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Diagnostic Accuracy of MRCP in Obstructive Jaundice Patients Taking ERCP/Histopathological Findings as Gold Standard

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Abstract

Magnetic resonance cholangiopancreatography (MRCP) is a non-invasive imaging modality that has high diagnostic accuracy for a wide range of bile duct and pancreatic duct pathologies. Endoscopic retrograde cholangiopancreatography (ERCP) is still the gold standard for the exploration of the biliopancreatic region. This study aimed to evaluate the efficacy of MRCP as a diagnostic tool compared to ERCP in diagnosing obstructive jaundice due to various biliary pathology. A prospective study of 50 consecutive patients with biliary obstruction referred for MRCP with subsequent assessment by ERCP as a gold standard. MRCP had sensitivity, specificity of 86.7% and 85.00% in bile duct stones,94.74% and 93.55% in bile duct strictures, 100%and 100% in biliary dilatation, 100% and 100% in bile duct tumor, 100% and 100% in pancreatic dilatation, 100% and 100% in pancreatic divisum,80% and 100% in ampullary tumors and sensitivity 100% and specificity 97.37% in periampullary lesion respectively. The study concluded that MRCP has high diagnostic accuracy and is equivalent to ERCP in diagnosing bile duct tumors, biliary dilation, pancreatic duct dilation, pancreatic divisum. In case of choledocholithiasis, bile duct strictures, periampullary and ampullary mass MRCP diagnostic accuracy slightly low/comparable to ERCP. However, no significant deference in diagnostic accuracy of MRCP&ERCP in obstructive jaundice patients in this small sample size study group

Keywords: ERCP, Magnetic Resonance Cholangiopancreatography, Bile Duct Strictures, Tumors

Introduction

Obstructive jaundice is a common problem in medical and surgical gastroenterological practice. It could be because of a variety of causes. The surgical jaundice can be caused by the obstruction of the bile duct as with gall stones, strictures, malignancy, such as cholangiocarcinoma, periampullary carcinoma,

carcinoma gall bladder and carcinoma head of pancreas. Recent technical imaging advances have highly aided in the diagnosis of biliary tract disease. A wide array of diagnostic procedures including the invasive procedures like endoscopic retrograde cholangiopancreatography (ERCP), percutaneous transhepatic cholangiography (PTC), endoscopic ultrasound (EUS) as well as noninvasive investigations like ultrasonography (USG), multidetector CT (MDCT) and magnetic resonance imaging (MRI). Magnetic Resonance Cholangiography (MRCP) have been utilized for evaluating the biliary tract in suspected obstructive jaundice. While ERCP and PTC are considered invasive techniques having unique advantage of getting a tissue diagnosis along with therapeutic intervention at the same time but is limited by the fact that it cannot provide extra luminal information. Moreover, ERCP has a failure rate of 3–10% and is also associated with life-threatening complications like pancreatitis, gastrointestinal (GI) tract perforation, bleeding, cholangitis, sepsis, etc. Ultrasonography (USG) is considered as the first-line investigation in imaging obstructive jaundice as it is not only non-invasive but also cost effective and widely available; however, its sensitivity and specificity ranges from 55 to 95% and 71 to 96%, respectively; thus, it can be used in the initial screening to further guide patients for MDCT, MRCP or ERCP in appropriate setting for accurate diagnosis MDCT with its recent advances of post-processing reconstruction techniques (Multiplanar Reconstruction (MPR) and Minimal Intensity Projection (MinIP) constitutes a fast and alternative noninvasive imaging technique improved diagnostic accuracy in detection of biliary calculi and for differentiating benign from malignant lesions. Moreover, the combined use of MPR and MinIP techniques significantly improves the visualization of the biliary ducts and their site of confluence compared with those obtained by axial CT. It is thus an excellent alternative for a non-invasive 2 one-stop-shop imaging of the hepato-biliary tree especially in those cases where MRI/ MRCP has its limitations MRCP though is considered the most reliable non-invasive technique, it has certain disadvantages. It is an expensive imaging technique utilizing prolonged examination time. It is also not widely available as a resource compared to MDCT. Patients with pacemakers and ferromagnetic implants, as well as claustrophobia cannot be imaged with MRI/MRCP. It is also susceptible to artifacts and requires adequate patient cooperation to successfully complete the study. In the recent era MRCP is considered an important noninvasive imaging modality for preoperative evaluation of patients with obstructive jaundice. It can replace the more invasive ERCP and PTC which were considered as first-line investigations in the past. With technical advances MRCP has proved to be a reliable noninvasive imaging technique in imaging the biliary tract in obstructive jaundice as well as help the surgeons in accurate therapeutic planning. MRCP consists of heavily T2 weighted sequences (long T2 TR) highlighting static fluid which would be present in dilated pancreatic and biliary ducts. Due to availability of the ultrafast sequences and the newer 3D sequences, the images after post-processing resemble direct cholangiogram as seen by ERCP or percutaneous transhepatic cholangiopancreatography. We intend to evaluate the role of MRCP in determining the etiological spectrum, the level and degree of biliary obstruction in cases of obstructive jaundice. Moreover, the purpose of our study is to compare and correlate MRCP findings with ERCP/ histopathological findings wherever possible.

