

Roles of External Carotid Artery Ligation in Neurosurgical Practices: a Literature Review and Suggestion

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Abstract

External carotid artery is a major blood supply of head and neck structures including cerebral meninges. With existence of multiple anastomoses between external and internal carotid arteries, ligation of external carotid artery has no disabling complications. Ligation of external carotid artery for control hemorrhage in the area of head and neck is necessary in some conditions. Less invasive arterial embolization has been introduced to an effective alternative. This study aimed to explore the roles of external carotid artery ligation (ECAL) in clinical practices up to the present day, especially in the field of neurosurgery in Thailand which neurovascular interventionists are very few. A medical journal search using MEDLINE and Academic Search Ultimate database and a manual search for the related journals were performed. Inclusion criteria was ECAL that was only used to control bleeding. A total of 766 articles were collected from 1872 to 2021. After removal of the duplications and the unrelated, 192 articles which ECAL was used for controlling hemorrhage were included in the review. The most frequent articles (121 papers) were in orofacial and neck diseases, followed by epistaxis (36 papers), craniofacial trauma (18 papers), brain and skull base lesions (13 papers) and mixed pathology (4 papers). External carotid artery ligation (ECAL) had its roles for neurosurgeons to treat patients with severe hemorrhage from craniofacial trauma and to decrease intraoperative blood loss in vascularized skull-base lesion surgery. Although endovascular interventions are less invasive, but in the setting that lack of intervention facilities or in unstable patients, ECAL is still a life-saving and useful procedure especially for neurosurgical training and practices in Thailand.

Keywords: external carotid artery; ligation; bleeding control; neurosurgery

Introduction

External carotid artery (ECA) is a branch of common carotid artery. There are eight branches supplying to the head and neck structures. Some branches form an anastomosis with branches of internal carotid and

vertebral arteries. Then anastomosis make a reserved blood supply to the head and neck including brain structures. The most common clinical applications in neurosurgery are to cut off blood supply pre-operatively to the intracranial lesions such as meningiomas

and vascular malformations. Profused bleeding in maxillofacial injuries and severe fracture anterior base of skull are another threatening injuries necessary to need ECA ligation as a life-saving procedures.

Blood loss from diseases, trauma or operative procedures is one of the major problems leading to patient's morbidity or even mortality. Local control of bleeding in the head and neck area including local packing and selective vessel ligation or cauterization are commonly used, but in some cases more aggressive techniques are needed. Ligation of external carotid artery, the main feeding vessels of head and neck, has been the surgical procedure of choice for bleeding control. With advanced medical technology, embolization has been recently introduced to be an alternative procedure because of its less invasive and more selective procedure. In this study, the external carotid artery ligation (ECAL) to control bleeding in craniofacial and neck pathologies and injuries are reviewed to elucidate its beneficial roles.

Method

Academic literature search in MEDLINE, Academic Search Ultimate database and a manual search were performed for the topic of the external carotid artery ligation in contents between 1887 to 2021 with the medical subject headings of external carotid artery ligation. The inclusion criteria was external carotid artery ligation that used for bleeding control. The duplicated and unrelated articles were excluded from the review. Then the enrolled articles were categorized into specific fields including brain lesions, craniofacial trauma, epistaxis, orofacial and neck lesions and mixed pathology. The roles of ECAL in the neurosurgical practice were discussed.

Results

A total of 766 articles (655 from MEDLINE, 105 from Academic Search Ultimate database and 6 from a manual search) were collected. The papers of ECAL in the fields of experiments, effects, complications and others which not related to bleeding control and the duplications were excluded. Remaining 192 papers were included in the review.

According to the 192 included articles, ECAL was used in control bleeding mostly in the fields of orofacial and neck lesions, followed by epistaxis, craniofacial trauma and brain lesions respectively (Figure 1).

