group
Nursal, 2010 (55)	Prospective randomized trial with 238 chronic pilonidal patients excluding acutely infected subjects with mean 29.7 months follow-up	Compare V-Y flap with primary closure using two methods; all layers closure and subcutaneous closure	No difference in complication and recurrence seen between groups
Muzi, 2010 (56)	Prospective randomized study with 260 patients non-infected pilonidal disease with more than three years follow up	Compare Limberg flap with Primary excision and closure	Wound infection was greater in primary closure method but time off work, recurrence and dehiscence rates were not different significantly;
Lorant, 2011 (57)	Prospective randomized trial with 80 non infected pilonidal disease patients with one year follow-up	Compare excision and primary closure with excision curettage and laying open	Excision and primary closure was associated with earlier healing but recurrence did not differ between groups
Sakr, 2012 (58)	Prospective randomized trial with 130 acute infected pilonidal abscess with mean 62 months follow-up	Compare incision and drainage with secondary intention wound healing, with incision and drainage with delayed excision and primary closure	No difference in hospital admission and time to return to work; Higher rate of acute wound complication in primary closure group; No difference in recurrence
Dass, 2012 (59)	Prospective randomized trial with 80 pilonidal disease patients with 12 months follow up	Compare excision and primary closure with excision and rhomboid flap	Higher rate of wound disruption, infection and recurrence in primary closure and higher rate of seroma and hematoma collection in rhomboid flap

the recurrence rate did not differ between groups but significantly lower in adhesive healing time (32). Using fibrin sealant reduced volume of drainage after Limberg flap, but the recurrence was not followed in this clinical trial (33). Another case series in which fibrin glue applied to the wound after excision and primary closure did not report recurrence and limited wound discharge was reported in 13% of patients (34).

3.7. Vacuum Dressing for Open Wounds

Application of negative pressure for chronic ulcers was previously well-studied. Some authors suggest using this method for open pilonidal wound and found reduced wound healing time with applying negative pressure to the wound (35, 36).

3.8. Flap Reconstruction

Flaps are classified based on vascular supply, composition, method of transfer and design (37). As shown in Table 2, multiple flap techniques have been proposed for treatment of pilonidal disease with different outcomes. Table 3 compares outcome of different flap methods.

The main aim of using flaps is to cover the excised skin defect with especial attention toward flattening of natal cleft. One of the newest surgical flap-based approaches is to release coccytaneous ligaments and closing the wound similar to cleft lift operation. This technique showed dramatically no recurrence in a 22 months follow-up (7). Another way of flattening the natal cleft is to use gluteal sliding plication in which the origin of glu-

teus maximus muscle over sacrum is elevated bilaterally and plicate to each other in the midline that produces a cushion under the skin of the excised tissue. The recurrence rate with this method was 1.8% (86). For classic Limberg flap, some studied found the maceration and delayed wound healing in inferior midline part of flap; thus, multiple studies suggest 1-2 cm lateralization of excision and this modification reduces the recurrence and wound complication (87, 88). One of the dilemmas during flap reconstruction regarding size of dissection is drain application. But it is showed that close drain suction application after Limberg flap did not change the rate of seroma or hematoma collection and was associated with higher rate of infection (89). Also using deep subcutaneous sutures for approximating the wound did not reduce unwarranted outcome in repair of excision site with V-Y advancement flap (55). The outcome of flap-based techniques is highly dependent to experience of the surgeons, as studies performed in plastic surgery departments have excellent outcomes; however, the most limitation of these studies are their low sample size.

3.9. Minimal Invasive Approaches

Some authors report acceptable results with simple sinotomy for treatment of pilonidal disease with recurrence rate of 10-12%, which seems to be acceptable (41, 90). Bascom's pit-pick operation is one based on off-midline closure of the wound with minimal tissue excision. The recurrence rate with this method was 12% and wound infection rate was nine percent (91). Other minimal