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Methods

This study included 50 patients with obstructive jaundice who underwent MRCP followed by ERCP in the department of Radiodiagnosis and Gastroentrology in Dr. S.N. Medical College and associated Hospitals Jodhpur between January 2023 to April 2024. This study was designed as a hospital based Cross Sectional observational study.

A pool of patients suspected of having obstructive jaundice based on their history, clinical symptoms, and laboratory test results including upper abdominal pain, deranged liver function enzymes, and a dilated IHBR on abdominal ultrasound, underwent MRCP followed by ERCP. The diagnostic accuracy of MRCP was determined by comparing it to ERCP (taken as a gold standard). In order to reduce the chances of passage of stone resulting in negative analysis, only those patients were included in which both procedures were conducted temporally close together (24-72 hours in most instances). All biomedical lab data, ERCP and histopathological reports collected for comparison with MRCP findings. The MRCP was done at MRI centre MDM/ MGH hospitals and ERCP was done at Gastroenterology department at MDM hospital Jodhpur. The main outcome measures were diagnostic accuracy with the help of sensitivity, specificity, PPV, and NPV. Pre-procedural preparation included six-hour duration of fasting which will helps in promoting filling of gall bladder. Patients were be fully examining first for MRI safety. Informed as well as written consent, described whole MRI procedure to patients and their attendant was taken.

Machine and Sequences

1.5-T MRI scanner (Philips, ACHIVA(SN72199)

Following sequences were obtained

1. localizer _3 plane
2. Axial and Coronal T2W
3. Axial and coronal T2_HASTE /SPAIR
4. Axial T1 In- phase
5. sMRCP_3D_HR, in two planes (coronal and axial section in plane with pancreatic duct) and MIP-sMRCP_3D_HR
6. Single shot MRCP

Table 1. Parameters used in various sequences

Parameters	T2W SPAIR/HASTE	T2W SPAIR /HASTE	T1W sequence In phase	MRCP_3D_HR	Single shot MRCP Thick slab
TR/TE(ms)	320/80	334/80	10/4.6	1200/702	8000/ 800
FOV	3785x325	345x345	375x300	261x261	300x300
Matrix size	220x260	384x384	252x149	258x206	320x256
Slice thickness(mm)	4mm	4mm	4mm	2mm	40mm
Slice gap(mm)	3mm	0mm	0mm	-1mm	0mm
Number of slices	30-35	25-30	30-35mm	110	12
Acquisition plane	Axial	Coronal	Axial	Coronal oblique	Coronal
Respiratory compensation				Navigated free breathing	Breath hold
				Gives source image and 3D MIP image of pancreatic-biliary system	Gives2Dprojection image of pancreatic-biliary system

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ERCP technique:

ERCP was performed using an Olympus CV150 duodenoscope, and fluoroscopic images were obtained using a Philips BV Libra system. Pre-procedural preparation included at least 12 h of fasting. OmnipaqueTM (iohexol) contrast was used and the procedure was performed under anaesthesia using propofol. ERCP was performed by a well-trained and experienced endoscopist. Cholangiograms were obtained Localizer in 3 planes.