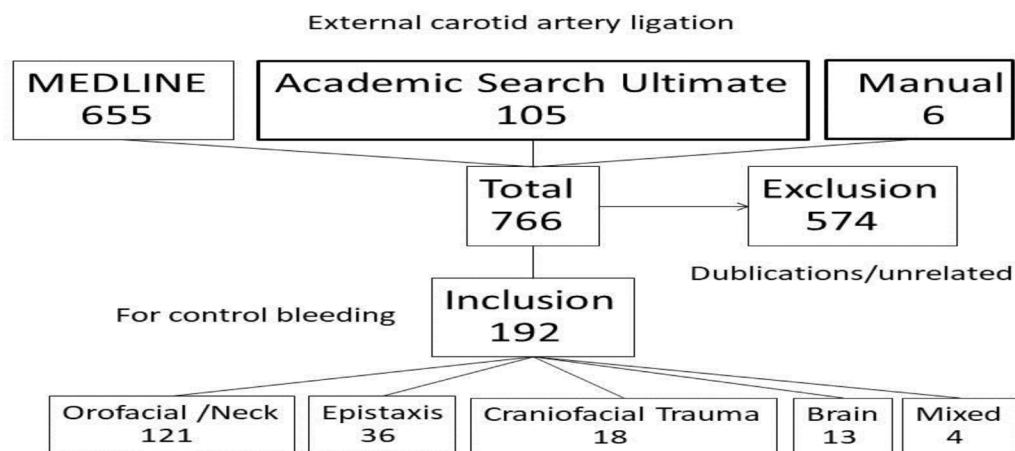
In the 121 articles of orofacial and neck lesions, ECAL were mostly reported in neoplasm treatment (63 articles), then in treatment of vascular lesions (31 articles), of post-tonsillectomy bleeding (13 articles) and of others (14 articles). The most recent published article was in 2021^(1,2). The specialists involved in this field were ENT physicians, maxillofacial surgeons, plastic surgeons and dentists.

In epistaxis articles (36 papers) which ENT physicians were directly involved, ECAL was still essential to control bleeding. Most recent article was in 2013⁽³⁾.

In craniofacial trauma articles (18 papers), serious uncontrolled bleedings from fracture sites or soft tissue lacerations were reported to be controlled with ECAL. The most recent article was published in 2021⁽⁴⁾. Specialists in trauma care team who might be responsible for these conditions were emergency physicians, trauma surgeons, maxillofacial surgeons, ENT physicians, plastic surgeons, general surgeons and neurosurgeons.

In brain lesions articles (13 papers), most reports

Figure 1 Results of academic article search



that ECAL was in parts of treatment were in dural arteriovenous malformations and in meningiomas which were in the specific cares of neurosurgeons. The most recent article reported in 2012⁽⁵⁾.

Discussion

According to the beneficial roles of ECAL, two fields that neurosurgeons are in responsible teams to care the patients are craniofacial trauma and brain lesions especially in skull base. Craniofacial traumatic patients who suffered from severe uncontrolled bleeding mostly had maxillofacial fractures with some degrees of traumatic brain injuries or skull fractures^(6,7). ECAL which is a short and uncomplicated operation has its role to be a life-saving procedure in these patients⁽⁸⁻¹¹⁾.

Neurosurgeon is always one of the trauma care team in general or regional hospitals in Thailand. Rather than of other specialists, availability and competency of neurosurgeons to perform this procedure (ECAL) in critical period should be widely considered. Endovascular embolization of offending arteries has been introduced to be the alternative⁽¹²⁻¹⁴⁾, but even in the setting that embolization is in full-time function,

unstable traumatic patients may gain more advantage from timely surgery.

The other role of ECAL in the field of neurosurgery is in reduction intraoperative blood loss in surgery for large cerebral meningiomas^(5,15-17) or skull base vascular lesions especially dural arteriovenous malformation⁽¹⁸⁻²⁰⁾. According to experimental results, ECAL significantly reduced blood flow in its distal branches^(21,22) with no serious disable complications even in bilateral ligation⁽²³⁾. Recently preoperative embolization to occlude feeding vessels of the lesions has been reported to be safe and effective in the hands of skilled interventionists but still has some failures or serious off-target complications and higher costs^(24,25).

Conclusion

Although with recently advanced technology in endovascular intervention, ECAL still has 2 roles for neurosurgical training and practice in Thailand. Firstly, in severe craniofacial trauma that uncontrolled bleeding occurs, ECAL remains a life-saving procedure especially in unstable patients. Secondly, in patients with large cranial meningiomas or dural ar-

teriovenous malformation, ECAL is an adjunctive or alternative procedure to treat these patients. The suggestion is ECAL should still be a necessary procedure in Thailand's neurosurgery training program and neurosurgical practices in the current situation.