Table 2. Proposed Flap Techniques

Technique	Outcome
Limberg (Rhomboid) Flap	Dehiscence: 10%, Infection: 7.1%, Recurrence: 1.6% (60); Infection: 5%, Hematoma: 2%, Recurrence: 3% (61); Dehiscence: 1.7%, Infection: 6.5%, Seroma: 2.2%, Recurrence: 3.1%(62); Seroma: 3.6%, Infection: 4%, Recurrence: 2.9% (63); Dehiscence: 4.1%, Seroma: 2%, Recurrence: 4.8% (64)
Dufourmental Rhomboid Flap	Dehiscence: 2.6%, Infection: 5.2%, Seroma or Hematoma: 2.9%, Recurrence: 2.3% (65); Dehiscence: 10%, Recurrence: 7%(66)
Cleft Lift Procedure	Dehiscence: 14%, Infection: 13%, Wound Break: 5%, Recurrence: 1% (67); Dehiscence: 0%, Infection: 3%, Wound Break: 0%, Recurrence: 0% (68); Dehiscence: 8.4%, Recurrence: 4.6% (69); Infection: 6.6%, Seroma:1.5%, Recurrence: 2.3% (70)
Bilateral Gluteus Maximus Fascia Advancing Flap	Infection: 3%, Seroma Collection: 4%, Recurrence: 0.7% (71)
V-Y Advancement Flap	Infection: 9.3%, Hematoma: 7%, Recurrence: 2% (72)
Superior Oblique V-Y Advancement Flap	Flap Failure or Necrosis: 0%, Recurrence: 0% (73)
Lumbar Adipofascial Turn Over Flap	Rate of complications did not report, Recurrence: 0% (74)
Lateral Adipofasciocutaneous Flap	Infection: 0%, Hematoma: 0%, Seroma: 0%, Recurrence: 0% (75); Dehiscence: 5.3%, Infection: 2.6%, Seroma: 15.8%, Hematoma: 2.6%, Recurrence:0% (76)
Elliptical rotation Flap	Rate of complications did not report, Recurrence: 0% (77)
Superior Gluteal Artery Perforator Flap	Dehiscence:0%, Infection: 0%, Seroma: 0%, Hematoma: 0%, Recurrence: 0% (78) Dehiscence:0%, Infection: 0%, Venous Congestion: 10%,Recurrence: 0% (79)
Multiple Z-plasty	Dehiscence: 0%, Infection:4.9%, Recurrence: 1.98% (80)
Crossed Triangular Flaps	Infection: 5.3%, Recurrence: 1.75% (81)

Table 3. Comparison of Different Flap Techniques

First Author, y	Patients and method	Intervention	Outcome
Unalp, 2007 (82)	Retrospective analysis of 111 non-recurrent pilonidal patients with mean 46 month follow up	Compare Limberg with lateral V-Y advancement flap	Wound complications was the same in each group; Recurrence was significantly lower in Limberg group
Ersoy, 2008 (83)	Prospective randomized trial with 100 non-infected pilonidal disease with one month follow up	Compare Karydakias flap with Limberg flap	Lower rate of infection in Limberg group
Can, 2010 (84)	Multicenter prospective randomized trial with 137 non infected pilonidal disease with 16 months follow up	Compare modified Karydakias flap with modified Limberg flap	No difference was observed between groups even wound complication or recurrence
Bessa, 2013 (85)	Prospective randomized controlled trial with 120 non infected chronic pilonidal disease with median 20 months follow-up	Compare modified Karydakias flap with modified Limberg flap	15% Full thickness disruption in Limberg group compare with no disruption in Karydakias group. Recurrence did not differ

invasive procedures are proposed such as radiofrequency sinus excision, which seems to have recurrence rate similar to excision and marsupialization but better patient satisfaction (92); using cutting seton (93); or Endoscopic treatment (94).

3.10. Role of Antibiotics

Intravenous cefuroxime and metronidazole during operation followed by five days oral co-amoxiclav did not change postoperative infection rate during first week, compared with single dose intravenous metronidazole-post. But the former regimen was associated with lower rate of infection in second and fourth week after operation

(95). Currently, there are no randomized controlled trials that compare using antibiotics versus placebo for surgical site infection, but systematic review of literature demonstrated that prophylactic use of antibiotics does not alter surgical site infection, healing or recurrence rate. Comparison of short term and long term antibiotic therapy also did not show any difference; even using gentamicin collagen sponge did not show any improvement (96).