Inclusion and Exclusion Criteria Inclusion:

1. All patients were clinical and laboratory evidence of obstructive jaundice undergoing Magnetic resonance cholangiopancreatography and subsequently assessed by Endoscopic retrograde cholangiopancreatography
2. Obstructive jaundice patients undergoing MRCP, ERCP & histopathology.

Exclusion

1. Patients having a contraindication for MRI – like cardiac pacemaker/cochlear implant/non MR compatible clips used on brain aneurysms/claustrophobia.
2. patients who had a deranged coagulation profile (international normalized ratio [INR] >1.5), were haemodynamically unstable
3. Patient have failed to ERCP examination due to scope negotiable
4. Patients lost to follow up.

Results and Discussion

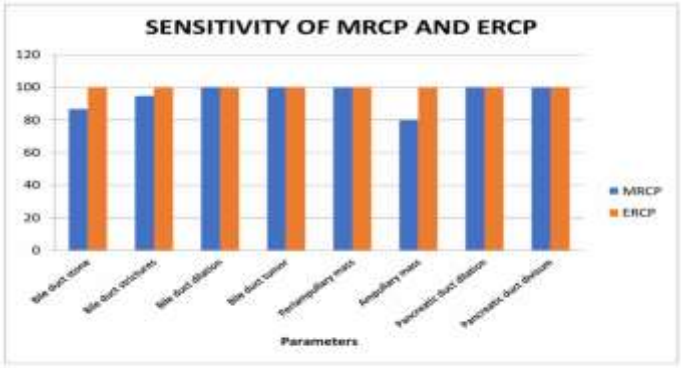
Summary of Sensitivity and Specificity

Table 2: Summary of Diagnostic efficacy for various pathologies

PARAMETER	MRCP			
	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
Bile duct Stones	86.7	85.00	89.66	80.95
Bile duct Strictures	94.74	93.55	90.00	96.67
Bile duct Dilatation	100	100	100	100
Bile duct Tumour	100	100	100	100
Periampullary Mass	100	97.37	92.31	100
Ampullary Mass	80	100	100	97.83
Pancreatic Dilation	100	100	100	100
Pancreatic Divisum	100	100	100	100

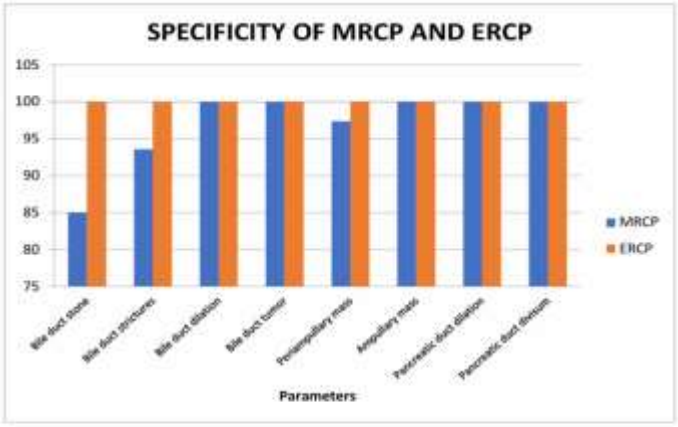
The above table shows sensitivity and specificity of ERCP and MRCP in detecting various pathologies.

Graph 1: Sensitivity of MRCP & ERCP



The above bar chart shows the sensitivity of MRCP and ERCP for various pathologies.

Graph 2: Specificity of MRCP and ERCP



The above bar chart shows the specificity of MRCP and ERCP in detecting various pathologies shown above.

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Discussion

The aim of our study was to assess the diagnostic accuracy of MRCP as a diagnostic imaging modality, compared to invasive ERCP in obstructive jaundice patients using specificity, sensitivity and positive and negative predictive values.

If the results favour MRCP then diagnostic ERCP could be completely avoided and MRCP can be used as the investigation of choice for diagnosing biliary abnormalities while ERCP shall be reserved only for therapeutic purpose solely (16).