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Conflicts of interest:

there is no conflicts of interests

Ethical approval:

case publication approved from Research Ethics Committees, Ratchaburi Hospital

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บทคัดย่อ: บทบาทของการผ่าตัดผูกหลอดเลือดแดง External Carotid ในเวชปฏิบัติของประสาทศัลยแพทย์: การทบทวนวรรณกรรม และการเสนอแนะ

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โรงพยาบาลราชบุรี จังหวัดราชบุรี

วารสารวิชาการสาธารณสุข 2566;32(2):356-61.

หลอดเลือดแดง external carotid เป็นหลอดเลือดหลักในการหล่อเลี้ยงอวัยวะบริเวณศีรษะและคอ รวมถึงเยื่อหุ้มสมองชั้นนอกด้วย มีการเชื่อมต่อระหว่างหลอดเลือดแดง external carotid กับ internal carotid อย่างมาก ทำให้การผูกหลอดเลือดแดง external carotid ไม่ส่งผลให้เกิดภาวะแทรกซ้อนที่รุนแรง การผูกหลอดเลือดแดง external carotid เพื่อควบคุมภาวะการมีเลือดออกบริเวณศีรษะและคอมีความจำเป็นสำหรับผู้ป่วยบางคน การอุดกั้นหลอดเลือดแดงด้วยวิธีการ embolization ได้ถูกนำมาใช้ เป็นทางเลือกที่มีประสิทธิผลในผู้ป่วยดังกล่าว เพื่อสำรวจบทบาทของการผ่าตัดผูกหลอดเลือดแดง external carotid ในเวชปฏิบัติจากอดีตถึงปัจจุบัน โดยเฉพาะในด้านศัลยกรรมระบบประสาทของประเทศไทยที่ยังขาดผู้เชี่ยวชาญด้าน neurovascular intervention ด้วยการค้นหาค้นหาบทความวิจัยที่เกี่ยวข้องกับการผ่าตัดผูกหลอดเลือดแดง external carotid จากฐานข้อมูล ของ MEDLINE, Academic Search Ultimate และการค้นหาด้วยตัวเอง โดยมีเกณฑ์นำเข้าเฉพาะที่ใช้ การผ่าตัดผูกหลอดเลือดแดง external carotid เพื่อควบคุมภาวะเลือดออก ผลการค้นหามีบทความวิจัยที่เกี่ยวข้องตั้งแต่ ปี ค.ศ. 1872 ถึง 2021 จำนวน 766 ฉบับ หลังจากคัดบทความวิจัยที่ซ้ำซ้อน และไม่เกี่ยวข้องออกแล้ว มีงานวิจัยจำนวน 192 ฉบับที่นำมาสู่การทบทวนการผ่าตัดผูกหลอดเลือดแดง external carotid พบในบทความวิจัยในการรักษาโรคทางใบหน้าและคอ มากที่สุด (121 ฉบับ) รองลงมาได้แก่ เลือดกำเดาออก (36 ฉบับ) บาดเจ็บต่อศีรษะและใบหน้า (18 ฉบับ) โรคของสมอง (13 ฉบับ) และรวมหลายโรค (4 ฉบับ) บทบาทของการผ่าตัดผูกหลอดเลือดแดง external carotid ในเวชปฏิบัติสำหรับประสาทศัลยแพทย์ยังคงมีอยู่ เพื่อรักษาผู้ป่วยบาดเจ็บที่ศีรษะและใบหน้าอย่างรุนแรง และพยาธิสภาพพื้นฐานของกะโหลกศีรษะ ถึงแม้ว่า endovascular intervention จะเป็นหัตถการใหม่ที่ล่งล้ำต่อร่างกายน้อยกว่าซึ่งสามารถนำมารักษาผู้ป่วยกลุ่มนี้ได้ แต่ในโรงพยาบาลที่ไม่มีขีดความสามารถด้านนี้ หรือในผู้ป่วยที่สัญญาณชีพอยู่ในช่วงที่อันตราย การผ่าตัดผูกหลอดเลือดแดง external carotid ยังคงเป็นหัตถการที่ใช้ช่วยชีวิต และมีประโยชน์สำหรับการฝึกอบรม และในเวชปฏิบัติของประสาทศัลยแพทย์ในประเทศไทย

คำสำคัญ: หลอดเลือดแดง external carotid; การผูก; การควบคุมภาวะเลือดออก; ศัลยกรรมระบบประสาท