3.11. Surgical Approach Toward Intractable Pilonidal Disease

One of the problems encountered during operation of these patients is extensive tissue loss from previous oper-

ation (97). In 2007, Bascom and Bascom report 69 intractable pilonidal diseases with mean previous three surgeries. Patients had their wound for about five years period and the wound left open and unhealed during this period. They could perform cleft lift procedure in 52 patients and all of them healed; although five patients needed second cleft lift and one patient required a third. They suggested that created cushion under the shallow midline and mobilized healthy skin over the deep cleft using this method made it a definite treatment for intractable cases of pilonidal disease (68). Result of this technique is not altered with patient's BMI (98). Rhomboid flap is also proposed for recurrent cases, but was associated with 10% recurrence and 15% wound infection (97).

3.12. Non Operative Therapies

Using phenol as a sclerosing agent is proposed for treating pilonidal disease; although, 80% solution or powdered crystalized form even with lower concentration of phenol seems also to be effective (99). Using powdered crystalized form of phenol was effective even in recurrent types of pilonidal disease (100). A case series of 143 patients treated with 80% phenol with 24 months follow-up had only 8.3% recurrence, which seems to be an effective cost-effective method (101).

3.13. Factors Affecting Outcome and Recurrence

It was thought that most causes of pilonidal recurrence is related to the remnant of sinus tract after surgery; but currently, this idea is changed and now it is believed that recurrence is related to acquisition of new disease rather than persistence of an old tract (102). Traditionally, role of hair for pilonidal disease and recurrence has been always proposed in pilonidal related literature. Some studies proposed laser depilation following pilonidal surgery or simultaneously during pilonidal surgery for patients with recurrent pilonidal disease (103-105). However razor epilation is associated with increased rate of recurrence, shown in a German study with approximately 11 years of follow-up (106). Multiple factors can alter the outcome, e.g. using methylene blue during surgery. However, immediate surgical intervention does not alter the outcome, as prolonged disease does not alter wound healing nor has an association with recurrence. Unlike what was thought before, smoking and obesity are not risk factor for recurrence and postoperative complication, as shown in a military 20 years cohort study (107, 108). Developing postoperative infection and presence of secondary sinus are also risk factors for recurrence (91). A prospective study of pilonidal disease postoperation complications revealed family tendency, cavity diameter, sinus number and surgery under local anesthesia is associated with higher complication rate. However, in this study, smoking and obesity was not associated with postoperative complication. In this study, using flap was associated with higher complication while primary closure had higher

recurrence rate (109). A Turkish study showed a 30% rate of wound complication with using local anesthesia (110). Having discharge in preoperative physical examination and developing postoperative surgical site infection also reported as risk factors of recurrence (55). Unlike above studies, an Arabian retrospective study suggests obesity and smoking as the only significant risk factor for surgical site infection after pilonidal surgery (111). Another study considered the size of resected tissue as a risk factor for postoperative infection. In this study resected specimen greater than 28 cm³ is associated with surgical site infection; however, this retrospective study found a borderline significant relationship between obesity and smoking with postoperative surgical site infection. This author suggests prolonged usage of postoperative antibiotics for patients with large size of specimen (112).

4. Conclusions

Numerous techniques have now been developed for treatment of sacrococcygeal pilonidal disease. It is now clearly showed better patients satisfaction with wound closure primarily or using flaps after surgery rather than leaving it open. One of the problems that make comparison of studies difficult is lacking pilonidal disease scoring systems in studies; thus, comparison of outcome in these studies is not logical. There are many reported risk factors for recurrence after surgery. Generally, it is highly recommended to adjust modifiable risk factors prior to surgery, such as laser depilation with lower rates and razor use with higher rates of recurrence. Different flap techniques showed no significant difference among each other. However, the advantages of Karydakis cleft lift flap in recurrent and complicated cases aren't noticeable in different studies, although wound complication is similar to other flap methods.

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Authors' Contributions

SVH: Study concept and design, Critical revision of the manuscript for important intellectual content, Administrative, technical, and material support, Study supervision; MR: Acquisition of data, Analysis and interpretation of data, Drafting of the manuscript; RR: Acquisition of data.

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