In our study, fifty obstructive jaundice patients (18 males and 32 females), age ranging from 15 to 90 years, we evaluated MRCP &ERCP various causes of biliary ductal obstruction (p=0.001)

Consistent with the study conducted by Kimura et al.(13) The number of affected women is slightly higher than that of affected men in the present study, which correlated with the study conducted by Ko et al.(14)

Commonest of the findings were choledocholithiasis (60%), bile ducts stricture (38%).and periampullary/ampullary malignancies (22%) causing biliary obstruction which was consistent with most of the studies carried out worldwide. According to O'Connor et al.(15) choledocholithiasis and CBD dilation were most commonly biliary tract pathologies which match our study.

In our study total thirty patients showed choledocholithiasis. Bile duct calculus/ calculi MRCP & ERCP detected bile duct stones in 26patients (true positive), ERCP alone detected bile duct stones in 4 patients (false negative), MRCP alone detected bile duct stone in 3patients (false positive) and 17 cases true negative. Three false positive because 2 cases showed filling defect due to debris in distal CBD and one case shows PNEUMOBILIA. In case of four false negatives in MRCP three patients showed small stone at the ampulla and it does not show filling defect, one patient shows respiratory motion artifact in MRCP study. According to Griffin et al(16), compared with MRCP, ERCP sensitivity, specificity, PPV, and NPV of 86%, 93%, 87%, and 82%, respectively, in diagnosing choledocholithiasis. According to Vitellas et al.(9), MRCP is comparable to ERCP in diagnosing choledocholithiasis, with sensitivities and specificities in the range of 81%–100% and 85%-100%, respectively.

The result of our study showed the diagnostic accuracy of MRCP sensitivity 86.7% and specificity 85.00% in detecting bile duct calculi was comparable to pervious study.

In our study 21 patients of bile duct strictures both benign and malignant pathologies included.

Benign (3)

1. Choledocholithiasis with cholangitis stricture both MRCP& ERCP positive.
2. Periampullary lymph node lesion MRCP positive & ERCP negative
3. Portal biliopathy MRCP positive & ERCP negative

Malignant (18)

1. Ampullary carcinoma: all five case was biopsy proven adenocarcinoma which positive in ERCP and one case MRCP failed to diagnosis of adenocarcinoma of ampulla
2. Hilar cholangiocarcinoma: four case of hilar cholangiocarcinoma showed extension in bi-lobar hepatic ducts, CHD, proximal CBD with secondary metastasis on MRCP with additional T1 and T2 W sequences and subsequently ERCP showed strictures with stent placed
3. Carcinoma of gall bladder infiltrating cystic duct and CHD: three cases showed positive on ERCP and MRCP

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4. Periampullary mass carcinoma: total six case (four carcinoma of head of pancreas + two case showed distal CBD cholangiocarcinoma with secondary metastasis) most of later histopathologically proved malignant etiology.

All case of cholangiocarcinoma and CA Head of pancreas showed CA 19-9 level above 1000 and secondary metastasis.

In which total nineteen (19) patients showed ERCP positive for bile duct strictures.

Two case false positive, one case of portal biliopathy showed compression on distal CBD not seen stricture ERCP examination.

Second case showed lymph node on MRCP its diagnosed stricture narrowing in distal CBD but ERCP its diagnosed periampullary necrotic lymph node not causing stricture.

One patient which was MRCP- & ERCP + (false negative) biopsy proven adenocarcinoma of ampullary which identified in ERCP.

According to Hintze et al. (17) considering ERCP as the gold standard, MRCP showed a sensitivity and PPV of 85% and 100%, respectively, in diagnosing bile duct stricture.

Lomas et al. (18). found MRCP to be highly accurate in diagnosing biliary stricture, with a sensitivity of 100% and specificity of 98%. The results of our study show the sensitivity and specificity to be 94.74% and 93.55%, respectively was comparable to previous studies.

According to Chan et al (19), in diagnosing bile duct dilatation, MRCP showed a sensitivity of 95%, specificity of 85 compared to ERCP (14). Hintze et al. (17). found the sensitivity and PPV of MRCP in detecting bile duct dilatation to be 83% and 91%, respectively. Our results showed 100 sensitivity and specificity of bile duct dilation which was high parameters and accordance with previous studies.

In our study six cases of bile duct tumors showed cholangiocarcinoma in which four hilar cholangiocarcinoma and two distal CBD cholangiocarcinoma. All cases showed secondary metastasis and high CA 19-9 level above 1000 IU/ml

Bile duct tumors showed 100% and 100% sensitivity and specificity respectively which was comparable study conducted by Pamos S et al.(20) where the sensitivity and specificity was 100 and 83.3% respectively. Additionally, MRCP was found to be better in delineating the extent of tumour and extra biliary extension as other sequences could simultaneously be acquired to asses resectability and nodal status could also be assessed. ERCP images showed the level of block however the proximal extent and involvement of adjacent structures could not be evaluated.

In our study six patients of pancreatic duct dilation which showed 100&100% sensitivity and specificity on MRCP and ERCP which comparable to study done by Coakley et al. (7), MRCP has a sensitivity of approximately 87%–100% for pancreatic duct dilatation. Soto et al. (21) found MRCP to have a sensitivity of 100% and 87% (observers 1 and 2, respectively) for diagnosing pancreatic duct dilatation. Takehara et al. (22). also found an agreement of 83% – 92% for diagnosing pancreatic duct dilatation by MRCP and ERCP.

One out of fifty patients diagnosed pancreatic DIVISUM in MRCP which was detected in ERCP According to Mosler et al. (23) ERCP is considered as gold standard 51 method in pancreas divisum diagnosis. According to their study sensitivity of MRCP in diagnosing pancreas divisum was around 73.3%. Thus, results in our study were in conclusive as study sample size was small.

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In our study five cases ampullary carcinoma included which were positive in ERCP, one case MRCP failed to diagnosis of ampulla carcinoma and others four positive MRCP. All five cases biopsy proved adenocarcinoma. According to the study conducted by Chen WX et al. (24) accuracy rate in detection of ampullary carcinoma was 100% for ERCP and 26.83% for MRCP, while in our study it was 80% accuracy of MRCP. They found significant difference between MRCP and ERCP because the selected large patients from February 2003 to March 2007 were analysed retrospectively. but our study only five patients, short time periods study and late onset presentation of patients.

In our study total seven case were detected periampullary lesion in which four cases of head of pancreas carcinoma, two cases of distal cholangiocarcinoma. all six cases showed secondary metastasis with high CA 19-9 level above 1000. All six true positive on MRCP and ERCP. One false positive case of tubercular lymph nodal mass in periampullary region which was not diagnosed in ERCP filled view because lesion distance from ampulla of Vater more than 2cm.

According to Sugita et al. (25), the sensitivity, specificity, of high-resolution MRI for the evaluation of periampullary carcinoma were 88%, and 100% respectively. They observed that MRCP can accurately detect the location, extension, and origin of periampullary carcinoma and is beneficial in the preoperative staging of tumours. According to Pamos et al.(20), the sensitivity and specificity of MRCP compared to ERCP in diagnosing periampullary carcinoma were 100% and 83%, respectively. In 52 our study periampullary lesion sensitivity 100% and specificity 97.37% which comparable to pervious study.

Thus, to conclude, MRCP has high sensitivity for CBD abnormalities such as stones, strictures and malignancies. MRCP may have slightly lower sensitivity for stone detection, but still to avoid unnecessary diagnostic ERCP; in cases with clinical suspicion of choledocholithiasis/ampullary stones, MRCP is recommended.

MRCP has comparable sensitivity for periampullary and ampullary malignancies and offers additional advantage of cross-sectional imaging, hence should score over ERCP. Sensitivity of MRCP for ancillary findings intrahepatic biliary dilatation, pancreatic duct dilation, pancreatic divisum equal ERCP. However, the sample size is a limiting factor for any definitive conclusion.

Conclusion

The aim of our study was to evaluate the diagnostic efficacy of MRCP compared to ERCP as a standard tool in our institution, using specificity, sensitivity, and positive and negative predictive values. We conclude that MRCP has high diagnostic accuracy and is equivalent to ERCP in diagnosing bile duct dilation and pancreatic duct dilation & abnormalities. In cases of bile duct strictures, choledocholithiasis, ampullary and periampullary carcinoma MRCP is comparable to ERCP. MRCP including T1and T2 WI sequencies can accurately detect the location, extension, and origin of periampullary carcinoma and is beneficial in the preoperative staging of tumours and also superior than ERCP MRCP should be method of choice for the diagnostic imaging of biliary tree in obstructive jaundice patients and ERCP may be reserved for therapeutic intervention in this setting as the commoner pathologies (stones, strictures and malignancies biliary tract) can be easily identified with high specificity with sensitivity. The results obtained in the study were comparable to pioneer studies conducted worldwide.

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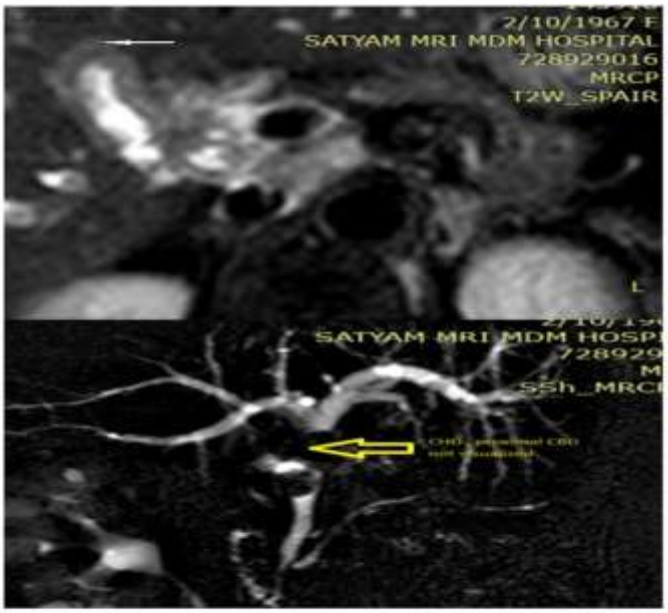
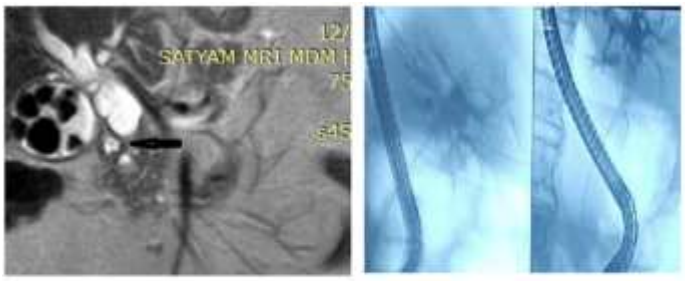
Figure 1:



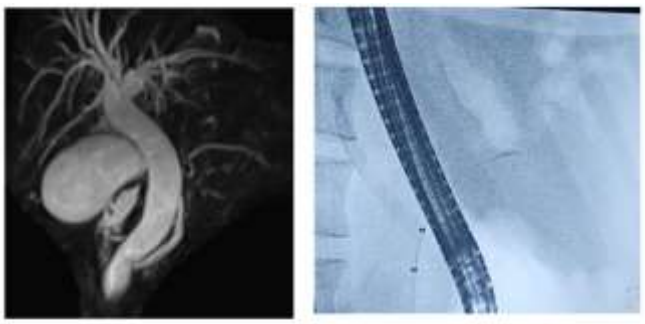
A 65 year male patient present with obstructive jaundice T2 SPAIR and single shot MRCP images shows asymmetrical diffuse gall bladder wall thickening with metastatic lymph node causing compression on CHD causing upstream moderate dilatation of the RHD , LHD and intrahepatic biliary channels however distal CBD normal s/o gall bladder carcinoma with metastatic lymph node

Figure 2:



58 year old male patient present with obstructive jaundice T2 SPAIR image shows abrupt cut off distal CBD with upstream dilatation of CBD with cholelithiasis and ERCP image shows dilated CBD & biliary tree

Figure 3:



A old aged patient present with obstructive jaundice single shot MRCP and ERCP air cholangiogram image showing upstream moderate dilatation of CBD and dilatation of pancreatic duct. ERCP brushing from the ampulla shows adenocarcinoma on histopathology

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